PROJECT MANUAL
VOLUME 2

Garberville Sanitary District

Garberville Tanks Replacement Project

DWR Project Number: SCDRF 4600015036

Prepared for:

Garberville Sanitary District

April 2024

022067

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Garberville Sanitary District
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Prepared for:

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"*Funding for this project has been provided in full or in part from the State Department of Water Resources*."
Project Number: SCDRF 4600015036

CALIFORNIA DEPARTMENT OF
WATER RESOURCES

Prepared by:

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April 2024

QA/QC: JOB___
Reference: 022067

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Technical Specifications

Final Submittal

Garberville Services District

Garberville Tanks Replacement Project

Prepared for:

Garberville Services District

Prepared by:

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 PROJECT PLANS

A. The Project Drawings consist of the following plan sheets:

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2. G-2.0 Index of Sheets
3. G-3.0 General Notes
4. G-4.0 Project Overview
5. G-5.0 Site Access Plan
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1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Overall Project Content: The Work to be completed under this Contract consists of furnishing all labor, equipment, materials, incidentals, and performing all Work necessary to construct facilities that comprise the Garberville Sanitary District (GSD Garberville Tanks Replacement) Project, as shown on the Drawings and described in these Specifications. The Project is broken

down into a base bid with five (5) components and one (1) additive alternate briefly described below. The summaries shown in section 1.2B are not intended to be full descriptions of the Work.

B. Civil work consists of:

1. Wallan Tank and Wallan Pump Station

a. Demolish existing Wallan tank, piping, and foundation.

b. Salvage existing poly tank and deliver to GSD.

c. Site grading at tank Site and service road and installation of aggregate base surfacing materials.

d. Furnish and install new 70,000-gallon, bolted steel, water storage tank appurtenances, foundation, and yard piping.

e. Installation of new tank radio, solar, and electrical components

f. Installation of security fencing and gate with lock

g. Install new 4-inch C900 piping between tank yard and existing tie-in located within private driveway.

h. Demolition of existing mechanical/electrical at Wallan pump station

i. Provision of a new towable generator

j. Pump house improvements on existing pump station exterior.

k. Furnish and install new booster pumps, generator and associated electrical and instrumentation.

l. **Location: Tank Site**—The existing and planned Wallan water storage tank site is located at approximately 40.107736 north latitude, -123.770431 west longitude and is accessed using a private driveway connecting to Wallan Road.

m. **Location: Pump House**—The existing Wallan Pump Station site is located at approximately 40.104878 north latitude, -123.771953 west longitude and is accessed using Wallan Road.

2. Arthur Road Pump Station Demolition and Alderpoint Pump Station.

a. Demolish existing Arthur Road Pump Station and associated pipe segments.

b. Excavation, backfill, and grading/site preparation for proposed pump station, PRV vault, and generator.

c. Construct a new 20 x 14 Alderpoint pump station,

d. Installation of pumps, appurtenances and associated mechanical and electrical instrumentation, including generator, foundation, and anchorage.

e. Furnishing and installation of new precast PRV vault with PRVs and all associated valves, piping, and appurtenances.

f. Installation of yard piping, service vaults, and appurtenances.

g. Installation of conduit, pole boxes, and meter for Pacific Gas and Electric (PG&E) connection

h. Site restoration.

i. **Location: Existing Pump House**—The existing Arthur Road Pump Station is located at approximately 40.105328 north latitude, -123.788528 west longitude and is accessed using Alderpoint Road.

j. **Location: (N) Pump House**—The planned Alderpoint Pump Station is located at approximately 40.105083 north latitude, -123.789433 west longitude and is accessed by Alderpoint Road.

3. **Alderpoint Road 8-inch C900 pipe installation.**

a. Installation of the new C900 8-inch PVC piping between the planned Alderpoint Pump Station yard, Arthur Road tie in, and Wallan Road tie in.

b. Surface Restoration.

c. Traffic Control along Alderpoint Road.

d. Tie in new alignment to existing utilities at Arthur Rd.

e. **Location**: Alderpoint Road.

4. **Robertson Tank Demolition**

a. Demolish existing Robertson tank and foundation.

b. Disposal of Asbestos Containing Construction Materials at offsite approved disposal site

c. Work shall be done in a manner that preserves the existing service line during the demolition of the tank and installation of the new 8-inch C900 piping along Alderpoint Road.

d. **Location**: The Robertson Tank site is located at approximately 40.106225 north latitude, -123.786492 west longitude and is accessed using a private driveway connecting to Alderpoint Road.

5. **General Items Civil Work includes:**

a. Sheeting, shoring and bracing as required based on Contractor means and methods

b. Implementation and maintenance of best management practices (BMPs) in accordance with the Stormwater Prevention Pollution Plan (SWPPP)

c. Pressure grouting of existing piping to be abandoned

6. **Additive Alternate #1 Tobin Well Site—Additive Alternate #1 civil work includes:**

    a. Stripping and removing topsoil for proposed gravel driveway.

    b. Installation of a new gravel driveway for access to planned generator at Tobin well Site.

    c. Furnish and install new generator, foundation, anchorage and associated instrumentation.

    d. Connection of the new electrical components and instrumentation to the existing pump house.

    e. **Location**: The Tobin Well site is located at approximately 40.100586 north latitude, -123.792472 west longitude and is accessed using Pine Lane.

1.3 CONTRACTOR'S DUTIES

A. It shall be the responsibility of the Contractor to examine the job Site before submitting the fee schedule. No allowance will be made on the Contractor's behalf for any extra expense incurred due to the failure to become acquainted with the full extent of Work to be done and the conditions under which the Work is to be performed.

B. The Contractor is directed to the following documents, which are available for review at the offices of the Owner, for information regarding subsurface geotechnical conditions and potential regulated materials conditions that the Contractor may encounter at the Site and in the performance of this Project:

    1. Plans/Drawings for Garberville Tanks Replacement Project

    2. Site-specific stormwater pollution prevention plan (SWPPP)

    3. Geotechnical Investigation—Engineering Geologic and Geotechnical Investigation Report—Revision 1, Proposed Water System Improvements for the Garberville Sanitary District, Humboldt County, California

    4. Asbestos and Lead Paint Sampling Report By Burnnelle & Clark Consulting LLC

    5. PG&E Greenbook

    6. Revegetation, Mitigation, Monitoring, and Reporting Plan, Garberville Sanitary District, Robertson/Wallan/Hurlbutt Tanks Replacement, Garberville CA.

    7. Mitigation, Monitoring, and Reporting Program

C. Except as specifically noted, the Contractor shall provide and pay for:

    1. Labor, materials, and equipment, and incidentals, and permits required by the Contractor for commencement of the Work

    2. Tools, construction equipment, and machinery

    3. Water and other utilities required for construction

    4. All insurance and bonds required by the Owner and as necessary to perform the Work

5. Legally required sales, consumer, and use taxes

6. All other facilities and services necessary for proper execution and completion of the Work

D. The Contractor shall be responsible for management of all Subcontractors for the duration of the Project.

E. The Contractor shall promptly submit to the Engineer written notice of any observed variance of Drawings or Contract Documents from legal requirements.

F. The Contractor shall provide unencumbered access to the Work area at all times to Authorized Representatives of the Engineer, the Owner, and funding agency personnel, and shall provide proper facilities for such access and inspection.

G. Warranty Inspection

Warranty inspection shall be conducted between the eleventh- and twelfth-month following completion of all Work and filing of the Notice of Acceptance. All personnel present at the Pre-Construction Conference should be present at this inspection. All defective Work shall be repaired to the satisfaction of the Owner and the Engineer. All repairs shall be performed at no cost to the Owner.

1.4 "OR EQUAL" AND "APPROVED EQUAL" PROVISION

A. The Engineer shall be the sole judge of what materials or components are acceptable under the "Or Approved Equal" provision shown on the Drawings and listed in these Technical Specifications. Refer to "Section 01 33 00 Submittals" and "Section 01 40 00 Quality Requirements" for Submittal, materials testing, and materials certification requirements of items submitted for review under this provision.

1.5 SALVAGE AND RE-USE OF EXISTING IMPROVEMENTS AND FACILITIES

A. Items noted on the Drawings as "to be salvaged" shall be removed from the job Site to a secure area, and delivered to GSD within five (5) working days of salvage. Only the items listed as "to be salvaged" shall be delivered unless otherwise specified by the Owner.

B. Items noted on the Drawings to be re-used or re-located shall be removed from their present location, safely stored, and protected from damage until installation in the new location or coordination with the Owner has taken place. The Contractor shall be responsible for repair of any damages resulting from removal, and shall provide new fittings, fasteners, and appurtenances required for installation in the new location.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Construction Operations: Work shall not be undertaken outside of the days/times listed in the Contract Documents.

B. Overnight, on-street parking of vehicles is prohibited. Whenever possible, vehicle and equipment parking shall be limited to the parking/staging locations shown on the Drawings, and behind locked gates for the protection of the vehicles and assets involved. Alternative parking locations shall be reviewed and approved by Owner.

1.7 CONTRACTOR'S RESPONSIBILITY FOR UTILITIES AND SERVICES

A. Utilities on the Drawings may be shown incorrectly or not at all. The Contractor shall contact Underground Service Alert (USA) at 811 at least forty-eight (48) hours, but not less than two (2) working days, prior to any demolition or excavation and request field markings of all underground utilities. Contractor shall also contact and notify Owner.

B. The Contractor shall locate, expose, and provide temporary support as needed for all existing Underground Facilities encountered during the Work. Hand tools shall be used when locating and exposing underground utilities.

C. The Contractor shall be solely responsible for damage done to any existing utilities, structures, or improvements, unless otherwise provided for on the Drawings, in these Specifications, or by direction from the Engineer. Replacement and/or repair shall restore damaged improvements to their original (or better) condition. The Utility Owner shall be the sole judge of the adequacy of the restoration.

D. Traffic flow shall be maintained at all times during working hours unless otherwise specified on the Drawings or in these Contract Documents.

1.8 RECORD DRAWINGS

A. The Contractor shall keep accurate and up-to-date records on a set of full-size Project prints. Record Drawings shall include additions to and deletions from the Work, and changes to the design, as well as any variation from information either shown on the Drawings or specified in the Contract Documents. These drawings shall be made available upon request to the Owner's representative.

B. See "Section 01 70 00 Execution and Closeout Requirements."

1.9 CONTRACTOR'S SEQUENCE OF CONSTRUCTION

A. Contractor shall be responsible for coordination and appropriate scheduling to maintain the prolonged phasing of this Project. To that end, the following summary descriptions of anticipated Work effort is provided for fee schedule development and construction purposes.

1. The existing potable water mains, water storage tanks, service lateral, and associated structures that provide potable water to the residences served by GSD must remain in service until all components of new potable water system have been installed, tested, disinfected, and approved for operation by the Owner.

2. Contractor shall coordinate with residences affected by any planned outages. No occupied residence shall be without utility service for more than eight (8) hours. Notify Owner 14 days in advance of any planned outage.

B. The following schedules and plans shall be provided by the Contractor to the Engineer at the Preconstruction Meeting, and shall be formally submitted within ten (10) days after the date of Notice to Proceed:

1. Schedule of Submittals, as described in "Section 01 33 00 Submittal Procedures"

2. Preliminary Work Schedule

3. Plan for establishing temporary access, staging areas, and required erosion control

measures prior to starting Work in affected areas of the Project

4. Schedule of Values for all lump sum bid items

5. Names and contact information of all significant Project personnel

C. New mechanical, electrical, and instrumentation and controls systems must be installed, tested, and fully operational before critical tie ins potable water distribution systems are completed.

D. Work on existing structures and facilities shall be performed on a schedule and in a manner that will permit the existing structure or facility to operate continuously unless otherwise approved by the Engineer.

1.10 PROJECT SAFETY

A. The Contractor shall submit both the Project Manager and the Project Foreman/ Superintendent's night emergency telephone numbers to the Owner and the Engineer prior to starting work on the Project so contact may be made, at all times, in case of emergency.

B. The Contractor shall be solely responsible for the safety of their Work, including but not limited to, the conditions of the Project Site and construction equipment, the safety of all persons involved in the Work, the general public within the Work area, and the surrounding private and public property. This requirement shall apply continuously and shall not be limited to normal working hours. Safety provisions shall conform to U.S. Department of Labor Occupational Safety and Health Administration (OSHA), the California Occupational Safety and Health Administration (Cal-OSHA), and all other applicable federal, state, county, and local laws, ordinances, and codes. Where any of these are in conflict, the more stringent requirement, as determined by the Engineer, shall be followed. The Contractor's failure to become thoroughly familiar with these safety provisions shall not relieve them from compliance with the obligations set forth under these provisions.

C. The control of traffic is crucial. The Work area must be arranged such that pedestrian, bicycle, and automobile traffic, where applicable, may pass around the Work area safely. All traffic control shall be in accordance with the approved Humboldt County Encroachment permit conditions.

D. The Contractor shall provide safety and first aid equipment at the job Site as required by the applicable regulatory agency. In addition, all workers shall be familiar with the procedure for summoning emergency medical personnel to the Project Site, if an injury were to occur.

E. If, during the course of the Project, serious damage, injury, or death occurs, the Contractor shall notify the Engineer and Owner as soon as possible. The Contractor shall document, in writing, details of any incidents involving property damage and/or personal injury that arise within the Project area. This documentation shall include statements from all known witnesses and shall be provided to the Engineer and Owner as soon as possible after any such incident.

F. Claims made by any person against the Contractor or Subcontractor as a result of an accident related to this Project shall be reported as soon as possible to the Engineer.

1.11 CONDUCT OF CONTRACTORS AND WORKERS

A. Whenever the Contractor, Subcontractor, or a worker encounters property owners or the general public at the job Site, they shall conduct themselves in a courteous, professional, and non-abusive manner. If any Subcontractor or person employed by the Contractor shall appear to the Engineer to be incompetent or to act in a disorderly or improper manner, that individual shall be discharged immediately at the direction of the Engineer and shall not be employed again on the Project.

B. The Owner reserves the right to terminate this Contract if, in the opinion of the Engineer, the Contractor, Subcontractor, or workers fail to comply with this requirement. If the Contract is terminated because of this provision, no compensation will be made for bid items that have not been satisfactorily completed.

1.12 PERMITS, CODES, AND ENVIRONMENTAL CONDITIONS

A. The Contractor shall coordinate with the Engineer to obtain all necessary permits for construction of Work.

B. All permits required for the Work shall be obtained and paid for by the Contractor prior to commencement of any work. The Contractor shall file a copy of all permits and notifications with the Engineer.

C. The Contractor shall conform to the requirements of all permits and licenses applicable to the Work, and shall comply with all applicable codes, and ordinances, rules, regulations, orders, and other legal requirements of the State Water Resources Control Board, the Division of Drinking Water, and the Garberville Sanitary District.

D. The Drawings and Specifications have been prepared to comply with anticipated permit requirements and environmental protection measures for the Project. The Contractor is advised that all work must comply with these requirements and that the cost of compliance with these requirements is included in payment for individual items of Work, and that no additional compensation for cost arising out of such compliance will be made.

E. Encroachment Permit: The Contractor will obtain and pay all fees associated with the Humboldt County Encroachment Permit. The Contractor will be required to sign for the permit and will be required to follow all of its requirements.

F. Grading Permit: The Contractor will obtain and pay all fees associated with the Humboldt County Grading Permit. The Contractor will be required to sign for the permit and will be required to follow all of its requirements.

G. Building Permit: The Contractor will obtain and pay all fees associated with the Humboldt County Building Permit. The Contractor will be required to sign for the permit and will be required to follow all of its requirements.

H. North Coast Unified Air Quality Management District: National Emissions Standards for Hazardous Air Pollutants (NESHAP) Notification of Demolition.

I. Material Disposal. When any material is to be disposed of outside the Project Work area, the Contractor shall obtain both a written agreement between the property owner and the Contractor and a copy of the permit that allows material disposal at the subject site. The agreement shall grant the Contractor permission to use the private property as a disposal site, and shall absolve GSD and any of its agents of all responsibility for consequences of such

usage. The permit copy shall be obtained from the property owner and other regulatory agencies as appropriate. Both the agreement and permit shall be filed with the Engineer prior to the use of the property, and the Contractor shall obtain permission from the Engineer to dispose of the material at the proposed location designated in the agreement and on the permit before any material is disposed of on said property. Receipts for disposal shall be provided to the Owner and Engineer upon request.

J. Codes and Standards

1. The Work of all trades shall conform to all applicable codes, laws, standards, regulations, etc., of the State of California, Humboldt County, and GSD. It is the intent that the Contractor shall comply with regulations of governmental agencies having jurisdiction over the Work to be performed.

2. Contractor shall arrange and pay for all inspections by governmental agencies and shall assume the cost of all corrective Work required as a result of such inspections.

1.13 DISPOSAL OF MATERIALS.

A. Disposal of materials shall not be permitted within the public right-of-way. The Contractor shall make their own arrangements for disposal sites outside the right-of-way, shall pay all costs involved, and shall obtain all required permits.

1.14 BACKFLOW PREVENTION

A. If the Contractor wishes to use water from the GSD water distribution system during the course of this Project, they shall obtain and attach an approved backflow preventer at the point where they connect to the GSD water system (that is, at a hydrant, water service, blow-off, etc.). The approved backflow prevention device shall be tested and certified by a certified tester and approved by the Engineer and GSD prior to use. The Contractor shall be responsible for the maintenance and protection of the backflow preventer.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION–NOT USED

END OF SECTION

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SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Schedule of Values

B. Application for Payment

C. Change Procedures

D. Defect Assessment

E. Unit Prices

F. Alternates

1.2 REFERENCES

A. Section 01 33 00—Submittal Procedures

B. Section 01 60 00—Product Requirements

C. Section 01 70 00—Execution and Closeout Requirements

1.3 SCHEDULE OF VALUES

A. The Contractor shall:

1. Submit Schedule of Values as electronic spreadsheet file in Microsoft Excel format.

2. Submit Schedule of Values within ten (10) days after date established in Notice to Proceed.

3. Include within each line item, direct proportional amount of Contractor's overhead and profit.

4. Revise Schedule of Values to list approved Change Orders with each Application for Payment.

1.4 APPLICATION FOR PAYMENT

A. <u>Incomplete pay request Submittals will be rejected immediately and will not be reviewed.</u>

B. Submit electronic file of each Application for Payment in portable document file (PDF) format.

C. Content and Format: Use Schedule of Values for listing items in Application for Payment.

D. Submit updated construction schedule with each Application for Payment.

E. Submit electronic copy of redline as-built markups with each Application for Payment. Progress payments will not be approved without current redline as-built markups.

F. Payment Period: Submit at intervals stipulated in the Agreement.

G. Submit Submittals with transmittal letter as specified in "Section 01 33 00 Submittal Procedures."

H. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:

1. Current construction photographs specified in "Section 01 33 00 Submittal Procedures"

2. Partial release of Liens from major Subcontractors and vendors.

3. Record Documents as specified in "Section 01 70 00 Execution and Closeout Requirements" for review by Owner. Submit Record Documents with each Application for Payment in electronic PDF format.

4. Construction Progress Schedule, revised and current as specified in "Section 01 33 00 Submittal Procedures"

1.5 CHANGE PROCEDURES

A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.

C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.

D. Use AIA G716–Request for Information and CSI Form 13.2A—Request for Interpretation for requesting interpretations.

E. Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.

F. Engineer may issue Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change with the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within seven (7) days.

G. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change and the effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on the Work by separate or other Contractors.

H. Stipulated Sum/Price Change Order: Based on Notice of Change and Contractor's fixed price quotation.

I. Unit Price Change Order: For Contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units that are not predetermined, execute Work under Construction Change Directive. Changes in Contract Sum/Price or Contract Time will be computed as specified for Change Order.

J. Construction Change Directive: Engineer may issue directive, on Construction Change Directive signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

K. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

L. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.

M. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.

N. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

O. Correlation of Contractor Submittals:

1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.

2. Promptly revise Progress Schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of Work affected by the change, and resubmit.

3. Promptly enter changes in Record Documents.

1.6 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of Engineer, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Owner.

D. Defective Work will be partially repaired according to instructions of Owner, and unit sum/price will be adjusted to new sum/price at discretion of Owner.

E. Individual Specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Owner to assess defects and identify payment adjustments is final.

G. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:

1. Products wasted or disposed of in a manner that is not acceptable
2. Products determined as unacceptable before or after placement
3. Products not completely unloaded from transporting vehicle
4. Products placed beyond lines and levels of the required Work
5. Products remaining on hand after completion of the Work
6. Loading, hauling, and disposing of rejected products

1.7 UNIT PRICES

A. Take measurements and compute quantities. Owner's Representative will verify measurements and quantities.

B. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only.

1. See Section 13 in the General and Supplementary Conditions for adjustments

C. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services, and incidentals; erection, application, or installation of item of the Work; overhead; and profit.

D. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work (Subject to Article 13 in the General Conditions and as amended in the Supplementary Conditions.)

E. Measurement of Quantities:

1. Weigh Scales: Inspected, tested, and certified by applicable State weights and measures department within past year
2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle
3. Metering Devices: Inspected, tested, and certified by applicable State department within past year
4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes measured by handbook weights; welded assemblies measured by handbook or scale weight
5. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness
6. Measurement by Area: Measured by square dimension using mean length and width or radius

7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord

8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means, or combination, as appropriate, as completed item or unit of the Work

1.8 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement. The Owner-Contractor Agreement may identify certain Alternates to remain an Owner option for a stipulated period.

B. Coordinate related Work and modify surrounding Work. Description for each Alternate is recognized to be abbreviated but requires that each change shall be complete for scope of Work affected.

1. Coordinate related requirements among Specification sections as required.

2. Include as part of each Alternate, miscellaneous devices, appurtenances, and similar items incidental to or necessary for complete installation.

3. Coordinate Alternate with adjacent Work and modify or adjust as necessary to ensure integration.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION–NOT USED

END OF SECTION

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SECTION 01 22 00

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 GENERAL

A. Unless otherwise specified in other individual sections of these Specifications, quantities of Work shall be determined from measurements or dimensions in horizontal planes. However, linear quantities of pipe shall be considered as being the true length measured along the longitudinal axis.

B. Units of measurement shall be in accordance with U.S. Standard Measures.

C. Materials and unit price items of Work are to be paid for on a measurement basis in accordance with Part 1.4 of this Section.

D. Bid items are not intended to be exclusive descriptions of Work categories and the Contractor shall determine and include in its pricing all materials, labor, and equipment necessary to complete each Bid Item as shown and specified. Omission of specific tasks in the measurement and payment section does not constitute a change order for completion.

1.2 LUMP SUM PRICE BREAKDOWN (SCHEDULE OF VALUES)

A. Immediately after award of the Contract and prior to approval of initial payment request, the Contractor shall submit a cost breakdown list (Schedule of Values) to the Engineer for all lump-sum bid items. This list shall consist of the major components of Work that make up the lump sum bid items and shall be used for determining progress pay estimates. The Contractor shall fill in the amounts for each component, prorating general costs (such as setup, overhead, and profit) in each component. The total of all components of each lump sum bid item shall equal the total of that lump sum bid item. If the amount indicated in the Contractor's Schedule of Values for any item on the list appears unbalanced, the Engineer may request that the Contractor revise the item as deemed necessary by the Engineer, unless the Contractor can substantiate these costs.

B. Only Work items of value to the Owner shall be included in the list. An item for cleanup shall be listed in the breakdown, in the amount of at least one quarter of one percent (0.25%) of the total bid item. If cleanup proceeds as the Project progresses, then partial payments of these amounts will be made accordingly.

1.3 GENERAL

A. All work shall be completed and placed in compliance with the Drawings and Specifications, and as directed by the Engineer.

1.4 MEASUREMENT AND PAYMENT ITEMS

Garberville Tanks Replacement items are defined and measured as follows:

WALLAN TANK AND PUMP STATION IMPROVEMENTS

1.1 MOBILIZATION/DEMOBILIZATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all labor, equipment, and materials necessary to establish and maintain a physical presence at the Project site for the duration of the Work, including, but not limited to, bid bond, performance bond, and guarantee bond fees; attendance at Project start-up and regular progress meetings; other periodic Project meetings; compliance with applicable Project reporting, invoicing, and progress payment processes; mobilization; protection of the public from safety hazards associated with the Contractor's pursuit of the Work; temporary fencing as required; temporary Project signage; temporary sanitation facilities; costs associated with acquiring, protecting, maintaining, and cleaning additional Work and staging areas as necessary; protection of materials stored onsite, according to the recommendations of the manufacturers of the materials that are to be incorporated into the Work; preparation of Submittals and requests for information (RFIs); timely removal of unsuitable materials from areas accessible to the public; regular Site cleanup; final Site cleanup; and demobilization—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

B. Two-thirds (67%) of the lump sum bid amount for this item shall be paid to the Contractor in the first progress payment. Upon completion of demobilization and complete Project cleanup satisfactory to the Engineer, one-third (33%) of the bid amount for this item shall be paid to the Contractor in the final progress payment.

1.2 DEMOLITION OF EXISTING WALLAN TANK, FOUNDATION AND PIPING

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, treatment and proper disposal of remaining water in tank after taken offline; temporary piping, demolition and removal of the existing Wallan redwood water tank, foundation, appurtenances, and surrounding concrete as shown on the demolition plan; removal, capping, salvage and disposal of abandoned valves, valve boxes and yard piping in accordance with the demolition plan; disposal of non-salvageable materials at an approved offsite disposal site; removal/salvage of poly tank; protection of utilities to remain; and Site cleanup—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer

1.3 70,000-GALLON, BOLTED STEEL WATER TANK AND FOUNDATION & DISINFECTION

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for all materials, labor, equipment, permits (where required), incidentals, and performance of all Work necessary to furnish, construct, and install the bolted steel water tank, including but not limited to, the tank foundation, cathodic protection system, and bolted steel tank complete and in-place; including tank floor, shell, and roof, reports and certifications required for tank, tank appurtenances, tank testing and disinfection, treatment and disposal of tank testing water, coordination with Garberville Sanitary District (GSD), startup and functional testing—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer. Design Services associated with the tank including foundation, tank, and cathodic protection are included in this item.

1.4 SITE GRADING AND SURFACING

A. Measurement for this item shall be on the basis of per square yard of grading and surfacing with Class 2 Agg base. Payment shall include full compensation for all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, excavation, temporary stockpiling, grading, moisture conditioning, stabilization, compaction, and proof-rolling of subgrade to the line and grades indicated; grading, placement, moisture conditioning and compaction of backfill and Class 2 aggregate surfacing materials; facilitation of testing; stockpiling and disposal of excess or unsuitable spoils, control of water; control of grade; repairs to utilities and services damaged during construction; cleanup and Site restoration—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

1.5 YARD PIPING

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to furnishing and installing all pipe and fittings associated with the Wallan tank, up to the tank appurtenances; trench excavation, shoring and bracing; stockpiling and disposal of excess or unsuitable trench spoils; control of water; control of grade; furnishment, installation, and placement of piping, pipe supports, expansion joints, valves and valve boxes not specifically covered under separate line items; placement of pipe bedding and cover; installation of pipeline tracer where required; placement and compaction of backfill; installation of thrust blocks, restrained joints, fittings and cut-off collars; facilitation of testing; repairs to utilities and services damaged during construction; cleaning, disinfection, bacteriological and hydrostatic testing of installed yard piping and appurtenances; ground surface restoration to the extents required for surfacing; public notification for any necessary water service interruption; coordination with the service user and services district personnel; and startup and functional testing—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer. Yard piping includes tank overflow and drain piping, drain inlets, and energy dissapator.

1.6 WALLAN TANK RADIO, SOLAR, AND ELECTRICAL

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for all materials, labor, equipment, permits (where required), and performance of all Work, including but not limited to, furnishing and installation of tank communications and level sensing system and associated appurtenances; solar power and battery system, mounting and anchoring of all equipment; complete and in place; wiring; connection; calibration; integration; PLC programming; adjustment; testing; operation; training for all electrical equipment, devices, and components related to the system and the production of operation and maintenance (O&M) manuals, as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

1.7 SECURITY FENCING AND GATE

A. Measurement and payment of this item shall be on the basis of the bid price per lineal foot of fence installed. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, the installation of security fencing and access gate with lock in the locations specified in the Drawings—all as described in the Contract Documents, as shown in the

Drawings, and as directed by the Engineer**.**

1.8 4-INCH C900 PVC DISTRIBUTION PIPING

A. Measurement and payment for C900 PVC Distribution Piping shall be on the basis of the bid price per linear foot of 4-inch water pipe installed. Payment shall include full compensation for all labor, materials, tools, equipment, permits (where required), incidentals, and for performing all Work involved in constructing 4-inch water pipe, complete and in place. Work includes, but is not limited to, providing timely notice to and obtaining all necessary permits, including encroachment permits from public and private utility agencies; advising Underground Services Alert (USA North) a minimum of 48-hours before ground disturbance of planned pothole activities; potholing; excavation, shoring and bracing; trenching; culvert crossings; stockpiling and disposal of excess or unsuitable trench spoils; placement and compaction of backfill; the facilitation of testing; installation of pipes, fittings, thrust blocks and restrained joints; repairs to utilities and services damaged during construction; cleaning, disinfection, bacteriological and hydrostatic testing; ground surface restoration; reconnection to existing water; and cleanup—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

1.9 DEMOLITION OF MECHANICAL/ELECTRICAL AT WALLAN PUMP STATION

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, demolition/removal of the existing pump station mechanical (piping, valving, pumps, etc.) and electrical components and associated appurtenances in accordance with the demolition plan, and protection of utilities to remain—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer**.**

1.10 ELECTRICAL/CONTROLS

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, furnishing, installation, wiring, connection, calibration, integration, PLC programming, HMI design and programming, adjustment, testing, operation, and training for all new electrical equipment, devices, and components; refeeding of existing lighting and receptacles; provision and installation of new conduit, and connection to existing meter and panel —all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

1.11 TOWABLE GENERATOR

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), and performance of all Work, including but not limited to, the furnishing of a trailer mounted diesel generator, adjustment, testing, operation, training for all electrical equipment, devices, and components, and the production of an O&M manual—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

1.12 PUMP STATION BUILDING EXTERIOR REPAIRS

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment permits (where required), incidentals, and performance of all Work, including but not limited to, the furnishing and installation of new Hardie-plank siding, standing seam metal roofing, entry doors, frames, and locks, all exterior trim—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer. Electrical modifications on the exterior of the building to be paid for elsewhere.

1.13 PUMP STATION PUMPS, PIPING, AND VALVES

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, furnishing and installation of pumps, equipment pads and anchorage, piping, valving, and supports within the pump station structure, appurtenances, and production of an O&M manual—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

ALDERPOINT PUMP STATION CONSTRUCTION AND ARTHUR ROAD PUMP STATION DEMOLITION

2.1 MOBILIZATION/DEMOBILIZATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all labor, equipment, and materials necessary to establish and maintain a physical presence at the Project site for the duration of the Work, including, but not limited to, bid bond, performance bond, and guarantee bond fees; attendance at Project start-up and regular progress meetings; other periodic Project meetings; compliance with applicable Project reporting, invoicing, and progress payment processes; mobilization; protection of the public from safety hazards associated with the Contractor's pursuit of the Work; temporary fencing as required; temporary Project signage; temporary sanitation facilities; costs associated with acquiring, protecting, maintaining, and cleaning additional Work and staging areas as necessary; protection of materials stored on Site, according to the recommendations of the manufacturers of the materials that are to be incorporated into the Work; preparation of submittals and requests for information (RFI); timely removal of unsuitable materials from areas accessible to the public; regular Site cleanup; final Site cleanup; and demobilization—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

B. Two-thirds (67%) of the lump sum bid amount for this item shall be paid to the Contractor in the first progress payment. Upon completion of demobilization and complete Project cleanup satisfactory to the Engineer, one-third (33%) of the bid amount for this item shall be paid to the Contractor in the final progress payment.

2.2 DEMOLITION OF ARTHUR ROAD PUMP STATION AND PIPING

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, clearing and grubbing, demolition/removal of the existing pump station, piping, mechanical and electrical equipment, pump station foundation, and appurtenances in accordance with demolition plan; removal and disposal of abandoned valves and valve boxes; protection of utilities to remain—all as

described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer. Site restoration to be paid for elsewhere.

2.3 SITE WORK AT NEW ALDERPOINT PUMP STATION

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, excavation, temporary stockpiling, grading, moisture conditioning, stabilization, compaction, and proof-rolling of subgrade to the line and grades indicated; placement, grading, placement, moisture conditioning and compaction of backfill and Class 2 aggregate surfacing materials; facilitation of testing; stockpiling and disposal of excess or unsuitable spoils, control of water; control of grade; repairs to utilities and services damaged during construction; furnishing and installation of bollards, including excavation necessary for their placement, spoils disposal, associated concrete, the facilitation of testing as required, surface restoration, cleanup—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

2.4 ALDERPOINT PUMP STATION BUILDING CONSTRUCTION (CMU)

A. Measurement and payment for this item shall be on the basis of the bid price per square foot of building constructed. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, construction of a new pump station building with slab-on-grade foundation, including the furnishment and installation of Class 2 aggregate with associated compaction, the facilitation of testing, concrete masonry unit walls, door with locks, roof structure and roofing, painting/coatings (when required on the Drawings), hoists and steel supports called for in the Drawings, where applicable, grading and excavation required for the installation of the structure, and all finish Work—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

2.5 ALDERPOINT PRESSURE RELIEF VALVE (PRV) VAULT/PRVS

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, provision of a new precast PRV vault with H-20 traffic rated hatches; excavation and backfill; and provision of 4" and 6" PRVs with integral pressure and position instrumentation, electrical wiring, conduit and testing, piping, and associated appurtenances—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

2.6 PUMP STATION PUMPS AND MECHANICAL

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, furnishing and installation of pumps, piping and supports, equipment pads and anchorage, shut off valves, motor operated valve, appurtenances; furnishment and installation of mini split units and exhaust fans; and production of an O&M manual—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

2.7 YARD PIPING

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for all materials, labor, equipment, and permits (where required), incidentals, and performance of all Work, including but not limited to furnishing and installing all pipe and fittings within the extents of the Alderpoint pump station yard Site; trench excavation, shoring and bracing; stockpiling and disposal of excess or unsuitable trench spoils; control of water; control of grade; furnishment, installation, and placement of piping, pipe supports, valves and valve boxes not specifically covered under separate line items; placement of pipe bedding and cover; installation of pipeline tracer where required; placement and compaction of backfill; installation of thrust blocks, restrained joints, fittings and cut-off collars; facilitation of testing; repairs to utilities and services damaged during construction; cleaning, disinfection, bacteriological and hydrostatic testing of installed yard piping and appurtenances; ground surface restoration to the extents required for surfacing; temporary piping; public notification for any necessary water service interruption; coordination with the service user and services district personnel; and startup and functional testing—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

2.8 PACIFIC GAS AND ELECTRIC (PG&E) SERVICE MODIFICATIONS

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, provision and installation of all Work shown in PG&E documents as required “by others” including the conduit, pole boxes, meter; and coordination with PG&E—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer

2.9 ELECTRICAL/CONTROLS

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, furnishing and installation of the generator with concrete pad foundation and anchorage, furnishing, installation, wiring, connection, calibration, integration, PLC programming, HMI design and programming, adjustment, testing, operation, and training for all electrical equipment, devices, and components; building electrical, exterior and interior lighting—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

2.10 SITE RESTORATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, topsoil preparation and conditioning; planting and seeding; provision, installation, and maintenance of temporary irrigation system for turf establishment; restoration of staging areas; temporary protection of new plantings, including stakes, mulch, and protective fencing (as applicable)—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

B. Fifty percent (50%) of the lump sum bid amount for this item shall be paid to the Contractor with procurement of materials, and the remaining fifty percent (50%) shall be paid upon final acceptance in the final progress payment.

3.1 MOBILIZATION/DEMOBILIZATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all labor, equipment, and materials necessary to establish and maintain a physical presence at the Project Site for the duration of the Work, including, but not limited to, bid bond, performance bond, and guarantee bond fees; attendance at Project start-up and regular progress meetings; other periodic Project meetings; compliance with applicable Project reporting, invoicing, and progress payment processes; mobilization; protection of the public from safety hazards associated with the Contractor's pursuit of the Work; temporary fencing as required; temporary Project signage; temporary sanitation facilities; costs associated with acquiring, protecting, maintaining, and cleaning additional Work and staging areas as necessary; protection of materials stored onsite, according to the recommendations of the manufacturers of the materials that are to be incorporated into the Work; preparation of submittals and requests for information (RFI); timely removal of unsuitable materials from areas accessible to the public; regular Site cleanup; final Site cleanup; and demobilization—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

B. Two-thirds (67%) of the lump sum bid amount for this item shall be paid to the Contractor in the first progress payment. Upon completion of demobilization and complete Project cleanup satisfactory to the Engineer, one-third (33%) of the bid amount for this item shall be paid to the Contractor in the final progress payment.

3.2 TRAFFIC CONTROL

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all labor, equipment, permits (where required), incidentals, and materials necessary for the control of traffic, complete and in place. Work includes, but is not limited to, obtaining the necessary encroachment permits from Humboldt County; submitting the proposed traffic control plan(s) to the County Department of Public Works for review and approval; modifying the proposed traffic control plan as required based on County review; advising public agencies and residents that will be impacted by construction activities with minimum 48-hour notice of construction activities, parking restrictions, and proposed closures; furnishing, placing, and maintaining traffic signs and safety warning devices, including devices with warning lights for those that must remain in place after working hours, and delineators as described in the approved traffic control plan; immediate removal and replacement of damaged or non-functional signs, warning devices, delineators; provision of all required personnel and flaggers to control traffic, including one-way traffic through the construction zone; and maintenance of traffic safety at all times in accordance with the approved traffic control plan—all as shown on the Drawings, as specified in the Contract Documents, and as directed by the Engineer.

3.3 8-INCH C900 PVC PIPING TO WALLAN ROAD TIE IN

A. Measurement and payment for 8-inch C900 PVC Piping to Wallan Road tie in shall be on the basis of the bid price per linear foot of 8-inch water pipe installed. Payment shall include full compensation for all labor, materials, tools, equipment, permits (where required), incidentals, and for performing all Work involved in constructing 8-inch water pipe, complete and in place. Work includes, but is not limited to, providing timely notice to and obtaining all necessary permits, including encroachment permits from public and private utility agencies; advising

Underground Services Alert (USA North) a minimum of 48-hours before ground disturbance of planned pothole activities; potholing, asphalt saw cutting and removal, excavation, shoring and bracing; trenching; culvert crossings; installation of pipe collars, stockpiling and disposal of excess or unsuitable trench spoils; placement and compaction of backfill; facilitation of testing; installation of pipes, fittings, thrust blocks and restrained joints; repairs to utilities and services damaged during construction; cleaning, disinfection, bacteriological and hydrostatic testing; ground surface restoration including asphalt surfacing; reconnection to existing water; and cleanup—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

3.4 ARTHUR ROAD TIE IN

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, furnishing and installation of piping, valves, fittings, and appurtenances associated with the tie in and connection of 8-inch PVC C900 at the intersection of Arthur Road; relocation of existing hydrant, thrust blocking and restraints, culvert crossing, surface restoration, disinfection, bacteriological and hydrostatic testing of installed piping and appurtenances —all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

ROBERTSON TANK AND ANTENNA TOWER

4.1 MOBILIZATION/DEMOBILIZATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all labor, equipment, and materials necessary to establish and maintain a physical presence at the Project Site for the duration of the Work, including, but not limited to, bid bond, performance bond, and guarantee bond fees; attendance at Project start-up and regular progress meetings; other periodic Project meetings; compliance with applicable Project reporting, invoicing, and progress payment processes; mobilization; protection of the public from safety hazards associated with the Contractor's pursuit of the Work; temporary fencing as required; temporary Project signage; temporary sanitation facilities; costs associated with acquiring, protecting, maintaining, and cleaning additional Work and staging areas as necessary; protection of materials stored on Site, according to the recommendations of the manufacturers of the materials that are to be incorporated into the Work; preparation of submittals and requests for information (RFI); timely removal of unsuitable materials from areas accessible to the public; regular Site cleanup; final Site cleanup; and demobilization—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

B. Two-thirds (67%) of the lump sum bid amount for this item shall be paid to the Contractor in the first progress payment. Upon completion of demobilization and complete Project cleanup satisfactory to the Engineer, one-third (33%) of the bid amount for this item shall be paid to the Contractor in the final progress payment.

4.2 DEMOLITION OF EXISTING ROBERTSON TANK AND FOUNDATION

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, treatment and proper

disposal of remaining water in tank after taken offline; demolition/removal of the existing Robertson Water Tank, foundation and appurtenances; temporary stockpiling, air sampling, provision of water for continuous wetting during demolition efforts; secure closure of existing pipes to remain buried at limits of abandonment; removal and disposal of abandoned valves and valve boxes; protection of all landscaping and architectural elements, and protection of utilities to remain—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

4.3 ASBESTOS CONTAINING CONSTRUCTION MATERIALS DISPOSAL

A. Measurement for this item shall be on basis of the bid price per ton of material disposed of. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, removal, hauling, packaging and disposal of existing tank debris to a permitted offsite location, and disposal fees associated with hazardous asbestos—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

4.4 REPEATER TOWER

A. Measurement for this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required) incidentals, and performance of all Work, including but not limited to, and Site security, excavation, furnishment and installation of the tower and foundation, complete and in place, furnishment and installation of batteries, enclosures and mounting, solar panels, antenna, grounding, wiring, conduit, connections, calibration, integration, PLC programming, HMI design and programming, adjustment, testing, operation, and training for all electrical equipment, devices, and components—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

4.5 BACKFILL TANK

A. Measurement and payment of this item shall be on the basis of the bid price per cubic yard of backfill used. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, furnishment, placement and compaction of backfill, furnishment, transport and placement of any required import materials to the Site, temporary stockpiling, grading to the lines shown on the Drawings, and the facilitation of testing—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

4.6 IMPORTED TOPSOIL

A. Measurement and payment of this item shall be on the basis of the bid price per cubic yard of topsoil applied, complete, and in place. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, furnishment, placement, and transport of imported materials to the Site, temporary stockpiling, grading to match the surroundings, and the facilitation of testing—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

4.7 SITE RESTORATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full

compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, topsoil preparation and conditioning; planting and seeding; provision, installation, and maintenance of temporary irrigation system for turf establishment; restoration of staging areas; temporary protection of new plantings, including stakes, mulch, and protective fencing (as applicable)—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

B. Fifty percent (50%) of the lump sum bid amount for this item shall be paid to the Contractor with procurement of materials, and the remaining fifty percent (50%) shall be paid upon final acceptance in the final progress payment.

GENERAL ITEMS

5.1 EXCAVATION, SHEETING, SHORING, AND BRACING

A. Contractor shall determine if excavation sheeting, shoring, or bracing is needed based on Contractor's selected means and methods. Measurement and payment of sheeting, shoring, bracing, or equivalent method, for protection of life and limb in open excavation shall be on a lump-sum basis. Payment for this item shall be considered full compensation for furnishing all labor, equipment, permits (where required), incidentals, and materials to conform to the requirements of the California Occupational Safety and Health Administration (Cal-OSHA) and the California Labor Code including, but not limited to Contractor's permit from the State Division of Industrial Safety (Cal-OSHA) for any excavation that falls under their jurisdiction, and filing a copy of the approved permit with the Engineer prior to initiating any Work covered under the permit; equipment and materials required for trench and excavation shoring and construction techniques for general safety, worker protection, and protection of adjacent property from the hazards of caving ground. The Contractor shall submit to the Engineer a detailed plan showing the proposed design of shoring, bracing, or other provisions to be made to protect the Work area from caving ground. Also included in this item is regular inspection and maintenance of the sheeting, shoring, bracing, or equivalent methods, and removal of all components of these installations at the completion of construction.

5.2 STORMWATER POLLUTION PREVENTION PLAN (SWPPP) IMPLEMENTATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, installing, constructing, maintaining, removing, and disposing of storm management best management practices (BMPs); all in accordance with the SWPPP, and as indicated on the Drawings where shown. The implementation Work for the duration of the Project shall include construction, placement, and maintenance of the BMP measures described in the SWPPP, monitoring BMP installations on a regular basis, and before and after precipitation events; removal and disposal of accumulated onsite sediment, such as street sweeping and dust control, on a daily basis; and prompt remediation of any deficiencies identified by the Owner's Site Representative or Delegate—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer. Work performed on any SWPPP implementation item will not preclude the allowance of a rain day so long as only SWPPP items are worked on.

5.3 PRESSURE GROUTING/PIPE ABANDONMENT

A. Measurement of this item shall be basis of the bid price per cubic yard of grout installed,

complete, and in place. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to temporary and final sealing of relief holes, furnishing and installation of all grouting materials, clean up, surface restoration—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

TOBIN WELL GENERATOR SITE (ADDITIVE ALTERNATE)

A1.1 MOBILIZATION\DEMOBILIZATION

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all labor, equipment, incidentals, and materials necessary to establish and maintain a physical presence at the project site for the duration of the Work, including, but not limited to, bid bond, performance bond, and guarantee bond fees; attendance at Project start-up and regular progress meetings; other periodic Project meetings; compliance with applicable Project reporting, invoicing, and progress payment processes; mobilization; protection of the public from safety hazards associated with the Contractor's pursuit of the Work; temporary fencing as required; temporary Project signage; temporary sanitation facilities; costs associated with acquiring, protecting, maintaining, and cleaning additional work and staging areas as necessary; protection of materials stored on Site, according to the recommendations of the manufacturers of the materials that are to be incorporated into the Work; preparation of Submittals and requests for information (RFI); timely removal of unsuitable materials from areas accessible to the public; regular Site cleanup; final Site cleanup; and demobilization—all as described in the Contract Documents, as shown in the Drawings, and as directed by the Engineer.

B. Two-thirds (67%) of the lump sum bid amount for this item shall be paid to the Contractor in the first progress payment. Upon completion of demobilization and complete Project cleanup satisfactory to the Engineer, one-third (33%) of the bid amount for this item shall be paid to the Contractor in the final progress payment.

A1.2 TOBIN WELL GENERATOR/ELECTRICAL/CONTROLS

A. Measurement of this item shall be on a lump sum basis. Payment shall include full compensation for furnishing all materials, labor, equipment, permits (where required), incidentals, and performance of all Work, including but not limited to, the furnishing/installation of the generator, foundation, and anchorage; the provision, integration, and testing of all electrical power and control systems, as specified in the Contract Documents, and as directed by the Engineer.

A1.3 SITE WORK AND RESTORATION

A. Payment of this item shall be on a lump sum basis. Payment shall include full compensation for the furnishing of all materials, labor, equipment, permits (where required) and performance of the Work, including, but not limited to, stripping and removing all vegetation in locations shown on the Drawings, the installation of a 6-inch-thick gravel driveway using Class 2 aggregate base, and Site restoration to match surrounding parcels, as specified in the Contract Documents, and as directed by the Engineer.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION–NOT USED

END OF SECTION

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SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. The procedure for requesting the approval of substitution of a product that is not equivalent to a product that is specified by descriptive or performance criteria or defined by reference to one or more of the following:

a. Name of manufacturer

b. Name of vendor

c. Trade name

d. Catalog number

B. Substitutions are not "equivalent."

C. This Specification section does not address substitutions for major equipment.

D. Request for Substitution–General:

1. Base all Bids on materials, equipment, and procedures specified.

2. Certain types of equipment and kinds of material are described in Specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers.

a. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog numbers, provided said products are "equivalent," as determined by Engineer.

3. Other types of equipment and kinds of material may be acceptable substitutions under the following conditions:

a. "Equivalents" are unavailable due to strike, discontinued production of products meeting specified requirements, or other factors beyond control of Contractor; or,

b. Contractor proposes a cost and/or time reduction incentive to the Owner.

1.2 QUALITY ASSURANCE

A. In making a request for substitution or in using an approved product, Contractor represents they:

1. Have investigated proposed product and have determined that it is adequate or superior in all respects to that specified, and that it will perform the function for which it is intended.

2. Will provide the same guarantee for substitute item as for product specified.

3. Will coordinate installation of accepted substitution into Work, to include building modifications if necessary, making such changes as may be required for Work to be complete in all respects.

4. Waive all claims for additional costs related to substitution which subsequently arise.

1.3 DEFINITIONS

A. Product: Manufactured material or equipment.

1.4 PROCEDURE FOR REQUESTING SUBSTITUTION

A. Substitution shall be considered only:

1. After Award of Contract.

2. Under the conditions stated herein.

B. Written request through Contractor only.

C. Transmittal Procedures:

1. Follow the transmittal procedures prescribed for “Shop Drawings” in Specification “Section 01 33 00 Submittal Procedures.”

a. Product substitution will be treated in a manner similar to "deviations," as described in Specification “Section 01 33 00 Submittal Procedures.”

b. List the heading title, number, and/or letter of the Section from which the proposed substitution deviates. Describe the deviation and justifications on the transmittal form in the space provided under the column with the heading “DESCRIPTION.”

i. Include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in Paragraph D below.

D. Transmittal Contents:

1. Product identification:

a. Manufacturer's name

b. Telephone number and representative contact name

2. Specification Section or Drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents

3. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.

4. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:

a. Size

b. Composition or materials of construction

c. Weight

d. Electrical or mechanical requirements

5. Product experience:

a. Location of past projects using product

b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.

c. Available field data and reports associated with proposed product.

6. Data relating to changes in construction schedule.

7. Data relating to changes in cost.

8. Samples:

a. At request of Engineer

b. Full size if requested by Engineer

c. Held until substantial completion

d. Engineer not responsible for loss or damage to samples

1.5 APPROVAL OR REJECTION

A. Written approval or rejection of substitution will be given by the Engineer.

B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product, if necessary to secure design intent.

C. In the event the substitution is approved, the resulting cost and/or time reduction will be documented by Change Order in accordance with the General Conditions.

D. Substitution will be rejected if:

1. Submittal is not through the Contractor with their stamp of approval.

2. Request is not made in accordance with this Specification section.

3. In the Engineer's opinion, acceptance will require substantial revision of the original design.

4. In the Engineer's opinion, substitution will not perform adequately the function consistent with the design intent.

E. Contractor shall reimburse Owner for the cost of Engineer's evaluation whether or not substitution is approved.

PART 2 PRODUCTS–(NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 EXECUTION–(NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION

EXHIBIT A

SUBSTITUTION REQUEST FORM

(One Item per each Form)

Project:		
Substitution Requestor:		
Contractor:		
Specification Section No:	Paragraph Title & No. (i.e. 2.1.A.1.c):	Specified Item:
Proposed Substitution:		
Provide Product Data Sheets, Manufacturer's written installation instructions, drawings, diagrams, or any other information as an attached to this Form that will demonstrate the proposed substitution is an Approved Equivalent.		
State differences between proposed substitutions and specified item. Differences include but are not limited to interrelationship with other items; materials, equipment, function, utility, life cycle costs, applied finished, appearances, and quality:		
State how the proposed substitution is compatible with or modifies other systems, parts, equipment or components of the Project and Work under the Contract:		
State what effect the proposed substitution has on dimensions indicated on the Drawings and previously reviewed Shop Drawings:		
State what effect the proposed substitution has on the Construction Schedule and Contract Time:		
State what effect the proposed substitution has on the Contract Price; including all direct and indirect impact and delay costs:		
Manufacturer's guarantees of the proposed and specified items are: ☐ Same ☐ Different (explain on attachment)		
The undersigned state that the function, utility, life cycle costs, applied finishes, appearance and quality of the proposed substitution are equal or superior to those of the specified item.		
For use by Project Representative: ☐ Accepted ☐ Accepted, with Qualifications ☐ Not Accepted ☐ Received Too Late _____ *(Date)* _____ *(Telephone)*		_____ *(Contractor's Signature)* _____ *(Contractor's Firm)* _____ *(Firms Address)* _____

Comments:

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SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and Project conditions

B. Preconstruction meeting

C. Site mobilization meeting

D. Progress meetings

E. Preinstallation meetings

F. Closeout meeting

1.2 COORDINATION AND PROJECT CONDITIONS

A. The Contractor shall:

1. Coordinate scheduling, Submittals, and Work of various sections of Project manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

2. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.

3. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practical; place runs parallel with lines of building. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

    a. Coordination of the Drawings: Prepare as required to coordinate all portions of Work. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important.

4. Coordination Meetings: In addition to other meetings specified in this section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.

5. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

6. Coordinate completion and clean-up of Work of separate sections in preparation for

Substantial Completion and for portions of Work designated for Owner's partial occupancy and for portions of Work designated for Owner's occupancy.

7. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

A. Owner’s Site Representative will schedule and preside over meeting after Notice of Award.

B. Attendance Required: Engineer, Owner, Contractor, Owner’s Site Representative, and major Subcontractors.

C. Minimum Agenda:

1. Execution of Owner-Contractor Agreement
2. Submission of executed Contractor and Subcontractor bonds and insurance certificates
3. Distribution of Contract Documents
4. Submission of List of Subcontractors, list of products, Schedule of Values, Submittal Schedule, and Progress Schedule
5. Designation of personnel representing parties in Contract and distribution of contact information
6. Communication procedures
7. Procedures and processing of requests for interpretations, field decisions, Field Orders, Submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures
8. Scheduling of Work and regular construction meetings
9. Critical Work sequencing
10. Waste management plan
11. Safety

D. Owner’s Site Representative: Record minutes and distribute digital copies to participants within two (2) days after meeting, to Engineer, Owner, and those affected by decisions made.

1.4 SITE MOBILIZATION MEETING

A. Engineer will schedule meeting at Project Site prior to Contractor occupancy. Owner’s Site Representative presides over meeting.

B. Attendance Required: Engineer, Owner, Contractor, Contractor's superintendent, special consultants, Owner’s Site Representative, and major Subcontractors.

C. Minimum Agenda:

1. Use of premises by Owner and Contractor
2. Owner's requirements and occupancy
3. Construction facilities and controls provided by Owner
4. Temporary utilities provided by Owner
5. Temporary facilities provided by Contractor
6. Survey and Site layout
7. Security and housekeeping procedures
8. Schedules
9. Procedures for testing
10. Procedures for maintaining record documents
11. Requirements for startup of equipment
12. Inspection and acceptance of equipment put into service during construction period

D. Owner's Site Representative: Record minutes and distribute digital copies to participants within two (2) days after meeting, to Engineer, Owner, and those affected by decisions made.

1.5 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at weekly intervals.

B. Owner's Site Representative will arrange meetings, prepare agenda with copies for participants, and preside over meetings.

C. Attendance Required: Contractor, Contractor's superintendent, major Subcontractors and suppliers, Engineer, Owner, and Owner's Site Representative as appropriate to agenda topics for each meeting.

D. Minimum Agenda:

1. Review of minutes of previous meetings
2. Review of Work progress
3. Field observations, problems, and decisions
4. Identification of problems impeding planned progress
5. Review of Submittal schedule and status of submittals
6. Review of offsite fabrication and delivery schedules
7. Maintenance of Progress Schedule
8. Corrective measures to regain projected schedules

9. Planned progress during succeeding Work period

10. Coordination of projected progress

11. Maintenance of quality and Work standards

12. Effect of proposed changes on Progress Schedule and coordination

13. Other business relating to Work

E. Owner's Site Representative: Record minutes and distribute digital copies to participants within two (2) days after meeting, to Engineer, Owner, and those affected by decisions made.

1.6 PREINSTALLATION MEETINGS

A. When required in individual Specification sections, convene preinstallation meetings at Project Site before starting Work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Engineer four (4) days in advance of meeting date.

D. Contractor shall prepare agenda and preside over meeting:

1. Review conditions of installation, preparation, and installation procedures.

2. Review coordination with related Work.

E. Owner's Site Representative: Record minutes and distribute digital copies to participants within two (2) days after meeting, to Engineer, Owner, and those affected by decisions made.

1.7 CLOSEOUT MEETING

A. Contractor shall submit request for Closeout Meeting to Owner, Engineer, and Owner's Site Representative a minimum of five (5) days in advance of requested meeting date.

B. Contractor shall request Project Closeout Meeting with sufficient time to prepare for requesting Substantial Completion.

C. Attendance Required: Contractor, Owner's Site Representative, major Subcontractors, Engineer, Owner, and others appropriate to agenda.

D. Minimum Agenda:

1. Start-up of facilities and systems

2. Operations and maintenance manuals

3. Testing, adjusting, and balancing

4. System demonstration and observation

5. Operation and maintenance instructions for Owner's personnel

6. Contractor's inspection of Work

7. Contractor's preparation of an initial "punch list"
8. Procedure to request Engineer inspection to determine date of Substantial Completion
9. Completion time for correcting deficiencies
10. Inspections by authorities having jurisdiction
11. Certificate of Occupancy and transfer of insurance responsibilities
12. Partial release of retainage
13. Final cleaning
14. Preparation for final inspection
15. Closeout Submittals:
    a. Project record documents
    b. Operating and maintenance documents
    c. Operating and maintenance materials
    d. Affidavits
16. Final Application for Payment
17. Contractor's demobilization of Site
18. Maintenance

E. Owner's Site Representative: Record minutes and distribute digital copies to participants within two (2) days after meeting, to Engineer, Owner, and those affected by decisions made.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION–NOT USED

END OF SECTION

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SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SUBMITTALS

A. Within ten (10) working days after date established in Notice to Proceed, submit proposed preliminary network diagram defining planned operations for first thirty (30) working days of Work, with general outline for remainder of Work.

B. Participate in review of preliminary and complete network diagrams jointly with Owner, Engineer, and Owner's Site Representative.

C. Within ten (10) working days after joint review of proposed preliminary network diagram, submit draft of proposed complete network diagram for review. Include written certification that all Subcontractors have reviewed and accepted proposed schedule.

D. Submit updated network schedules with each pay request.

E. Submit as electronic file in PDF format to Owner's Site Representative.

F. Submit network schedules under transmittal letter form specified in "Section 01 33 00 Submittal Procedures."

G. Schedule Updates:

1. Overall percent complete, projected and actual
2. Completion progress by listed activity and subactivity, to within five (5) working days prior to Submittal
3. Changes in Work scope and activities modified since Submittal
4. Delays in Submittals or resubmittals, deliveries, or Work
5. Adjusted or modified sequences of Work
6. Other identifiable changes
7. Revised projections of progress and completion

H. Narrative Progress Report:

1. Submitted with each monthly submission of progress schedule
2. Summary of Work completed during the past period between reports
3. Work planned during the next period

4. Explanation of differences between summary of Work completed and Work planned in previously submitted report

5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones

6. Corrective action taken or proposed action

1.2 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel specializing in Critical Path Method (CPM) scheduling with two (2) years minimum experience in scheduling construction work of complexity comparable to the Project and having use of computer facilities capable of delivering detailed graphic printout.

B. Contractor's Construction Manager's Administrative Personnel: two (2) years' minimum experience in using and monitoring CPM schedules on comparable projects.

1.3 BAR CHART SCHEDULES

A. Format: Bar chart schedule, to include at least:

1. Identification and listing in chronological order of those activities reasonably required to complete the Work, including:

a. Subcontract Work

b. Major equipment design, fabrication, factory testing, and delivery dates, including required lead times

c. Move-in and other preliminary activities

d. Equipment and equipment system test and startup activities

e. Project closeout and cleanup

f. Work sequences, constraints, and milestones

2. Listings identified by specification section number

3. Identification of the following:

a. Horizontal timeframe by year, month, and week

b. Duration, early start, and completion for each activity and subactivity

c. Critical activities and Project float

d. Subschedules to define further critical portions of Work

1.4 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of schedules with Owner/Engineer at each Submittal.

B. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.

C. After review, revise schedules incorporating results of review, and resubmit within ten (10) working days.

1.5 UPDATING SCHEDULES

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of Work.

C. Identify activities modified since previous Submittal, major changes in Work, and other identifiable changes.

D. Upon approval of a Change Order, include the change in the next schedule Submittal.

E. Indicate changes required to maintain date of Substantial Completion and Final Completion.

F. Submit reports as required to support recommended changes.

G. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect, including effects of changes on schedules of separate Contractors.

1.6 DISTRIBUTION

A. Following joint review, distribute copies of updated schedules to Contractor's Project Site file, to Subcontractors, suppliers, Engineer, Owner, Owner's Site Representative, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 PRODUCTS—NOT USED

PART 3 EXECUTION—NOT USED

END OF SECTION

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 01 20 00—Price and Payment Procedures

B. Section 01 33 00—Submittal Procedures

C. Section 01 40 00—Quality Requirements

D. Section 01 43 33—Manufacturers' Field Services

E. Section 01 60 00—Product Requirements

F. Section 01 70 00—Execution and Closeout Requirements

G. Section 01 78 23—Operation and Maintenance Data

H. Section 01 91 14—Equipment Testing and Facility Startup

1.2 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Deferred Submittal: Information submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that Submittal has been found to be in general conformance with Project's design.

C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

D. Design Data Submittal: Assumptions, performance and design criteria, loads, load diagrams, calculations, applicable codes and regulations, design software information, and factory test results used by Contractor and/or product manufacturer used for the Work as specified in the project Drawings and Specifications.

E. Sample Submittal: Physical sample of material as indicated in individual Specification sections prepared from same materials to be used for the Work cured and finished in manner specified, and physically identical with product proposed for use.

1.3 PROCEDURES

A. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each Submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.

2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.

3. PDF files shall be set to open "Bookmarks and Page" view.

4. Add general information to each PDF file, including title, subject, author, and keywords.

5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper size will be accepted.

6. Submit new electronic files for each resubmittal.

7. Include a copy of the "Transmittal of Contractor's Submittal" form, located at the end of this Section, with each electronic file.

8. Engineer will reject Submittal that is not electronically submitted, unless specifically accepted.

9. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.

10. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

B. Transmittal of Submittal:

1. Contractor shall:

a. Review each Submittal and check for compliance with Contract Documents.

b. Stamp each Submittal with uniform approval stamp before submitting to Engineer.

i. Stamp to include Project name, Submittal number, Specification number, Contractor's reviewer's name, submittal date, and statement certifying Submittal has been reviewed, checked, and approved for compliance with Contract Documents.

ii. Engineer will not review Submittals that do not bear Contractor's approval stamp and will return them without action.

2. Complete, sign, and transmit with each Submittal package, one (1) "Transmittal of Contractor's Submittal" form attached at end of this Section.

3. Identify each Submittal with the following:

a. Numbering and Tracking System:

i. Sequentially number each Submittal.

ii. Resubmission of Submittal shall have original number with sequential alphabetic suffix.

b. Specification section and paragraph to which Submittal applies

c. Project title and Engineer's project number

d. Date of transmittal

e. Names of Contractor, Subcontractor or supplier, and manufacturer as appropriate

f. Attach Specification section to which Submittal applies. Place check mark (√) adjacent to each paragraph to which the Submittal complies, or place and "X" adjacent to each paragraph to which the submittal does not comply.

4. Identify and describe each deviation or variation from Contract Documents.

C. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.

2. Package Submittal information by individual Specification section. Do not combine different Specification sections together in Submittal package, unless otherwise directed in Specification.

3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.

4. Index with labeled tab dividers or bookmarks in orderly manner.

D. Timeliness: Submit in accordance with the "Schedule of Submittals," and requirements of individual Specification sections.

E. Processing Time:

1. Time for review shall commence on Engineer's receipt of Submittal.

2. Engineer will act upon Contractor's submittal and transmit response to Contractor at an average of fourteen (14) days after receipt, unless otherwise specified.

3. Resubmittals will be subject to same review time.

4. No adjustment of contract times or price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

F. Resubmittals: Clearly identify each correction or change made.

G. Incomplete Submittals:

1. Engineer will return entire Submittal for Contractor's revision if preliminary review deems it incomplete.

2. When any of the following are missing, Submittal will be deemed incomplete:

    a. Contractor's review stamp; completed and signed

    b. "Transmittal of Contractor's Submittal;" completed and signed

H. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."

1.4 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual Specification sections.

B. Shop Drawings:

1. Identify and Indicate:

    a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.

    b. Equipment and Component Title: Identical to the title shown on the Drawings.

    c. Critical field dimensions and relationships to other critical features of the Work.

    d. Note dimensions established by field measurement.

    e. Draw Project-specific information accurately to scale.

2. Manufacturer's standard schematic drawings and diagrams as follows:

    a. Modify to delete information that is not applicable to the Work.

    b. Supplement standard information to provide information specifically applicable to the Work.

3. Product Data:

    a. Provide as specified in individual Specifications.

    b. If multiple product models, sizes, and optional features are included in product data Submittal, Contractor shall specifically and clearly call out sizes, model numbers and options relevant to the Project. Failure to do so will result in rejected Submittals.
        1. Deferred Submittal: See Drawings for list of deferred Submittals.

    c. Contractor-design drawings and product data related to permanent construction.

        i. Written and graphic information

        ii. Drawings

        iii. Cut sheets

        iv. Data sheets

v. Action item Submittals requested in individual Specification section

4. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and Drawings for review and acceptance by Engineer. Documentation of review and approval provided on Engineer's comment form, along with completed Submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

5. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Submit two (2), unless otherwise specified in individual Specifications.

2. Preparation: Mount, display, or package samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:

a. Manufacturer's name

b. Model number

c. Material

d. Sample source

3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available

4. Full-size Samples:

a. Sized as indicated in individual Specification section

b. Prepared from same materials to be used for the Work

c. Cured and finished in manner specified

d. Physically identical with product proposed for use

D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute electronically, as noted:

1. No Exceptions Taken (Approved):

a. Contractor may incorporate product(s) or implement Work covered by Submittal.

2. Make Corrections Noted (Approved as Noted):

a. Contractor may incorporate product(s) or implement Work covered by Submittal, in accordance with Engineer's notations.

3. Amend and Resubmit (Resubmit as Noted):

a. Make corrections or obtain missing portions and resubmit.

4. Reject/Resubmit:

    a. Submittal rejected, Contractor may not incorporate product(s) or implement Work covered by Submittal.

    b. Resubmit Submittal in accordance with these Specifications.

1.5 INFORMATIONAL SUBMITTALS

A. General:

1. Refer to individual Specification sections for specific Submittal requirements.

2. Engineer will review each Submittal. If Submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines Submittal does not meet conditions of the Contract and is, therefore, considered unacceptable, Engineer will return Submittal response copy with review comments to Contractor and require that Submittal be corrected and resubmitted.

B. Certificates:

1. General:

    a. Provide notarized statement that includes signature of entity responsible for preparing certification.

    b. Certificates shall be signed by officer or other individual authorized to sign documents on behalf of that entity.

2. Welding: In accordance with individual Specification sections

3. Installer: Written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual Specification section

4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements

5. Certificates of Successful Testing or Inspection: Submitted when testing or inspection is required by Laws and Regulations or governing agency or specified in individual Specification sections

6. Manufacturer's Certificate of Compliance: In accordance with "Section 01 60 00–Product Requirements"

7. Manufacturer's Certificate of Proper Installation: In accordance with "Section 01 43 33–Manufacturers' Field Services"

C. Construction photographs and video in accordance with Contract Documents

D. Contractor-design data (related to temporary construction):

1. Written and graphic information

2. List of assumptions

3. List of performance and design criteria
4. Summary of loads or load diagram, if applicable
5. Calculations
6. List of applicable codes and regulations
7. Name and version of software used if any
8. Information requested in individual Specification section

E. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification section.

F. Deferred Submittals: See the Drawings for a list of deferred Submittals.

1. Contractor-design data related to permanent construction:
   a. List of assumptions
   b. List of performance and design criteria
   c. Summary of loads or load diagram, if applicable
   d. Calculations
   e. List of applicable codes and regulations
   f. Name and version of design software used if any
   g. Factory test results
   h. Informational Submittals requested in individual Specification section
2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer.
3. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed Submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

G. Payment:

1. Application for Payment: In accordance with "Section 01 20 00 Price and Payment Procedures"
2. Schedule of Values: In accordance with "Section 01 20 00 Price and Payment Procedures"

H. Quality Control Documentation: In accordance with "Section 01 40 00 Quality Requirements"

I. Schedules:

1. Schedule of Submittals

    a. Within ten (10) days after date of Notice to Proceed, submit proposed Schedule of Submittals. Prepare separately or in combination with Progress Schedule.

    b. Carefully review Project technical Specifications and list in Schedule of Submittals each separate Submittal anticipated for entirety of Project, in accordance with this and other technical Specification section requirements.

    c. Show for each, at a minimum, the following:

        i. Specification section number.

        ii. Identification by numbering and tracking system as specified under Paragraph 1.03.B "Transmittal of Submittal," above.

    d. Estimated date of submission to Engineer, including reviewing and processing time.

    e. If multiple submittals will be provided for a given Specification section number, list each submittal separately on the Schedule of Submittals, including estimated date of submission for each.

    f. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.

2. Progress Schedules

    a. Within ten (10) days after date of Notice to Proceed, submit proposed preliminary schedule defining planned operations for first thirty (30) days of Work, with general outline for remainder of Work.

    b. Submit updated schedule every month under transmittal letter form specified in "Section 01 33 00 Submittal Procedures."

    c. Progress Schedule Updates shall include:

        i. Overall percent complete, projected and actual.

        ii. Completion progress by listed activity and sub-activity, to within five (5) working days prior to Submittal.

        iii. Changes in Work scope and activities modified since Submittal.

        iv. Delays in Submittals or resubmittals, deliveries, or Work.

        v. Adjusted or modified sequences of Work.

        vi. Other identifiable changes.

        vii. Revised projections of progress and completion.

        viii. Progress Schedules.

J. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.

K. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, consultant, installer, and other professionals.

L. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.

2. Transmit to Engineer for Owner's records one (1) copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

M. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.

2. Factory: to include the following:

   a. Identification of product and Specification section, type of inspection or test with referenced standard or code

   b. Date of test, Project title and number, and name and signature of authorized person

   c. Test results

   d. If test or inspection are deemed material or equipment not in compliance with Contract Documents, identification of corrective action necessary to bring into compliance

   e. Interpretation of test results, when requested by Engineer

   f. Other items as identified in individual Specification sections

3. Field: at a minimum, include the following:

   a. Project title and number

   b. Date and time

   c. Record of temperature and weather conditions

   d. Identification of product and Specification section

   e. Type and location of test, sample, or inspection, including referenced standard or code

   f. Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector

   g. If test or inspection deems material or equipment not in compliance with Contract Documents, identification of corrective action necessary to bring into compliance

   h. Interpretation of test results, when requested by Engineer

   i. Other items as identified in individual Specification sections

N. Operation and Maintenance Data: As required in "Section 01 78 23 Operation and Maintenance Data"

O. Testing and Startup Data: In accordance with "Section 01 91 14 Equipment Testing and Facility Startup"

P. Training Data: In accordance with "Section 01 43 33 Manufacturers' Field Services"

Q. Closeout Submittals: In accordance with "Section 01 70 00 Execution and Closeout Requirements"

1.6 SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. "Transmittal of Contractor's Submittal."

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION–NOT USED

END OF SECTION

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL
(Attach to Each Submittal)

DATE: _____

TO: _____

_____

_____

Submittal No.: _____

☐ New Submittal ☐ Resubmittal

Project: _____

Project No: _____

Specification Section No.: _____

(Cover only one section with each transmittal)

FROM: _____
Contractor

Schedule Date of Submittal:
_____

SUBMITTAL TYPE: ☐ Shop Drawing ☐ Sample ☐ Informational ☐ Design Data ☐ Deferred ☐ Substitution

The following items are hereby submitted:

Item No.	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal, ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies, and iii) authorization is hereby granted to Engineer to reproduce and distribute each file as many times as necessary for Project documentation.

By: _____
Contractor (Authorized Signature)

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SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.

B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise work quality.

C. Perform Work using persons qualified to produce required and specified quality.

D. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of the Contract Documents.

E. Supervise performance of the Work in such a manner and by such means to ensure that the Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.2 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.3 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current as of date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards and maintain onsite when required by product Specification sections.

D. When requirements of indicated reference standards conflict with the Contract Documents, request clarification from Engineer before proceeding.

E. Contractual relationships, duties, or responsibilities of parties in the Contract and those of Engineer shall not be altered from the Contract Documents by mention or inference in reference documents.

1.4 LABELING

A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:

1. Model number

2. Serial number

3. Performance characteristics

1.5 TESTING AND INSPECTION SERVICES

A. Owner will employ and pay for specified services of an independent firm to perform testing and inspection.

B. Independent firm will perform tests, inspections, and other services specified in individual Specification sections and as required by Engineer.

1. Laboratory: Authorized to operate in State of California

2. Laboratory Staff: Full-time specialist on staff to review services

3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants

C. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-site testing as required by Engineer or Owner.

D. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, in duplicate, indicating observations and results of tests and compliance or noncompliance with the Contract Documents.

1. Submit final report indicating correction of Work previously reported as noncompliant.

E. Contractor shall cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Contractor shall notify Owner/Engineer and independent firm a minimum of 24 hours before expected time for operations requiring services unless noted otherwise.

2. Contractor shall arrange with independent firm and pay for additional samples and tests required for Contractor's use.

F. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform the Work, according to requirements of the Contract Documents.

G. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by the same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

H. Testing Agency Responsibilities:

1. Test samples of mixes submitted by Contractor.
2. Provide qualified personnel at Site. Cooperate with Owner/Engineer and Contractor in performance of services.
3. Perform indicated sampling and testing of products according to specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Owner/Engineer and Contractor of observed irregularities or nonconformance of Work or products.
6. Perform additional tests required by Owner/Engineer.

I. Testing Agency Reports: After each test, promptly submit copy of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Owner/Engineer, provide interpretation of test results. Include the following:

1. Date issued
2. Project title and number
3. Name of inspector
4. Date and time of sampling or inspection
5. Identification of product and Specification section
6. Location in Project
7. Type of inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents

J. Limits on Testing Authority:

1. Agency or laboratory may not release, revoke, alter, or expand on requirements of the Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

1.6 MANUFACTURERS' FIELD SERVICES

A. Refer to: “Section 01 43 33 Manufacturers' Field Services”

1.7 WARRANTY INSPECTION

A. A warranty inspection will be performed by the Owner, Engineer, and any necessary specialized inspectors. This inspection will be performed one month prior to the termination of the performance bond. The Contractor will be notified of any deficiencies and shall immediately commence with any and all corrections including provision of labor, materials, and equipment.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION–NOT USED

END OF SECTION

SECTION 01 41 00

REGULATORY REQUIREMENTS AND PERMITS

PART 1 GENERAL

1.1 CONTRACTOR

A. Contractor shall at all times observe and comply with all federal and state laws, and lawful regulations issued thereunder, and local laws, ordinances, and regulations, which in any manner affect the activities of the Contractor under this Contract, and further, shall observe and comply with all orders or decrees that exist at present and those that may be enacted later by bodies or tribunals having any jurisdiction or authority over such activities of the Contractor.

B. Contractor shall be responsible and liable for all accidents, damage, or injury to any person or property resulting from any activities, duties, and obligations of the Contractor under this Contract for which the Contractor may be legally liable, and the Contractor shall hold harmless, and shall indemnify the Engineer, the Owner and its officers, employees, and agents against any and all claims, demands, loss, injury, damage, actions, and costs of actions whatsoever that they or any of them may sustain by reason of any act, omission, or neglect of Contractor or employees, agents, representatives, or assignees of Contractor in connection with the activities, duties, and obligations of the Contractor under this Contract.

C. The Contractor shall be responsible to pay any fine levied by a regulatory agency for violation resulting from non-compliance with a permit.

1.2 PERMITTING AGENCIES, ENVIRONMENTAL DOCUMENTS, AND REQUIREMENTS

A. All permits required for the Work shall be obtained and paid for by the Contractor prior to commencement of any Work.

B. The Contractor shall conform to the requirements of all permits and licenses applicable to the Work, and shall comply with all applicable codes, ordinances, rules, regulations, orders, and other legal requirements of the Garberville Sanitary District and all applicable agencies having jurisdiction over the Work.

C. The Drawings and Specifications have been prepared to comply with anticipated permit requirements and environmental protection measures for the Project. The Contractor is advised that all Work must comply with these requirements and that the cost of compliance with these requirements is included in payment for individual items of Work, and that no additional compensation for cost arising out of such compliance will be made.

D. The following permits are required to be obtained by Contractor prior to construction of the Project:

1. Encroachment Permit: Humboldt County Planning and Building Department

2. Grading Permit: Humboldt County Planning and Building Department

3. Building Permit: Humboldt County Planning and Building Department

E. The following permits and environmental compliance documents obtained by the Owner will be supplied to the Contractor:

1. Project Description (Exhibit A)
2. Mitigation Monitoring and Reporting Program (Exhibit B)
3. Revegetation Mitigation Monitoring and Reporting Plan (Exhibit C)
4. Asbestos Survey, Lead Paint Sampling, and Lead Waste Characterization Report (Exhibit F)
5. Stormwater Pollution Prevention Plan (Exhibit G)
6. Permits Anticipated to be included in Exhibit D
    a. Humboldt County General Plan Conformance Review, Special Permit, Encroachment Permit **[Placeholder]**
    b. Demolition Permit: North Coast Unified Air Quality Management District, National Emissions Standards for Hazardous Air Pollutants (NESHAP), Notification of Demolition **[Placeholder]**
    c. NCUAQMD Authority to Construct, Permits to Operate **[Placeholder]**
    d. Humboldt County Environmental Health - CUPA **[Placeholder]**

F. The Contractor shall obtain copies of the permits from the Owner, or from the administrative agencies that issued the permits, and shall maintain copies of each relevant permit on Site during construction.

G. Contractor shall submit copies of each permit and notification to the Engineer.

PART 2 PRODUCTS—NOT USED

PART 3 EXECUTION—NOT USED

END OF SECTION

SECTION 01 43 33

MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.1 DEFINITIONS

A. Person-Day: One (1) person for eight (8) hours not including travel to Site within regular Contractor working hours.

1.2 SUBMITTALS

A. Refer to Specification "Section 01 33 00 Submittal Procedures."

B. Informational Submittals:

1. Submit qualifications of Manufacturer's Observer to Engineer a minimum of twenty (20) working days in advance of required observations. Manufacturer's Observer is subject to approval of Engineer.

2. Training Lesson Plan: Submit, in accordance with requirements of this Specification, not less than twenty (20) working days prior to scheduled training and revise as necessary for acceptance.

3. Training Session Recordings: Furnish Owner with two (2) complete sets of recordings fully indexed and cataloged with printed label stating session and date recorded.

4. Operations and Maintenance information: Furnish Owner with two (2) printed copies, bound and tabulated with table of contents, and one (1) electronic file copy in PDF format.

5. Manufacturer's Certificate of Proper Installation: two (2) printed copies and one (1) electronic file copy in PDF format.

6. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions to Engineer immediately.

1.3 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual Specification section.

B. Representative subject to acceptance by Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

1.4 REQUIREMENTS

A. When specified in individual Specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions; conditions of surfaces and installation; quality of Work; startup of equipment; testing, adjusting, and balancing of equipment; commissioning as applicable, and to initiate instructions when necessary.

PART 2 PRODUCTS-NOT USED

PART 3 EXECUTION

3.1 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services, when required by an individual Specification section, to meet the requirements of this section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, time required to perform specified services shall be considered incidental.

C. Schedule manufacturer's services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.

F. When specified in individual Specification sections, manufacturers' onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation, or application procedures

2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation

3. Providing, on a daily basis, copies of manufacturers' representatives' field notes and data to Engineer

4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer

5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems

6. Assistance during functional and performance testing, and facility startup and evaluation

7. Training of Owner's personnel in the operation and maintenance of respective product as described by manufacturer's operations and maintenance procedures and as required by

individual Specification sections

3.2 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. When so specified, a "Manufacturer's Certificate of Proper Installation" form, a copy of which is attached to this section, shall be completed, and signed by equipment manufacturer's representative.

B. Such form shall certify signing party is a duly authorized representative of manufacturer; is empowered by manufacturer to inspect, approve, and operate their equipment; and is authorized to make recommendations required to ensure equipment is complete and operational.

3.3 TRAINING

A. General:

1. Provide training such that operations and maintenance staff have the information needed to safely operate, maintain, repair, and troubleshoot the equipment and systems provided.

2. Furnish manufacturer's representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as required by applicable Specification sections.

3. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in "Section 01 78 23 Operation and Maintenance Data."

4. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.

5. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:

   a. respective manufacturer,

   b. estimated dates for installation completion, and

   c. estimated training dates.

2. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives.

3. Adjust schedule for interruptions in operability of equipment.

4. Coordinate submission of operation and maintenance manuals in accordance with "Section 01 78 23 Operation and Maintenance Data." Provide approved preliminary (not Final Submittal) Operation and Maintenance Manual for specific pieces of equipment or systems

a minimum of twenty (20) working days prior to training session for that piece of equipment or system.

5. Do not perform training until Lesson Plan and preliminary Operations and Maintenance Manual has been approved by the Engineer.

C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information:

1. Title and objectives
2. Recommended attendees (such as, managers, engineers, operators, maintenance workers)
3. Course description and goals
4. Outline of course content to include at a minimum:
    a. Overview of equipment and/or system
    b. Operating function and system theory
    c. Startup and shutdown procedures
    d. Alternative and emergency operation
    e. Preventative maintenance
    f. Troubleshooting
    g. Specific safety procedures and precautions
5. Estimated class duration for each session or portion of session
6. Format (such as, lecture, self-study, demonstration, hands-on)
7. Instruction materials and equipment requirements
8. Resumes of instructors providing training

D. Recording of Training Sessions:

1. Furnish audio and digital color video recording of training sessions, including manufacturer's representatives' classroom sessions, to the Owner for future use by operations and maintenance personnel in training of equipment and systems.
2. Use .MP4 or other format suitable for playback on standard equipment available commercially in the United States.
3. Provide microphones for instructors to record clear high quality audio recording.
4. If multiple training sessions are contained, label files based on content for facilitate playback selection.

3.4 SUPPLEMENT

A. The supplement listed below, following “End of Section,” is part of this Specification.

1. Manufacturer’s Certificate of Proper Installation

END OF SECTION

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MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

Manufacturer: _____ Equipment Name: _____

Tag No: _____ Serial No: _____

Owner: _____ Spec. Section: _____

_____ Project No: _____

I hereby certify that the above-referenced equipment/system has been:
(Check applicable box)

Yes	No	NA	
☐	☐	☐	Installed in accordance with Manufacturer's recommendations.
☐	☐	☐	Inspected, checked, and adjusted.
☐	☐	☐	Serviced with proper initial lubricants.
☐	☐	☐	Electrical and mechanical connections meet quality and safety standards.
☐	☐	☐	All applicable safety equipment has been properly installed.
☐	☐	☐	Functional tests.
☐	☐	☐	Meets specifications and is ready for startup.
☐	☐	☐	System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

_____

_____

_____

I, the undersigned manufacturer's representative, hereby certify that I am: i) a duly authorized representative of the manufacturer; ii) empowered by the manufacturer to inspect, approve, and operate their equipment; and iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative: _____
(Printed Name of Authorized Representative)

_____
(Authorized Signature)

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SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary Facilities During Construction
2. Temporary Survey Control
3. Temporary Electricity
4. Temporary Ventilation and Heating/Cooling
5. Temporary Water Service
6. Temporary Sanitary Facilities
7. Field Offices and Sheds
8. Parking
9. Progress Cleaning and Waste Removal
10. Traffic Regulation
11. Fire-Prevention Facilities
12. Barriers
13. Security
14. Water Control
15. Dust Control
16. Erosion and Sediment Control
17. Temporary Staging Area Protections
18. Noise Control
19. Pollution Control
20. Removal of Utilities, Facilities, and Controls

B. Related Sections:

1. Section 01 74 19—Construction Waste Management and Disposal

1.2 TEMPORARY FACILITIES DURING CONSTRUCTION

A. Each Contractor: Coordinate with General Contractor and Owner's Site Representative and provide the following items as necessary for execution of the Work including associated costs:

1. Construction aids

2. Temporary fire protection, dust control, erosion and sediment control, water control, noise control, and other necessary temporary controls

3. Temporary barriers, barricades, and similar devices as necessary for safety and protection of construction personnel and existing public and private facilities

4. Temporary field office including electrical service

5. Temporary sanitary facilities

6. Temporary construction yard and lay-down area. See Drawings for permitted locations. Coordinate with Owner when not shown.

7. Temporary heating and moisture/humidity control as required for proper concrete and finishing system installation and curing

8. Temporary provisions for protection of installed Work

9. Maintain conditions throughout construction to allow for continued operation of the water storage tanks and water distribution pumps and associated controls. Coordinate with Owner for service tie-ins and any interruption of service of existing water/wastewater systems.

B. The Contractor's use of private property external to the parcels or easements provided by the Owner for any purpose associated with this Project will require a written agreement between the property owner and the Contractor. The agreement shall grant the Contractor permission to use the private property and shall absolve the Owner of all consequences of such usage.

1.3 TEMPORARY SURVEY CONTROL

A. The Contractor must establish construction survey control. Contractor shall be responsible for maintaining line and grade and protecting temporary survey control points. Existing survey monuments, reference points, and other existing monumentation shall be preserved. Any survey necessary to restore damaged or removed monuments or points shall be completed by the Contractor using a California licensed Professional Land Surveyor, at no additional cost to the Owner.

1.4 TEMPORARY ELECTRICITY

A. The Contractor shall be responsible for provision of temporary utility power service including all coordination with the Utility Company, provision of power distribution panelboard, equipment rack, conduit, wire, and receptacles as required for the construction of the Project.

1.5 TEMPORARY VENTILATION AND HEATING/COOLING

A. Enclose building before activating temporary heating/cooling.

B. Ventilate enclosed areas where construction is in progress to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

C. Maintain minimum ambient indoor temperature of 50 degrees Fahrenheit within enclosed areas where construction is in progress unless indicated otherwise in individual Specification sections.

1.6 TEMPORARY WATER SERVICE

A. The Owner may provide very limited temporary potable water service for the Contractor's use. The Contractor shall exercise measures to conserve water and may be required to provide additional sources of temporary water if their demands exceed the available supply.

B. If the Contractor uses the Owner's water supply, the Contractor shall measure all usage with a flow meter and report quantities to the Owner.

C. Any use of the existing water systems shall be coordinated with the Owner and shall not negatively impact the Owner's drinking water distribution operations or supply commitments.

D. If the Contractor uses water from the Owner's distribution system during the course of this Project, the use of a backflow preventer is required. Coordinate with Owner for acceptable equipment and procedures.

1.7 TEMPORARY SANITARY FACILITIES

A. Furnish and install all required temporary toilet and hand-washing facilities for use by Contractor's personnel. Comply with County Health Department requirements and those of other public agencies having jurisdiction. Provide regular maintenance and sanitary conditions at all times.

1.8 FIELD OFFICES AND SHEDS

A. Construction: Portable or mobile buildings, or buildings constructed with floors raised aboveground, securely fixed to temporary foundations with steps and landings at entrance doors.

1. Construction: Structurally sound, secure, weathertight enclosures for office and storage spaces. Maintain during progress of Work; remove enclosures at completion of Work.

B. Installation:

1. Employee Residential Occupancy: Not allowed on Owner's property or staging areas.

C. Maintenance and Cleaning:

1. Periodic cleaning and maintenance for field office, sheds, and storage area, as required by Health Department for sanitary facilities.

D. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to same as or better than original condition.

1.9 PARKING

A. Provide temporary gravel surface parking areas to accommodate construction personnel at Contractor's yard or staging area.

B. Locate as approved by Owner.

C. If onsite space is not adequate, provide additional offsite parking.

D. Maintenance:

1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, and the like.

2. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.

E. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.10 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain Project Site in clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, before enclosing spaces.

C. Sweep using a broom and vacuum clean interior areas before starting surface finishing and continue cleaning to eliminate dust. Vacuum dirt and dust from paved surfaces daily, or more frequently, if required, when Work is in progress in public right-of-way.

D. Collect and remove waste materials, debris, and rubbish from Project Site periodically and dispose of offsite. Comply with "Section 01 74 19 Construction Waste Management and Disposal."

1.11 TRAFFIC REGULATION

A. The Contractor shall provide for standard traffic controls to ensure safe passage through the construction areas.

B. Signs, Signals, and Devices:

1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction

2. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction

3. Flag Person Equipment: As required by authorities having jurisdiction

C. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

D. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

E. Haul Routes:

1. Consult with authorities having jurisdiction and establish public thoroughfares to be used for haul routes and Site access.

F. Traffic Control Plan, Signs and Signals:

1. Provide signs at approaches to active Work Sites as needed to direct construction and affected public traffic, including pedestrian and bicycle, through the Work zones in accordance with the Drawings.

2. Relocate signs as Work progresses, to maintain effective traffic control.

3. If any street closure is required during construction, Contractor shall gain approval for street closure to the Humboldt County Department of Public Works or the Owner, as applicable, at least 30 days prior to the proposed closure and shall not proceed with closure until approval has been received. Contractor shall notify emergency service providers, school districts, and affected residents and businesses at least 48 hours before the closure and shall coordinate construction activities with affected parties and give priority to emergency vehicles at traffic control stations.

4. Notify Humboldt County Department of Public Works, California Highway Patrol, and Humboldt County Sherrif's Office at least 48 hours prior to conducting any traffic control that requires closures of both traffic lanes for longer than 5 minutes.

5. Emergency vehicles shall be permitted ingress/egress at all times.

G. Removal:

1. Maintain equipment and devices throughout construction.

2. Remove equipment and devices when no longer required.

3. Repair damage caused by installation.

1.12 FIRE-PREVENTION FACILITIES

A. Prohibit smoking within buildings under construction. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.

B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A: 60B:C UL rating, or as required for materials on Site.

1. Provide minimum of one (1) fire extinguisher in every construction trailer, temporary office, and storage shed.

1.13 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide construction fencing for protection of sensitive vegetation and wetlands as indicated on the Drawings.

C. Replace trees and plants damaged by construction operations unless noted otherwise.

D. Protect vehicular traffic, stored materials, Site, and structures not owned by Contractor/Subcontractors from damage.

1.14 SECURITY

A. Security Program:

1. Protect Work on existing premises from theft, vandalism, and unauthorized entry.

2. Provide temporary security fencing during construction period to protect Contractor’s materials and supplies.

3. Contractor is responsible for the security of their facilities, equipment, and materials within the construction site.

4. Maintain program throughout construction period until Owner occupancy.

1.15 WATER CONTROL

A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment and dispose water as required by oversight agencies.

B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.

C. Contractor shall be responsible for maintenance of proper soil moisture conditions during backfill operations and shall perform all necessary Work to obtain specified relative compaction values.

1.16 DUST CONTROL

A. Execute Work by methods that minimize raising dust from construction operations.

B. Provide positive means to prevent airborne dust from dispersing into atmosphere and into Owner-occupied areas.

1.17 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills. Prevent erosion and sediment transport.

B. Minimize surface area of bare soil exposed at any given time.

C. Provide temporary measures (best management practices [BMPs]) including berms, dikes, drains, settling basins, and other devices to prevent concentrated water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

F. Comply with Owner-developed stormwater pollution prevention plan (SWPPP), as required by the lasted version of the Construction General Permit.

1.18 TEMPORARY STAGING AREA PROTECTION

A. The Contractor shall furnish and install temporary ground protection mats covering the staging area provided by the Owner. Ground protection mats shall prevent soil damage, soil erosion, soil loss, and minimize soil compaction.

B. Temporary ground protection mats shall be in place throughout the duration of construction and removed following completion of construction.

C. Temporary fencing shall be installed around the staging area to protect the Contractor's equipment and materials, and to exclude a private property Owner's livestock.

D. Existing fencing removed for construction shall be replaced in-kind including access gates, with the exception of locations where new chain link security fencing is installed.

1.19 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.20 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction. Promptly remove and properly dispose of waste material from the Site.

1.21 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials before the site inspection that precedes Application for Final Payment.

B. Remove underground installations to minimum depth of 2 feet. Restore original surface runoff patterns.

C. Clean and repair damage caused by installation or use of temporary Work.

D. Restore existing and permanent facilities used during construction to their original, or better, condition.

E. Restore all laydown areas as specified in the Drawings.

PART 2 PRODUCTS

2.1 TEMPORARY STAGING AREA GROUND PROTECTION MATS

A. Manufacturers:

1. Signature Systems, SignaRoad
2. DICA, Tufftrack XL
3. Or Approved Equal

B. Ground protection mats shall meet the following minimum requirements:

1. Constructed from durable composite material.
2. Rated for repeated heavy equipment loading, including heavy tracked equipment and cranes.
3. Load Rating: 400 pounds per square inch
4. Interlocking and/or ground-anchored to prevent displacement during repeated heavy loading and heavy equipment traffic.
5. Thickness: 2.0 inches
6. Material: clean, non-conductive, inert, non-water-absorbing
7. Resistant to UV degradation

PART 3 EXECUTION–NOT USED

END OF SECTION

SECTION 01 58 00

PROJECT IDENTIFICATION

PART 1 GENERAL

1.1 PROJECT SIGNAGE

A. Contractor shall place a Project sign in a prominent location at each Project Site and shall maintain the sign in good condition for the duration of the construction period.

B. The sign shall be prepared in a professional manner.

C. The sign shall include the following disclosure statement and color logos (final logos to available from the Owner or Owner's Representative):

D. "Funding for this project has been provided in full or in part under the [FUNDING SOURCE TO BE IDENTIFIED PRIOR TO ORDERING SIGN] through an agreement with the State Water Resources Control Board."

1.2 SUBMITTALS

A. Furnish sign layout proof prior to sign construction.

B. "Section 01 33 00 Submittal Procedures: Requirements for Submittals"

PART 2 PRODUCTS

2.1 GENERAL

A. The Project sign shall not be ordered prior to Owner approval of the sign proof.

B. The Project sign shall be at least 4 feet tall by 8 feet wide and made of ¾-inch thick exterior grade plywood or other approved material.

C. The Project sign shall not be affixed to trees, or utility poles.

D. Vertical posts used to mount the sign shall be of sufficient strength to withstand strong winds.

PART 3 EXECUTION

3.1 GENERAL

A. Coordinate Project sign installation location with Owner.

B. The Project sign shall be visible to the public.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 PRODUCTS

A. At minimum, comply with specified requirements and reference standards.

B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.

C. Contractor shall furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide enough product, on time, to meet Project requirements.

D. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.

E. Furnish interchangeable components from same manufacturer for components being replaced.

1.2 PRODUCT DELIVERY REQUIREMENTS

A. Comply with delivery requirements in “Section 01 74 19 Construction Waste Management and Disposal.”

B. Transport and handle products according to manufacturer's instructions.

C. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

D. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.3 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products according to manufacturer's instructions.

B. Store products with seals and labels intact and legible.

C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.

D. For exterior storage of fabricated products, place products on sloped supports aboveground.

E. Provide bonded offsite storage and protection when Site does not permit onsite storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.4 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one or multiple manufacturers named and complying with Specifications; no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, in accordance with Project Contract Documents.

PART 2 PRODUCTS– NOT USED

PART 3 EXECUTION– NOT USED

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 CLOSEOUT PROCEDURES

A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:

1. Submit maintenance manuals, Project Record Documents, digital images of construction photographs, and other similar final record data in compliance with this section.

2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this section.

3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.

4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include “Certificate of Occupancy,” operating certificates, and similar releases from authorities having jurisdiction and utility companies.

5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.

6. Make final change-over of locks eliminating construction master-key system and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.

7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.

8. Perform final cleaning according to this section.

B. Substantial Completion Inspection:

1. When Contractor considers Work to be substantially complete, submit to Engineer:

   a. Written certificate that Work, or designated portion, is substantially complete

   b. List of items to be completed or corrected (initial punch list)

2. Within ten (10) days after receipt of request for Substantial Completion, Engineer will make inspection to determine whether Work or designated portion is substantially complete.

3. If Engineer determines that Work is not substantially complete:

a. Engineer will promptly notify Contractor in writing, stating reasons for their opinion.

b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.

c. Engineer will re-inspect Work.

d. Redo and inspection of deficient Work shall be repeated until Work passes Engineer's inspection.

4. When Engineer finds that Work is substantially complete, Engineer will:

a. Prepare “Certificate of Substantial Completion” on “EJCDC C-625—Certificate of Substantial Completion” accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).

b. Submit certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in certificate.

5. After Work is substantially complete, Contractor shall:

a. Allow Owner occupancy of Project under provisions stated in “Certificate of Substantial Completion.”

b. Complete Work listed for completion or correction within period stipulated.

C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.

1. When Contractor considers Work to be complete, submit written certification that:

a. Contract Documents have been reviewed.

b. Work has been examined for compliance with Contract Documents.

c. Work has been completed according to Contract Documents.

d. Work is completed and ready for final inspection.

e. Final operations and maintenance data has been delivered to Owner for all relevant equipment and systems, in hard copy and electronic formats, in accordance with Technical Specifications.

2. Submittals: Submit the following:

a. Final punch list indicating all items have been completed or corrected.

b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include “Certificates of Insurance” for products and completed operations where required.

c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.

d. Accounting statement for final changes to Contract Sum.

e. Contractor's affidavit of payment of debts and claims on “AIA G706—Contractor's Affidavit of Payment of Debts and Claims”

f. Contractor affidavit of release of liens on “AIA G706A—Contractor's Affidavit of Release of Liens”

g. Consent of surety to final payment on “AIA G707—Consent of Surety to Final Payment Form”

3. Perform final cleaning for Contractor-soiled areas according to this section.

D. Final Completion Inspection:

1. Within ten (10) days after receipt of request for final inspection, Engineer will make inspection to determine whether Work or designated portion is complete.

2. If Engineer considers Work to be incomplete or defective:

a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.

b. Contractor shall remedy stated deficiencies and send second written request to Engineer that Work is complete.

c. Engineer will re-inspect Work.

d. Redo and inspection of deficient Work shall be repeated until Work passes Engineer's inspection.

1.2 STARTING OF SYSTEMS

A. Coordinate schedule for startup of various equipment and systems.

B. Notify Engineer fourteen (14) days prior to startup of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.

G. When specified in individual Specification sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.3 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two (2) weeks

prior to date of final inspection. Refer to “Section 01 43 33 Manufacturers’ Field Services” for additional training requirements.

B. Demonstrate Project equipment and instruct in classroom environment located at the Project Site and instructed by qualified manufacturer's representative who is knowledgeable about the Project.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at designated location.

E. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instruction.

F. Required instruction time for each item of equipment and system is specified in individual Specification sections.

1.4 PROJECT RECORD DOCUMENTS

A. Maintain on site one (1) set of the following Record Documents; record actual revisions to the Work:

1. Drawings
2. Specifications
3. Addenda
4. Change Orders and other modifications to the Contract
5. Reviewed Shop Drawings, product data, and samples
6. Manufacturer's instruction for assembly, installation, and adjusting
7. Permits

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store Record Documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product section, description of actual products installed, including the following:

1. Manufacturer's name and product model and number
2. Product substitutions or alternates used
3. Changes made by Addenda and modifications

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:

1. Contract modifications such as addenda, supplementary instructions, change directives, Field Orders, minor changes in the Work, and Change Orders

2. Locations of concealed elements of the Work

3. Depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities

4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation

5. Identification and location of existing buried or concealed items encountered during Project

6. Measured depths of foundations in relation to finish main floor datum

7. Measured horizontal and vertical locations of Underground Utilities and appurtenances, referenced to permanent surface improvements

8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work

9. Field changes of dimension and detail

10. Details not on original Drawings

G. Allow Engineer access to visually review Contractor's Record Drawings at any time during the course of construction; Engineer's review is anticipated to occur on a monthly basis at minimum. Maintain digital markup of Record Drawings and submit with each Application for Payment.

H. Contractor's failure to maintain up-to-date Record Drawings may result in delay of progress payment, until Contractor can demonstrate that record documents reflect construction progress in accordance with this Section.

I. Submit marked-up paper copy documents to Engineer before Substantial Completion, with claim for final Application for Payment.

J. Submit PDF electronic files of marked-up documents to Engineer before Substantial Completion.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit in electronic and hard copy formats, as described in "Section 01 78 23 Operation and Maintenance Data."

B. Submit all relevant product data for both "Equipment and Systems" and "Materials and Finishes" supplied under this Contract, as described in "Section 01 78 23 Operation and Maintenance Data."

1.6 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification sections.

B. Deliver to Project Site; obtain receipt prior to final payment.

1.7 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten (10) days after completion of applicable item of Work.

B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute Submittals when required.

E. Include table of contents and assemble in three (3)-D-side ring binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time of Submittals:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten (10) days after acceptance.

2. Make other Submittals within ten (10) days after date of Substantial Completion, prior to final Application for Payment.

3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten (10) days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual Specification sections.

D. Verify that utility services are available with correct characteristics and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 EXECUTION

A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one (1) set of manufacturer's installation instructions at Project Site during installation and until completion of construction.

B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.

2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.

3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Engineer for final decision.

E. Allow for expansion of materials and building movement.

F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.

1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.

2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.

G. Mounting Heights: Where not indicated, mount individual units of Work at industry-recognized standard mounting heights for particular application.

1. Refer questionable mounting heights choices to Engineer for final decision.

2. Ensure elements identified as “ADA accessible” comply with applicable codes and regulations.

H. Adjust operating products and equipment to ensure smooth and unhindered operation.

I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 CUTTING AND PATCHING

A. Employ skilled and experienced installers to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:

1. Structural integrity of element
2. Integrity of weather-exposed or moisture-resistant elements
3. Efficiency, maintenance, or safety of element
4. Visual qualities of sight-exposed elements
5. Work of Owner or separate contractor

C. Execute cutting, fitting, and patching, including excavation and fill to complete Work and to:

1. Fit the several parts together, to integrate with other Work.
2. Uncover Work to install or correct ill-timed Work.
3. Remove and replace defective and nonconforming Work.
4. Remove samples of installed Work for testing.
5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute Work by methods necessary to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.

E. Cut masonry and concrete materials using masonry saw or core drill.

F. Restore Work with new products according to requirements of Contract Documents.

G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.

H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.

J. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.5 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual Specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits.

D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material

manufacturer.

F. Prohibit traffic from landscaped areas.

G. Protect all sensitive environmental areas as shown on the plans and comply with all project permit conditions.

3.6 FINAL CLEANING

A. Contractor to provide final cleaning of all interior and exterior Work; remove all construction debris, waste, surplus materials, and construction facilities from the site, as identified by the Owner, prior to final acceptance. Contractor shall dispose of waste in accordance with local, state, and federal regulations.

B. Clean surfaces exposed to view; remove temporary labels, stains, and foreign substances.

C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

D. Replace filters of operating equipment.

E. Clean Site; sweep paved areas; rake clean landscaped surfaces.

END OF SECTION

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SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 PLAN REQUIREMENTS

A. The Contractor shall develop and implement construction waste management plan as approved by Owner.

B. Intent:

1. Divert construction, demolition, and land-clearing debris from landfill disposal.

2. Redirect recyclable material back to manufacturing process.

3. Generate cost savings or increase minimal additional cost to Project for waste disposal.

1.2 SUBMITTALS

A. Refer to “Section 01 33 00 Submittal Procedures: Requirements for Submittals”

B. Construction Waste Management Plan: The Contractor shall submit construction waste management plan describing methods and procedures for implementation and monitoring compliance including the following:

1. Transportation company hauling construction waste to waste processing facilities

2. Recycling and adaptive reuse processing facilities and waste type each facility will accept

3. Construction waste materials anticipated for recycling and adaptive reuse

4. On-Site sorting and Site storage methods

5. Materials to be salvaged

6. Disposal Site Agreements, see Contract Section 00650

1.3 CONSTRUCTION WASTE MANAGEMENT PLAN

A. Implement construction waste management plan at start of construction.

B. Review construction waste management plan at preconstruction meeting and progress meetings as specified in “Section 01 30 00 Administrative Requirements.”

C. Maintain ongoing coordination with Owner to address issues and ensure compliance with the waste management plan.

D. Distribute approved construction waste management plan to Subcontractors and others affected by plan requirements.

E. Oversee plan implementation, instruct construction personnel for plan compliance, and document plan results.

F. Materials required to be recycled include:

1. Packing materials including paper, cardboard, foam plastic, and sheeting
2. Recyclable plastics
3. Organic plant debris
4. Earth materials
5. Native stone and granular fill
6. Asphalt and concrete paving
7. Wood with and without embedded nails and staples.
8. Glass
9. Metals

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION

3.1 CONSTRUCTION WASTE COLLECTION

A. The Contactor shall:

1. Collect construction waste materials in marked bins or containers and arrange for transportation to recycling centers or adaptive salvage and reuse processing facilities.
2. Maintain recycling and adaptive reuse storage and collection area in orderly arrangement with materials separated to eliminate co-mingling of materials required to be delivered separately to waste processing facility.
3. Store construction waste materials to prevent environmental pollution, fire hazards, hazards to persons and property, and contamination of stored materials.
4. Cover construction waste materials subject to disintegration, evaporation, settling, or runoff to prevent polluting air, water, and soil.

3.2 CONSTRUCTION WASTE DISPOSAL

A. The Contractor shall:

1. Deliver construction waste to waste processing facilities. **Obtain receipt for deliveries**. Provide copies of receipts to Owner's Representative at regular Construction Progress Meetings.

2. Dispose of construction waste not capable of being recycled by delivery to landfill, incinerator, or another legal disposal facility. **Obtain receipt for deliveries**. Provide copies of receipts to Owner's Representative at regular construction progress meetings.

END OF SECTION

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 DEFINITIONS

A. Preliminary Data: Initial and subsequent submissions for Engineer's review.

B. Final Data: Engineer-accepted data, submitted as specified herein.

C. Maintenance Operation: As used on "Maintenance Summary Form" (attached) is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, calibration, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.2 MANUALS

A. Separate manuals for each pump station shall be prepared and provided in accordance with the following sections. The content of each pump station manual shall encompass all product data, operations and maintenance procedures, and spare parts for the motors, pumps, and instrumentation supplied for the station. Results of startup testing adjustments, setpoints, and field testing shall also be provided. Additionally, the manual shall contain the associated control system operation information, schematics, details, and all other matter as described in Sections 26 00 00, 40 68 00, and 40 70 00.

1. Each pump station shall be provided with two (2) printed copies, and one (1) digital copy.

B. A project-side manual shall also be prepared and provided in accordance with the following sections. This complete manual shall encompass all aspects of the project including the pump stations as detailed above.

1.3 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data: Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer. Submit prior to shipment date.

2. Final Data: Submit instructional manual formatted data not less than thirty (30) days prior to installation of equipment or system. Submit compilation formatted and electronic media formatted data prior to Substantial Completion of Project.

3. Operations and maintenance data for all Project equipment shall be submitted prior to 50 percent completion of the Project Schedule of Values.

B. Pump Station Manuals:

1. Submit a digital copy of preliminary manuals for approval not less than thirty (30) days prior

to functional testing and startup of the pump stations.

2. Submit final digital and printed copies prior to 95 percent completion of the pump station line-item schedule of value.

C. Materials and Finishes Data:

1. Preliminary Data: Submit at least fifteen (15) days prior to request for final inspection.

2. Final Data: Submit within ten (10) days after final inspection.

1.4 DATA FORMAT

A. Prepare preliminary data in the form of an instructional manual as described in 1.4B. Prepare final data in data compilation format and on electronic media as described in 1.4C & D.

B. Instructional Manual Format:

1. Binder: Commercial quality, permanent, 3-ring or 3-post binders with durable plastic cover

2. Size: 8½ inches by 11 inches, minimum

3. Cover: Identify manual with typed or printed title “OPERATION AND MAINTENANCE DATA” and list:

a. Project title

b. Designate applicable system, equipment, material, or finish

c. Identity of separate structure as applicable

d. Identify volume number if more than one (1) volume

e. Identify general subject matter covered in manual Identity of equipment number and Specification section

4. Spine:

a. Project title

b. Identify volume number if more than one (1) volume

5. Title Page:

a. Contractor name, address, and telephone number

b. Subcontractor, supplier, installer, or maintenance contractor’s name, address, and telephone number, as appropriate

i. Identify area of responsibility of each.

ii. Provide name and telephone number of local source of supply for parts and replacement.

6. Table of Contents:

a. Neatly typewritten and arranged in systematic order with consecutive page numbers

b. Each product identified by product name and other identifying numbers or symbols as set forth in Contract Documents

7. Paper: 20-pound minimum, white for typed pages

8. Text: Manufacturer's printed data, or neatly typewritten

9. Three (3)-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data

10. Material shall be suitable for reproduction, with quality equal to original–photocopying of material will be acceptable, except for material containing photographs

C. Data Compilation Format:

1. Compile all Engineer-accepted preliminary operations and maintenance (O&M) data into a hard-copy, hard-bound set.

2. Each set shall consist of the following:

a. Binder: Commercial quality, permanent, 3-ring or 3-post binders with durable plastic cover

b. Cover: each volume identified with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO. ___ OF ___," and list:

i. Project title

ii. Contractor's name, address, and telephone number

iii. If entire volume covers equipment or system provided by one (1) supplier include the following:
(1) Identity of general subject matter covered in manual
(2) Identity of equipment number and Specification section

c. Provide each volume with title page and typed table of contents with consecutive page numbers. Place entire set, identified by volume number, in each binder.

d. Table of contents neatly typewritten, arranged in a systematic order:

i. Include list of each product, indexed to content of each volume.

ii. Designate system or equipment for which it is intended.

iii. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

e. Section Dividers:

i. Heavy, 80-pound cover weight, tabbed with numbered plastic index tabs

ii. Flyleaf:

(1) For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment

(2) List with Each Product:

(a) Provide name, address, and telephone number of subcontractor, supplier, installer, and maintenance contractor, as appropriate.

(b) Identify area of responsibility of each.

(c) Provide local source of supply for parts and replacement.

(3) Identity of separate structure as applicable.

a) Assemble and bind material, as much as possible, in same order as specified in the Contract Documents.

D. Electronic Media Format:

1. Portable Document Format (PDF):

a. After all preliminary data has been found to be acceptable to Engineer, submit operation and maintenance data in PDF format on portable Universal Serial Bus (USB) drive.

b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name

c. Files to be fully functional and viewable in most recent version of Adobe Acrobat

1.5 SUBMITTALS

A. Informational:

1. Data Outline: Submit two (2) copies of a detailed outline of proposed organization and contents of final data prior to preparation of preliminary data.

2. Preliminary Data:

a. Submit two (2) copies for Engineer's review.

b. If data meets conditions of the Contract:

i. one (1) copy will be returned to Contractor

ii. one (1) copy will be forwarded to Resident Project Representative

c. If data does not meet conditions of the Contract:

i. All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.

ii. Engineer's comments will be retained in Engineer's file.

iii. Resubmit two (2) copies revised in accordance with Engineer's comments.

iv. Final Data: Submit three (3) copies in format specified herein.

1.6 DATA FOR EQUIPMENT AND SYSTEMS

A. Content for Each Unit (or Common Units) and System:

1. Product Data:

a. Include only those sheets that are pertinent to specific product.

b. Clearly annotate each sheet to:

i. Identify specific product or part installed.

ii. Identify data applicable to installation.

iii. Delete references to inapplicable information.

c. Function, normal operating characteristics, and limiting conditions

d. Performance curves, engineering data, nameplate data, and tests

e. Complete nomenclature and commercial number of replaceable parts

f. Original manufacturer's parts list, illustrations, detailed assembly Drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance

g. Spare parts ordering instructions

h. Where applicable, identify installed spares and other provisions for future work (for example, reserved panel space, unused components, wiring, and terminals)

2. As-installed, color-coded piping diagrams

3. Charts of valve tag numbers, with the location and function of each valve

4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:

a. Format:

i. Provide reinforced, punched, binder tab; bind in with text.

ii. Reduce to 8½ inches by 11 inches, or 11 inches by 17 inches folded to 8½ inches by 11 inches.

iii. Where reduction is impractical, fold and place in 8½-inch by 11-inch envelopes bound in text.

iv. Identify Specification section and product on Drawings and envelopes.

b. Relations of component parts of equipment and systems

c. Control and flow diagrams

d. Coordinate Drawings with Project record documents to ensure correct illustration of completed installation.

5. Instructions and Procedures: Within text, as required to supplement product data

a. Format:

i. Organize in consistent format under separate heading for each different procedure.

ii. Provide logical sequence of instructions for each procedure.

iii. Provide information sheet for Owner's personnel, including:
(1) Proper procedures in event of failure
(2) Instances that might affect validity of guarantee or Bond

b. Installation Instructions: Including alignment, adjusting, calibrating, and checking

c. Operating Procedures:

i. Startup, break-in, routine, and normal operating instructions

ii. Test procedures and results of factory tests where required

iii. Regulation, control, stopping, and emergency instructions

iv. Description of operation sequence by control manufacturer

v. Shutdown instructions for both short and extended duration

vi. Summer and winter operating instructions, as applicable

vii. Safety precautions

viii. Special operating instructions

d. Maintenance and Overhaul Procedures:

i. Routine maintenance

ii. Guide to troubleshooting

iii. Disassembly, removal, repair, reinstallation, and reassembly

6. Guarantee, Bond, and Service Agreement: In accordance with "Section 01 70 00 Execution and Closeout Requirements"

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:

a. Function, normal operating characteristics, and limiting conditions

b. Performance curves, engineering data, nameplate data, and tests

c. Complete nomenclature and commercial number of replaceable parts

d. Interconnection wiring diagrams, including control and lighting systems

2. Circuit Directories of Panelboards:

a. Electrical service

b. Control requirements and interfaces

c. Communication requirements and interfaces

d. List of electrical relay settings, and control and alarm contact settings

e. Electrical interconnection wiring diagram, including as applicable, single-line, three (3)-line, schematic and internal wiring, and external interconnection wiring

f. As-installed control diagrams by control manufacturer

3. Operating Procedures:

a. Routine and normal operating instructions

b. Startup and shutdown sequences, normal and emergency

c. Safety precautions

d. Special operating instructions

4. Maintenance Procedures:

a. Routine maintenance

b. Guide to troubleshooting

c. Adjustment and checking

d. List of relay settings, control settings, and alarm contact settings

5. Manufacturer's printed operating and maintenance instructions

6. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage

C. Maintenance Summary:

1. Compile individual "Maintenance Summary Form" (attached) for each applicable equipment item, respective unit, or system, and for components or sub-units.

2. Format:

a. Use "Maintenance Summary Form" included at the end of this section or electronic facsimile of such.

b. Each maintenance summary may take as many pages as required.

c. Use only 8½-inch by 11-inch size paper.

d. Complete using typewriter or electronic printing.

3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.

4. Recommended Spare Parts:

a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.

b. "Unit" is the unit of measure for ordering the part.

c. "Quantity" is the number of units recommended.

d. "Unit Cost" is the current purchase price.

1.7 DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:

a. Catalog number, size, and composition

b. Color and texture designations

c. Information required for reordering special-manufactured products

2. Instructions for Care and Maintenance:

a. Manufacturer's recommendation for types of cleaning agents and methods

b. Cautions against cleaning agents and methods that are detrimental to product

c. Recommended schedule for cleaning and maintenance

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:

a. Applicable standards

b. Chemical composition

c. Details of installation

2. Instructions for inspection, maintenance, and repair

1.8 SUPPLEMENT

A. The supplement listed below, following "End of Section," is part of this Specification.

1. "Maintenance Summary Form"

PART 2 PRODUCTS–(NOT USED)

PART 3 EXECUTION–(NOT USED)

END OF SECTION

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MAINTENANCE SUMMARY FORM

Project: _____ Contract No.: _____

1. Equipment Item: _____
2. Manufacturer: _____
3. Equipment/Tag Number(s): _____
4. Weight of Individual Components (more than 100 pounds): _____
5. Nameplate Data (HP, voltage, speed, etc.): _____
6. Manufacturer's Local Representative: _____
   a. Name: Telephone No.:
   b. Address: _____
7. MAINTENANCE REQUIREMENTS:

Maintenance Operation Comments	**Frequency**	**Lubricant (If Applicable)**
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY. Use additional sheets as needed.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01 91 14

EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.1 DEFINITIONS

A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.

B. Factory Demonstration Test (FDT): All testing required to be conducted at the fabricator's/manufacturer's/vendor's offsite locations, witnessed or not, regardless of the specific descriptive title used for testing in the Contract Documents.

C. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.

1. Functional Test Part 1 (FT1): Performed by Contractor to test and document installed equipment is ready for operation.

2. Functional Test Part 2 (FT2): Combined effort between Contractor and Contractor's Systems Integrator to confirm that installed equipment including applications software, is ready for operation.

D. Electrical System Commissioning: As defined in "Section 26 00 00 Electrical"

E. Performance Test (PT): Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.

F. Clean Water Demonstration Test (CWDT): Testing where specific requirements are verified by operating the facility with clean water.

G. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function, such as a pump station.

H. Startup: Period when water is introduced to the facility and prior to facility performance demonstration.

I. Facility Performance Demonstration (Period):

1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.

2. Such demonstration is for the purposes of:

a. verifying to Owner entire facility performs as a whole, and

b. documenting performance characteristics of completed facility for Owner's records.

3. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor unless such performance is otherwise specified.

J. Substantial Completion:

1. See General Condition for Final Inspection and Final Payment Claims.

2. Follows Facility Performance Demonstration (successful).

1.2 SUBMITTALS

A. Refer to "Section 01 33 00 Submittal Procedures"

B. Informational Submittals:

1. Facility Startup and Performance Demonstration Plan

2. Functional and performance test results

3. Completed Unit Process Startup Form for each unit process

4. Completed Facility Performance Demonstration/Certification Form

5. Master Operation and Maintenance Training Schedule

1.3 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

A. Develop a written plan, in conjunction with equipment manufacturers and the Owner's operations personnel; to include the following:

1. Functional and performance testing of each component

2. Step-by-step instructions for clean water testing including any necessary temporary equipment and piping required

3. Step-by-step instructions for startup of each unit process and the complete facility

4. Unit Process Startup Form (sample attached), to minimally include the following:

a. Description of the unit process, including equipment numbers/ nomenclature of each item of equipment and all included devices

b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.

c. Startup requirements for each unit process, including water, power, chemicals, etc.

d. Space for evaluation comments

5. Facility Performance Demonstration/Certification Form (sample attached) to include the following at minimum:

a. Description of unit processes included in the facility startup

b. Sequence of unit process startup to achieve facility startup

c. Description of computerized operations, if any, included in the facility

d. Contractor certification facility is capable of performing its intended function(s), including fully automatic operation

e. Signature spaces for Manufacturers' Representatives, Contractor, and Engineer

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Facility Startup Meetings: Schedule, in accordance with requirements of "Section 01 30 00 Administrative Requirements," to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and both manufacturer and Owner involvement.

B. Contractor's Testing and Startup Representative:

1. Designate and provide one (1) or more personnel to coordinate and expedite testing and facility startup.

2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.

C. Provide temporary valves, gauges, piping, test equipment, and other materials and equipment required for testing and startup.

D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing Work so as not to interfere with or delay testing and startup.

E. Owner will:

1. Provide water, power, chemicals, and other items as required for startup, unless otherwise indicated.

2. Operate process units and facility with support of Contractor.

3. Provide labor and materials as required for laboratory analyses.

3.2 EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.

2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.

3. Obtain and submit from equipment manufacturer's representative "Manufacturer's Certificate of Proper Installation Form," in accordance with "Section 01 43 33 Manufacturers' Field Services," when required by individual Specification sections.

4. "Equipment Test Report Form:" Provide written test report for each item of equipment to be tested, to include the minimum information:

    a. Owner/Project Name

    b. Equipment or item tested

    c. Date and time of test

    d. Type of test performed (functional or performance)

    e. Test method

    f. Test conditions

    g. Test results

    h. Signature spaces for Contractor and Engineer as witness

5. Cleaning and Checking: Prior to beginning functional testing:

    a. Calibrate testing equipment in accordance with manufacturer's instructions.

    b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.

    c. Lubricate equipment in accordance with manufacturer's instructions.

    d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.

    e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

    f. Check power supply to electric-powered equipment for correct voltage.

    g. Adjust clearances and torque.

    h. Test piping for leaks.

6. Ready-to-test determination will be by Engineer based at least on the following:

    a. Acceptable Operation and Maintenance Data

    b. Notification by Contractor of equipment readiness for testing

    c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified

d. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested

e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment

f. Satisfactory fulfillment of other specified manufacturer's responsibilities

g. Equipment and electrical tagging complete

h. Delivery of all spare parts and special tools

B. Electrical and Communications Systems Testing:

1. Perform satisfactory testing and commissioning of electrical, communications and control systems as specified in "Section 26 00 00 Electrical."

2. Prepare test report summarizing test method and results.

3. When, in Engineer's opinion, equipment meets commissioning requirements specified, such equipment will be accepted for purposes of advancing to functional testing phase, if required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's approval of completed test and inspection report submittals.

C. Functional Tests (FT1 and FT2):

1. Conduct as specified in individual Specification sections.

2. Notify Owner and Engineer in writing at least ten (10) days prior to scheduled date of testing.

3. Functional testing shall not commence until electrical commissioning has been completed and accepted by Engineer as having satisfied the electrical commissioning requirements specified.

4. Prepare equipment test report summarizing test method and results.

5. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on equipment test report.

D. Performance Test (PT):

1. Conduct as specified in individual Specification sections.

2. Notify Engineer and Owner in writing at least ten (10) days prior to scheduled date of test.

3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.

4. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.

5. Provide all necessary startup consumables including temporary discharge piping, and air

filters.

6. Prepare equipment test report summarizing test method and results.

7. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on equipment test report.

E. Clean Water Demonstration Test (CWDT):

1. Every component, system, or subsystem shall be tested with clean water to confirm specified requirements are met.

2. Contractor is responsible for furnishing and installing all required temporary piping, appurtenances, facilities, etc. required to conduct functional and performance testing.

3. Contractor shall remove and dispose of all temporary piping, appurtenances, facilities, etc. after they are no longer required.

4. Contractor shall repair all permanent elements of the Work affected by the temporary piping, appurtenances, facilities, etc.

5. All aspects of the Work and all Project facilities must be functional and operate in automatic mode 24 hours per day, seven (7) days per week during the CWDT at varying flow rates established by the Engineer.

6. Time lost during the test for equipment repairs, wiring corrections, control point settings, or other reasons that are not determined by the Engineer to be grounds to restart the test shall be justifiable cause for extending the test duration by an amount of time equal to the time required to repair the problems.

7. Operation of the system for the CWDT shall be conducted on a schedule or plan of operations developed and supported by the Contractor as approved by the Owner and Engineer.

8. Contractor shall provide personnel to operate the Work and support said testing activities to be performed in accordance with the facility startup and performance demonstration plan prepared by the Contractor.

9. During the test, furnish the services of authorized representatives of the manufacturers, in addition to those services required in support of other testing, as necessary, to correct faulty equipment operation, calibration, adjustment, or related flaws.

3.3 STARTUP OF FACILITY

A. Prior to facility startup, equipment shall be accepted by Engineer as having met functional, performance, and clean water demonstration testing requirements specified.

B. Make adjustments, repairs, and corrections necessary to complete facility startup.

C. Startup shall be considered complete when, in the opinion of the Engineer, unit process has operated in manner intended for seven (7) continuous days without significant interruption. This period is in addition to functional, performance, and clean water demonstration test

periods specified elsewhere.

D. Significant Interruption: May include any of the following events as determined by Engineer:

1. Failure of Contractor to provide and maintain qualified onsite startup personnel as scheduled.

2. Failure to meet specified functional operation for more than two (2) consecutive hours.

3. Failure of any critical equipment or unit process that is not satisfactorily corrected within two (2) hours after failure.

4. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within eight (8) hours after failure.

E. A significant interruption will require corrections to be made and reset of the startup test period.

3.4 FACILITY PERFORMANCE DEMONSTRATION

A. When, in the opinion of the Engineer, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.

B. Demonstrate proper operation of required interfaces within and between individual unit processes.

C. After facility is operating, complete performance testing of equipment and systems.

D. Document, as defined in facility startup and performance demonstration plan, the performance of the facility including its computer system, until all unit processes are operable and under control of computer system.

E. Certify, on the “Facility Performance Demonstration/Certification Form,” that facility is capable of performing its intended function(s), including fully automatic and computerized operation.

3.5 SUPPLEMENTS

A. Supplements listed below, following “End of Section,” are a part of this Specification:

1. “Unit Process Startup Form”

2. “Equipment Test Report Form”

END OF SECTION

UNIT PROCESS STARTUP FORM

Owner: _____ **Project:** _____

Unit Process Description: (description and number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (water, power, chemicals, etc.): _____

Evaluation Comments: _____

EQUIPMENT TEST REPORT FORM

Owner: _____ **Project Name:** _____

Equipment or Item Tested: _____

_____

_____

Date: _____ **Time of Test:** _____

Type of Test Performed: ☐ Functional ☐ Performance

Test Method: _____

_____

_____

_____

Test Conditions: _____

_____

_____

_____

Test Results: _____

_____

_____

_____

_____

Witness:

_____ _____

Contractor Engineer

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Existing Conditions 02

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SECTION 02 22 00

EXISTING CONDITIONS ASSESSMENT

PART 1 GENERAL

1.1 INFORMATION ON SITE CONDITIONS

A. All information obtained by the Engineer regarding Site conditions, subsurface information, groundwater elevations, existing construction of Site facilities, and existing Underground Utilities and similar data are shown on the Drawings, in these Specifications, or are referenced in subsurface investigations prepared by Owner.

1.2 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall satisfy themselves as to:

1. the nature and location of the Work;

2. the general and local conditions (particularly those bearing upon availability of transportation, disposal, handling, and storage of materials; availability of labor, water, electric power, roads; and uncertainties of weather, wind speeds and directions, or similar physical conditions at the Site);

3. the conformation and conditions of the ground;

4. Asbestos and Lead Survey Report sampling and results;

5. the character of equipment facilities needed before and during the execution of the Work;

6. all other matters that can in any way affect the Work, or the cost thereof under this Contract.

B. The Contractor shall become familiar with the character, quality, and quantity of surface and subsurface materials to be encountered from inspecting the Site, any exploratory work done by the Owner and from information presented by the Drawings and Specifications made a part of this Contract. Any failure by the Contractor to become acquainted with all the available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the Work.

C. The Contractor shall anticipate underground obstructions (such as water lines, sewer lines, utility lines, concrete, water table, soil conditions, and debris). No extra payment will be allowed for the removal, replacement, repair, or possible increased cost caused by underground obstructions. Any such lines or obstructions indicated on the map show only the approximate location and must be verified in the field by the Contractor. The Owner and Engineer will endeavor to familiarize the Contractor with all known underground service laterals for utilities and obstructions, but this will not relieve the Contractor from full responsibility in anticipating and locating all underground obstructions.

D. Existing survey monuments, reference points, wetland boundary, rare plant area delineation, and other existing monumentation shall be preserved. If such facilities must be removed, the Contractor shall notify the Engineer ten (10) working days prior to the required removal so that such points can be referenced for reinstallation. The Contractor using a licensed Land Surveyor, at no additional cost to the Owner, and shall complete such surveys and reinstallation.

1.3 ADDITIONAL INFORMATION

A. Prior to bidding, Bidders may make their own subsurface investigations subject to time schedules and arrangements approved in advance by the Engineer. Before any subsurface test holes are excavated, Bidders shall obtain permits from the agencies governing the rights-of-way prior to performing such work.

PART 2 PRODUCTS– NOT USED

PART 3 EXECUTION– NOT USED

END OF SECTION

SECTION 02 41 19

DEMOLITION AND DISPOSAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolishing designated building equipment and fixtures
2. Demolishing designated construction
3. Cutting and alterations for completion of the Work
4. Removing designated items for reuse and Owner's retention
5. Protecting items designated to remain
6. Removing demolished materials

1.2 SUBMITTALS

A. Refer to "Section 01 33 00–Submittal Procedures: Requirements for Submittals"

B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.

C. Disposal Site Agreement(s): For each Disposal Site (if multiple), see Contract Section 00650

D. Salvage Receipt from Owner: Obtain receipt from Owner for salvaged items

E. Shop Drawings:

1. Indicate demolition and removal sequence.
2. Indicate location of items designated for Owner's retention.
3. Indicate location and construction of temporary Work.

1.3 CLOSEOUT SUBMITTALS

A. Refer to "Section 01 70 00–Execution and Closeout Requirements: Requirements for Submittals"

B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.

C. Salvaged equipment assembly instructions: Provide instructions for the reassembly of all salvaged equipment.

D. Obtain receipts for delivery of disposed material and make available to Owner.

1.4 QUALITY ASSURANCE

A. Conform to applicable code for demolition Work, dust control, and products requiring electrical disconnection and re-connection.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

D. Conform to applicable description of demolition Work described in environmental documents and contained in agency conditions of approval.

1.5 SEQUENCING

A. Refer to “Section 01 10 00 Summary of Work”

1.6 SCHEDULING

A. Refer to “Section 01 30 00 Administrative Requirements” and “Section 01 32 16 Construction Progress Schedule: Requirements for scheduling”

B. Schedule Work to coincide with new construction.

C. Coordinate utility and building service interruptions with Owner.

1. Schedule tie-ins to existing systems to minimize disruption. Provide Owner with a minimum 14-day advance notice of any desired disruptions in service and proceed only with the Owner’s approval.

2. Cooperate with Owner in scheduling noisy operations and waste removal that may impact any private property owners.

1.7 PROJECT CONDITIONS

A. Cease operations immediately if structure appears to be in danger and notify Engineer. Re-direct Work to avoid delay; Do not resume operations in the area until directed by the Owner.

B. Refer to Project Drawings for demolition of existing tank structures and intent of disposal. See Asbestos and Lead Survey in the Contract Exhibits section.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to bidding, the Contractor shall inspect the existing construction and make their own determination as to the difficulty of performing this Work. The Drawings indicate the general construction and are not intended to be complete in every detail.

B. Prior to any demolition Work, carefully re-inspect the Site and determine the extent of Work involved. Immediately report any discrepancies to the Engineer.

C. Notify affected utility companies before starting Work and comply with their requirements.

D. Mark location and termination of utilities.

E. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public and the Owner.

F. Protection of Existing Structures: Use any means necessary to protect existing structures designated to remain. In the event of damage, immediately make all repairs and replacements necessary to obtain the Engineer's approval, at no additional cost to the Owner. Erect barriers, fences, enclosures, chutes, and shoring to protect personnel, structures, and utilities remaining intact.

G. Erect and maintain weatherproof closures for exterior openings.

H. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.

I. Provide appropriate temporary signage, including signage for exit or building egress.

J. Do not close or obstruct building egress path.

K. Do not disable or disrupt building fire or life safety systems without three (3) days prior written notice to Owner.

L. Provide air quality sampling, dust control, and wetting equipment for demolition of tank structures.

1. Contractor to refer to Asbestos and Lead Survey in the Contract Exhibits section and accommodate for additional inspection and sampling of tank structure when drained.

3.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner. Contractor shall facilitate a walk through of all facilities with the Owner fourteen (14) days prior to demolition and shall clearly identify & tag all items, components, and equipment to be salvaged.

B. Protect designated salvage items from demolition operations until items can be removed and delivered to the Owner

C. Carefully remove building components and equipment indicated to be salvaged.

D. Disassemble as required to permit removal from building.

E. Package small and loose parts to avoid loss.

F. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

G. Prepare assembly instructions consistent with disassembled parts. Package assembly

instructions in protective envelope and securely attach to each disassembled salvaged item.

H. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

A. Provide air quality sampling, dust control, and wetting equipment for demolition of tank structures.

1. Contractor to refer to Asbestos and Lead Survey in the Contract Exhibits section.

B. Provide caps, plugs, and blind flanges for pipeline ends to be abandoned and/or removed and install concrete or grout plugs to permanently seal openings in accordance with the Drawings.

C. Conduct demolition to minimize interference with adjacent building areas.

D. Fill and compact demolished areas excavated at grade to recommended density with crushed rock or approved material to proposed subgrade in accordance with the Contract Documents, the Drawings, and as directed by the Engineer. Unless otherwise noted in the Drawings, fill shall be approved backfill material specified in these Specifications.

E. Disconnect and remove designated utilities within demolition areas.

F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate record drawings indicating location and type of service for capped utilities remaining after demolition.

G. Demolish in orderly and careful manner. Protect existing improvements and items to be retained or salvaged. Any damage to retained or salvaged items as a result of demolition Work shall be repaired by the Contractor at their own cost.

H. Carefully remove building components indicated to be reused.

1. Disassemble components as required to permit removal.

2. Package small and loose parts to avoid loss.

3. Mark components and packaged parts to permit reinstallation.

4. Store components protected from construction operations until reinstalled.

I. Remove demolished materials from Site except where specifically noted otherwise. Do not burn or bury materials on Site.

J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

K. Remove temporary Work.

3.4 DISPOSAL

A. Remove all debris and items not to be salvaged from the Site and leave the Site in a neat and orderly condition as required in the Drawings and Contract Documents. All debris must be disposed of at a permitted, approved, off-site disposal location, at the Contractor's expense,

unless otherwise specified.

1. Obtain receipts for delivery of disposed material and make available to Owner.

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03 Concrete

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural concrete
2. Steel reinforcement
3. Reglets, bolts, anchors, cans, sleeves, column anchor bolts, and so on
4. Concrete and cement finishing
5. Concrete formwork and accessories
6. Surface treatment and curing
7. Special inspections
8. Drilling of existing concrete and masonry for placement of bars, dowels, and rods

B. Exclusions: Section does not include Specifications for structural concrete, reinforcement, or any other related items pertaining to either the cast-in-place water storage tank or factory bolted steel storage tank.

1. Work pertaining to the Factory-Bolted Steel Water Storage Tank shall be per the manufacturer's plans and specifications stamped by a Licensed Structural or Civil Engineer licensed in the State of California.
2. Work pertaining to the AWWA D110 Type I concrete water storage tank shall be per the manufacturer's plans and specifications stamped by a Licensed Structural or Civil Engineer licensed in the State of California.

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117—Specification for Tolerances for Concrete Construction and Materials
2. ACI 301—Specifications for Structural Concrete
3. ACI 318—Building Code Requirements for Structural Concrete.
4. ACI 347—Guide to Formwork for Concrete
5. ACI 350—Code Requirements for Environmental Engineering Concrete Structures

6. ACI SP-66—ACI Detailing Manual

B. American National Standard Institute (ANSI):

1. ANSI A135.4—Basic Hardboard

C. ASTM-International (ASTM):

1. ASTM A615—Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
2. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field
3. ASTM C33—Standard Specification for Concrete Aggregates
4. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
5. ASTM C42—Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
6. ASTM C94—Standard Specification for Ready-Mixed Concrete
7. ASTM C143—Standard Test Method for Slump of Hydraulic-Cement Concrete
8. ASTM C150—Standard Specification for Portland Cement
9. ASTM C172—Standard Practice for Sampling Freshly Mixed Concrete
10. ASTM C173—Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
11. ASTM C231—Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
12. ASTM C260—Standard Specification for Air-Entraining Admixtures for Concrete
13. ASTM C309—Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
14. ASTM C494—Standard Specification for Chemical Admixtures for Concrete
15. ASTM D1751—Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
16. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials

D. Concrete Reinforcing Steel Institute:

1. CRSI Manual of Standard Practice
2. ICC-Evaluation Service Report Program (ESR)
3. Specific to rebar adhesive anchoring system used

E. National Institute of Standards and Technology (NIST):

1. NIST PS 1—Structural Plywood

F. American Forest and Paper Association:

1. AF&PA—National Design Specifications for Wood Construction

G. The Engineered Wood Association

1. APA/EWA PS 1—Voluntary Product Standard for Construction and Industrial Plywood

H. West Coast Lumber Inspection Bureau:

1. WCLIB: Standard Grading Rules for West Coast Lumber

1.3 SUBMITTALS

A. General Requirements

1. Refer to “Section 01 33 00 Submittal Procedures:" Requirements for Submittals.

2. Construction and fabrications or mixing of materials shall not begin until Engineer has reviewed and approved Contractor submittals governing all aspects of the intended Work.

B. Product Data:

1. Manufacturer's catalog sheets including instruction for use and description of application shall be provided on each of the following materials:

a. Epoxies

b. Grouts

c. Admixtures

d. Curing Compounds

e. Chemical Hardeners

f. Bonding agents

g. Moisture Barriers

h. Vapor Retarders

i. Concrete Sealants

j. Expansion Joint Fillers

k. Form Liners

l. Plastic Waterstops

2. Rebar adhesive anchoring system ESR

3. Manufacturer's Mill Certification Report for reinforcement.
4. Data verifying that composite wood products contain no urea formaldehyde resins
    a. Virgin wood: Forest Stewardship Council (FSC) certification

C. Design Data:

1. Concrete mix design for each concrete strength
    a. Identify mix ingredients and proportions, including admixtures.
    b. Separate mix designs, when admixtures are required, for the following:
        i. Hot and cold weather concrete Work
        ii. Air entrained concrete Work

D. Shop Drawings:

1. Submit formwork, shoring, and reshoring Shop Drawings.
    a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding, and bracing, and temporary supports
    b. Means of leakage prevention for concrete exposed to view in finished construction
    c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement
    d. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3
    e. Procedure and schedule for removal of shores and installation and removal of reshores.
2. Placing Drawings showing fabrication dimensions and placement locations of reinforcement and reinforcement supports
        i. Placing Drawings must indicate locations of splices, lengths of lap splices, and details of mechanical and welded splices.
3. Location and ails of construction joints:
    a. In the absence of specific construction joint locations described on the Drawings, the Contractor shall submit marked-up copies of the Contract Documents with proposed locations of construction joints clearly identified, a schedule of proposed concrete placement operations, and any proposed revisions to the concrete reinforcement layout, sizes, or configurations.

E. Informational Data:

1. Concrete batch plant weight tags shall be carried to the site by the batch plant truck driver and submitted to the Inspector by the Contractor on the day of delivery for all concrete

delivered to the Site.

F. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.4 CLOSEOUT SUBMITTALS

A) Refer to “Section 01 70 00 Execution and Closeout Requirements.”

B) Project Record Documents: Contractor shall accurately record actual locations of embedded utilities and components concealed from view in finished construction and provide the “as constructed” documentation to the Engineer before final payment.

1.5 QUALITY ASSURANCE

A) Sampling, Testing, and Special Inspections shall be paid for by Owner unless noted otherwise in these Specifications. Re-sampling, re-testing, or re-inspection due to failed results will be paid by Owner and billed to Contractor. Contractor shall be responsible for all costs resulting from procurement or installation of materials that fail to meet the requirements of these Specifications.

B) Perform Work in accordance with ACI 318, ACI 347, and ACI 350.

C) Acquire cement and aggregate from one (1) source for Work.

D) For wood products furnished for Work of this Section, comply with AF & PA requirements.

1.6 SEQUENCING AND SCHEDULING

A) Obtain information and instructions from other trades and suppliers in ample time to schedule and coordinate the installation of items furnished by them to be embedded in concrete so provision for their Work can be made without delaying the Project.

B) Do any cutting and patching made necessary by failure or delay in complying with these requirements, at no cost to Owner.

1.7 SAMPLING, TESTING, AND INSPECTION

A) All materials and Work shall be subject to inspection at the batch plant, and at the building Site. Material or Work quality not complying fully with the Drawings, and/or Specifications will be rejected.

B) If the Engineer, through oversight or otherwise, has accepted material or Work that is defective or contrary to Specifications, this material or Work, regardless of state of completion, may be rejected.

C) The Contractor shall cooperate with and notify Engineer at least 48 hours in advance of inspection required and shall provide samples and facilities for inspection without extra charge.

PART 2 MATERIALS

2.1 FORMWORK MATERIALS

A. Form-facing material in contact with concrete must be lumber or plywood.

B. Submit product information on proposed form-facing materials if different from that specified herein.

C. Submit manufacturer's product data on form liner proposed for use with each formed surface.

D. Contractor shall design formwork, shores, re-shores, and backshores to support loads transmitted to them and to comply with applicable building code requirements.

E. Contractor shall design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.

F. Contractor shall design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.

G. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.

H. Design formwork joints to inhibit leakage of mortar.

I. Wood Forms

1. Provide lumber that is square edged or tongue-and-groove boards 6 inches or 8 inches in width, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better, or ANSI A135.4, hardboard for smooth form lining.

2. Submit data verifying that composite wood products contain no urea formaldehyde resins.

3. Virgin wood used must be FSC-certified.

J. Concrete Form Plywood (Standard Rough)

1. Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 16 mm, 5/8-inch thick.

2. Each panel labeled with grade trademark of APA/EWA.

K. Overlaid Concrete Form Plywood (Standard Smooth)

1. Provide plywood that conforms to APA/EWA “HD Overlay Plyform Structural I Exterior” grade, minimum of ¾ inch thick

2. Each panel labeled with grade trademark of APA/EWA

L. Formwork Accessories

1. Use commercially manufactured formwork accessories, including ties and hangers.

2. Form ties and accessories must not reduce the effective cover of the reinforcement.

3. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture or impair natural bonding characteristics of coatings intended for use on concrete

4. Corners: Chamfer, rigid plastic, or wood strip type; ¾ x ¾ inch size; maximum possible lengths

5. Form Anchors and Hangers:

   a. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.

   b. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.

   c. Penetration of structural steel members is not permitted.

M. Form Ties

1. Use form ties with ends or end fasteners that can be removed without damage to concrete.

2. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in walls.

3. The breakback distance for ferrous ties must be at least 3/4 inch for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.

4. If the breakback distance is less than 3/4 in., use coated or corrosion-resistant ties.

2.2 PORTLAND CEMENT

A. Portland Cement shall conform to ASTM C150 for Type II cement. Use a single, approved standard brand throughout Work.

2.3 CONCRETE AGGREGATES

A. Aggregates for hardrock concrete shall conform to ASTM C33 Class 1S.

2.4 WATER

A. Mixing water for concrete shall be clean and free from deleterious amounts of acids, alkalis, or organic materials.

2.5 ADMIXTURES

A. AIR-ENTRAINING ADMIXTURE

1. Air-entraining admixtures shall conform to the requirements of ASTM C260.

B. WATER-REDUCING ADMIXTURE

1. Water-reducing admixtures shall conform to the requirements of ASTM C494, Type A, and contain no more than 0.1 percent chloride ions.

C. HIGH-RANGE WATER-REDUCING ADMIXTURE (SUPER PLASTICIZER)

1. Super Plasticizer shall conform to the requirements of ASTM C494, Type F or Type G and contain no more than 0.1 percent chloride ions. Fly Ash: ASTM C618

D. WATER-REDUCING, RETARDING ADMIXTURE

1. Water-reducing, retarding admixtures shall conform to the requirements of ASTM C494, Type D, and contain no more than 0.1 percent chloride ions.

E. SILICA FUME:

1. Silica Fume shall conform to the requirements of ASTM C1240.

F. FLY ASH:

1. Fly Ash shall conform to the requirements of ASTM C618.

2.6 CONCRETE

A. Concrete Mix Requirements: Concrete shall have a minimum 28-day compressive strength, minimum cement content, and maximum water/cement ratio as listed in the table below:

Concrete Class	**Minimum 28-day Compressive Strength**	**Minimum Cement Content**	**Maximum Water/Cement Ratio Non-Air Entrained**
Class A	4,000 pounds per square inch (psi)	6 sacks	0.48
Class B	3,000 psi	5.5 sacks	0.55
Class C	2,500 psi	5 sacks	0.60
Class D	2,000 psi	5 sacks	0.75

B. Concrete Mix Designs: The following table presents a schedule of classes of concrete, maximum aggregate, maximum slump, and air content for each type of concrete, which shall be as follows.

Concrete Element	**Class of Concrete**	**Max. Size Aggregate**	**Slump (Inch)**		**Total Air Content**
			Max.	**Min.**	
Grade Beams, Pile Caps, Equip. Pedestal	A	3/4	4	1	5-7%
Foundations, Floor Slabs, Slab on grade	B	3/4	4	1	5-7%
Paving, Sidewalks	C	3/4	4	1	--
All Other Concrete	D	3/4	4	1	--

C. Admixtures.

1. Admixtures are not required. Contractor may add specified admixtures provided they have submitted, for review and comment by the Engineer, a complete submittal of the proposed

admixture prior to mixing the concrete.

D. Concrete Shrinkage.

1. Allowable shrinkage: 0.048 percent per ASTM C157.

2. Allowable Shrinkage: 0.040 percent at 21 days per ASTM C157 as modified by Structural Engineers Association of California (SEAOC).

2.7 REINFORCEMENT

A. Bend reinforcement cold. Bends for reinforcing steel shall be made in accordance with ACI 318 latest edition. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117.

B. When handling and storing coated reinforcement, use equipment and methods that do not damage the coating. If stored outdoors for more than 2 months, cover coated reinforcement with opaque protective material.

C. Reinforcing bars must be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.

D. Reinforcing bars conform to the requirements of ASTM A615 with the bars marked S, Grade 60, unless otherwise specified.

E. Submit manufacturer's certified test report for reinforcement.

F. Submit mill certificates for reinforcing bars.

2.8 NON-SHRINK GROUT

A. Category II:

1. Usage: Machine bases 25 HP or less, Through-bolt/snap-tie openings

2. Nonmetallic, nongas-liberating

3. Prepackaged natural aggregate grout requiring only the addition of water

4. Conformance with ASTM C1107/C1107M and COE CRD-C621

5. Grout shall not bleed at maximum allowed water.

6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days

7. Manufacturers and Products:

a. BASF Building Systems, Inc., Shakopee, MN; Master Flow 928

b. Five Star Products Inc, Fairfield, CT; Five Star Fluid Grout 100

c. Euclid Chemical Co, Cleveland, OH; Hi Flow Grout

d. Dayton Superior Corp, Kansas City, KS; Sure Grip High Performance Grout

e. L & M Construction Chemicals, Inc, Omaha, NE; Crystex

f. Or Approved Equal

B. Two- or Three-Part Epoxy Grout

1. Two (2) liquid epoxy components

2. One (1) inert aggregate filler component, if required

3. As required by equipment manufacturers for equipment anchoring or mounting bolts

4. As required for concrete reinforcing rod insertion into drilled holes in existing concrete structures

5. Manufacturer and Product

a. HILTI HIT500 V3

b. Or Approved Equal.

6. Non shrink grout shall be premixed compound consisting of non-metallic aggregate, cement, water retarding, and plasticizing agents; capable of developing a minimum compressive strength of 2,400 psi in 2 days and 7,000 psi in 28 days.

PART 3 EXECUTION

3.1 GENERAL

A. Produce concrete of required consistency and strength to present appearance satisfactory to the Engineer.

B. Use only one (1) brand of cement unless otherwise authorized by the Engineer.

C. Embedded Items: Place all pipe sleeves, inserts, anchors bolts, angle frames, ties, and other embedded items required for adjoining Work or for its support prior to concreting. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor bolt slots shall be filled temporarily with a readily removable material to prevent entry of concrete into the voids.

D. Store materials delivered to the job and protect them from foreign matter and exposure to any elements that would reduce the properties of the material.

3.2 EXAMINATION

A. Furnish and install all forms, clamps, accessories, and so on, required for all poured-in-place concrete on the below grade and unexposed portions above grade. Where sides of excavations have been cut neat and accurate to size for pouring of concrete directly against the excavation, forms for footings will not be required.

B. Furnish and install all forms, clamps, sealer, accessories, and so on, required for all poured-in-place concrete above grade that will be exposed.

C. Provide crack control and keyed cold joint forms.

D. Verify lines, levels, and centers before proceeding with formwork. Verify that the dimensions agree with the Drawings.

3.3 FORMWORK INSTALLATION

A. Manufactured assemblies may be used as forms provided that maximum loadings and deflections used on jacks, brackets, columns, joists, and other manufacturer devices does not exceed the manufacturer's recommendations.

B. Earth Forms:

1. Trench earth forms neatly, accurately, and at least 2 inches wider than footing widths indicated on Drawings.

2. Trim sides and bottom of earth forms.

3. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing.

4. Form sides of footings where earth sloughs.

5. Tamp earth forms firm and clean forms of debris and loose material before depositing concrete.

C. Formwork–General:

1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.

2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.

3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.

4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.

5. Complete wedging and bracing before placing concrete.

D. Forms for Smooth Finish Concrete:

1. Use steel, plywood, or lined board forms.

2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.

3. Install form lining with close-fitting square joints between separate sheets without springing into place.

4. Use full-size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

E. Architectural Form Liners:

1. Erect architectural side of formwork first.
2. Attach form liner to forms before installing form ties.
3. Install form liners, square with joints and pattern aligned.
4. Seal form liner joints to prevent grout leaks.
5. Dress joints and edges to match form liner pattern and texture.

F. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

G. Framing, Studding, and Bracing:

1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 2 inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement, or accidental impact.

H. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 318.

I. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

J. Obtain Architect/Engineer’s approval before framing openings in structural members not indicated on Drawings.

3.4 APPLICATION OF FORM-RELEASE AGENT

A. Apply form-release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form-release agent where concrete surfaces are indicated to receive special

finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed Work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish." Apply form coatings before placing reinforcing steel.

3.5 REINFORCEMENT PLACEMENT

A. Prior to all Work of the section, carefully inspect the installed Work of other trades, and verify that all Work is sufficiently complete to permit the start of Work under this section and that the completed Work of this section will be in complete accordance with the original design and the reviewed Shop Drawings. In the event of discrepancy, immediately notify the Engineer in writing.

B. In the event conduits, pipes, inserts, sleeves, or any other item interferes with placing the reinforcement as indicated on the Drawings or approved Shop Drawings, or as otherwise required, immediately notify the Engineer and obtain approval on procedure before placement of reinforcement is started.

C. Do not field-bend reinforcing steel in a manner that will injure material, cause the bars to be bent on too tight a radius, or that is not indicated as allowed on the Drawings or permitted by Engineer. Do not straighten bent or kinked bars for use on Project without permission of Engineer. Replace bars that have kinks or bends not shown on the Drawings.

D. All reinforcement shall be placed in strict conformity with the requirements of the engineering Drawings, all as to location, position, and spacing of members. It shall be supported and secured against displacement by the use of adequate and proper wire supporting and spacing devices, tie wires, etc. so that it will remain in its proper position in the finished structure.

E. Preserve clear space between parallel bars of not less than 1½ times the nominal diameter of round bars and in no case shall the clear distance be less than 1½ inches or less than 1⅓ times the maximum size of aggregate for concrete. Bars placed in shotcrete shall have a minimum clearance between bars of 2½ inches for No. 5 and smaller and 6 bar diameters for bars larger than No. 5.

F. Lap splices shall be contact lap splices in accordance with ACI 318 unless noted otherwise on the Contract Drawings. Bars shall be wired together at laps. Wherever possible, stagger splices in adjacent bars. Make all splices in wire fabric at least 1½ meshes wide or 12-inches, whichever is greater. When splicing in areas to receive shotcrete, lap splices shall be non-contact with at least 2-inch clearance between bars.

G. Take all means necessary to ensure that steel reinforcement, at the time concrete is placed around it, is completely free from rust, dirt, loose mill scale, oil, paint, and all coatings that will destroy or reduce the bond between steel and concrete.

H. The Contractor shall notify the Engineer at least 24 hours in advance of when inspections are required.

3.6 INSTALLATION OF INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Forms shall be constructed of sound material, of the correct shape and dimension, mortar tight, and of sufficient strength, and so braced and tied together that the movement of equipment, men, materials, or placing and vibrating the concrete will not throw them out of line or position. Construct so that they may be easily removed without damage to the concrete. Any movement or bellying of forms during construction shall be considered just cause for their removal and that of the concrete Work so affected. All formed joints on concrete surfaces to be exposed shall be taped and shall align so joints will not be apparent on the concrete surfaces. All dirt, chips, sawdust, and other foreign matter shall be completely removed before concrete is placed.

B. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly coated with an approved form sealer. The form sealer shall be of high penetrating quality leaving no film on the surface of the forms that can be absorbed by the concrete.

C. Form supports shall be placed on adequate foundations and have sufficient strength and bracing to prevent settlement or distortion from the weight of the concrete or other cause. Support shall rest on double-wedged shim, or other approved means, so that the forms will be maintained at the proper grade.

D. Before concrete is placed in any form, the horizontal and vertical position of the form shall be carefully verified, and all inaccuracies, corrected. All wedging and bracing shall be completed in advance of placing of concrete.

E. Boards or other form materials that have been damaged, checked, or warped prior to placing of concrete shall be removed from the forms and replaced with approved materials or otherwise corrected to the satisfaction of the Engineer.

F. Assign a sufficient number of personnel to keep watch on and maintain the forms during placing of concrete. Satisfactorily remedy any displacement or looseness of forms or reinforcement before placing of concrete. No form shall be moved or altered except as may be specifically directed.

G. Locate and place items required to be cast directly into concrete.

H. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

I. Install water stops continuous without displacing reinforcement.

J. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

K. Form Ties:

1. Use sufficient strength and sufficient quantity to prevent spreading of forms.

2. Place ties at least 1 inch away from finished surface of concrete.

3. Leave inner rods in concrete when forms are stripped.

4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless otherwise shown on Drawings.

L. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

M. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.

2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.

3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.

4. Arrange joints in continuous line straight, true, and sharp.

N. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.

2. Do not embed wood or uncoated aluminum in concrete.

3. Obtain installation and setting information for embedded items furnished under other Specification sections.

4. Securely anchor embedded items in correct location and alignment prior to placing concrete.

5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

O. Openings for Items Passing Through Concrete:

1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other sections.

2. Coordinate Work to avoid cutting and patching of concrete after placement.

3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

a. Screeds:

i. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.

ii. Slope slabs to drain where required or as shown on Drawings.

iii. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

b. Screed Supports:

c. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad, or base type screed supports that will not puncture membrane.

d. Staking through membrane is not permitted.

4. Cleanouts and Access Panels:

a. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.

b. Clean forms and surfaces against which concrete is to be placed. Remove chips, sawdust, and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.7 SPECIAL INSPECTIONS

A. Special Inspections listed are for the Contractor reference only and are not part of the Contract Documents. They are included to assist the Contractor in understanding the Owner-provided services so that those services may be factored into the Contractor's pricing and schedule.

1. Formwork Special Inspections:

a. Shape, location, and dimensions.

i. Inspect in accordance with dimensions and details on Drawings.

ii. Frequency: Inspect prior to each concrete pour.

2. Reinforcing Special Inspections:

a. Rebar size, spacing, lap length and concrete cover

i. Inspect in accordance with Drawings and Specifications.

ii. Frequency: Inspect prior to each concrete pour.

b. Rebar adhesive anchoring system:

i. Inspect in accordance with ICC-ES report (ESR).

ii. Frequency: Continuous inspection required for all post-installed anchors.

c. Mechanical splices:

i. Inspect in accordance with ICC-ES report (ESR).

ii. Frequency: Continuous inspection required for all post-installed anchors.

B. Mixing, Placing, Jointing, and Curing Special Inspections:

1. Perform concrete tests per this Specification "Section 03 30 00-Cast-In-Place Concrete"

2. Verification of proper mix design.

a. Frequency: Periodically, prior to each concrete pour.

3. Proper concrete placement techniques.

    a. Inspect per requirements of this Specification “Section-03 30 00-Cast-In-Place Concrete”

    b. Frequency: During each concrete pour.

4. Proper curing temperature and techniques.

    a. Inspect per requirements of this Specification “Section-03 30 00-Cast-In-Place Concrete”

    b. Frequency: Periodically, but not less than every third day.

5. Joints:

    a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.

    b. Frequency: Prior to each concrete pour.

6. Waterstops:

    a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstop.

    b. Frequency: Prior to each concrete pour.

    c. Testing PVC Waterstop Joints:

        i. Samples of field fabricated waterstop butt joints may be selected at random by the Engineer for testing by a laboratory at the Owner's expense.
            (1) When tested, they shall have a tensile strength across the joints equal to at least 600 psi.

C. Anchor to Concrete Special Inspection:

1. Post installed anchors as required by the Building Code, ICC-ES reports (ESR), and as specified by the Engineer.

    a. Frequency: as specified in the ICC-ES report (ESR).

2. Cast-in-place concrete anchors, including anchor size, embedment, material, and location.

    a. Frequency: Prior to each concrete pour.

3. Cast-in-place and post installed concrete anchors pull test.

    a. Frequency: Following full concrete cure and prior to installation of anchored equipment.

3.8 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

A. To facilitate testing and inspection, perform the following:

1. Furnish any necessary labor to assist testing agency in obtaining and handling samples at site.

2. Provide and maintain for sole use of testing agency, adequate facilities for safe storage and proper curing of test specimens on site for first 24 hours as required by ASTM C31.

3. Take samples at point of placement into concrete member.

B. Notify Engineer and Owner's Testing Agency sufficiently in advance of operations (minimum of 24 hours) to allow for assignment of personnel and for scheduled completion of quality tests.

3.9 MIXING

A. Use ready-mixed concrete complying with ASTM C94 and with the requirements of Contract Documents. Mix for a period of not less than ten (10) minutes; at least three (3) minutes of mixing period shall be immediately prior to discharging at the job.

B. Materials shall be proportioned by weighing. Pozzolan shall be introduced into the mixer with cement and other components of the concrete mix; Pozzolan shall not be introduced into a wet mixer ahead of other materials or with mixing water.

C. Concrete shall be delivered to the site of Work and discharge shall be completed within 1½ hours after introduction of the water to the mixture.

D. Introduction of additional water after initial mixing is permitted if held back during batch operations and is accounted for in the mix design.

3.10 WEATHER REQUIREMENTS

A. Do not mix or place when atmospheric temperature is below 40 degrees Fahrenheit (˚F) or when conditions indicate temperature will fall below 40˚F within 72 hours. Reinforcement, forms, and ground that concrete will contact shall be completely free of frost. Keep concrete and formwork at a temperature not less than 50˚F for not less than 72 hours after pouring.

B. When temperature is above 80˚F, Contractor shall take precautions to ensure that rebar temperature does not exceed ambient temperature.

C. Temperature of concrete at time of placing shall not be less than 50˚F and not more than 85˚F.

3.11 CONSTRUCTION JOINTS

A. Construction joints are not allowed in tank foundations.

B. Location and details of construction joints shall be as indicated on the Drawing details, as specified, and as submitted by the Contractor and approved by the Engineer. In the absence of specific construction joint locations described on the Drawings, the Contractor shall submit marked-up copies of the Contract Documents with proposed locations of construction joints clearly identified, a schedule of proposed concrete placement operations, and any proposed revisions to the concrete reinforcement layout, sizes, or configurations.

1. Locate wall vertical construction joints as described in Drawing details, and wall horizontal construction joints at ten (10) foot maximum centers.

2. Locate floor slab and foundation base slab vertical construction joints so that concrete placement areas are approximately square with a maximum area of 1,600 square feet.

Length of the longer side of slab placement shall be less than twice the length of the shorter side, or 40 feet, maximum.

3. Locate construction joints at columns and walls at the underside of beams, girders, haunches, drop panels, column capitals, and at floor panels; haunches, drop panels, and column capitals are placed monolithically with, and considered a part of the supported roof or floor. Column bases do not need to be placed monolithically with the floor below.

4. Locate construction joints in beams and girders at the middle of the span, unless a beam intersects a girder at that point; offset the construction joint in the girder a distance of twice the beam width from the middle of the span if this condition occurs. Include details of reinforcement layout for transferring shear and other forces across the construction joint.

5. Locate construction joints in suspended slabs at or near span center in flat or T-beam slab construction; do not locate a construction joint between a slab and a concrete beam or girder.

6. A minimum of 48 hours shall elapse before placement of adjoining concrete structure using a construction joint.

C. Allow a minimum of five (5) working days for the Engineer's review of the Construction Joint Submittal.

D. Prepare surfaces of previously placed concrete; sandblast all construction joint surfaces with coarse sand, or waterblast with clean, potable water to clean and roughen entire joint surface, exposing coarse aggregate solidly embedded in concrete matrix. Clean forms and reinforcing steel of drips and dried cement laitance. Coat surfaces with approved bonding agent according to manufacturer's recommendations.

3.12 CONVEYING AND PLACING

A. All concrete shall be mixed and delivered in accordance with the requirements of ASTM C94. All concrete shall be placed, finished, and cured and all other pertinent construction practices shall be in accordance with the requirements of ACI 301.

B. Notify Engineer at least 48 hours before placing any concrete.

C. Before placing, clean mixing and conveying equipment, and clean forms and space to be occupied by concrete and wet forms. Remove groundwater until completion of Work.

D. Place no concrete in any unit of Work until all formwork has been completely constructed, all reinforcements are secured in place, all items to be built into concrete are in place, and form ties at constructions joints are tightened.

E. Concrete shall be placed so that a uniform appearance of surfaces will be obtained. The concrete will be free of all rock pockets, honeycombs, and voids. Deposit as neatly as practical in its final position.

F. The sub-grade must be moist when the concrete is placed for floor slab to prevent excessive loss of water from the concrete mix.

G. Carry on concreting, once started, as a continuous operation until the section of approved size

and shape is completed. Make pour cut-offs of approved detail and location.

H. Handle concrete as rapidly as practicable from mixer to place of deposit by methods that prevent separation or loss of ingredients. Deposit as nearly as practicable in final position to avoid rehandling or flowing. Do not drop concrete freely where reinforcing bars will cause segregation or drop freely more than 4 feet. Use a tremie pipe or chute for heights greater than 4 feet. Deposit to maintain a plastic surface approximately horizontal. In walls, deposit in horizontal layers not over 18 inches deep. In pouring columns, walls, or thin sections of considerable heights, use openings in forms, elephant trunks, tremies, or other approved devices which permit concrete to be placed without segregation or accumulation of hardened concrete on forms or metal reinforcement above the level of the concrete. Install so concrete will be dropped vertically. Secure water stops in correct position using hog rings or grommets, spaced 12 inches on center along the length of the water stop and wire tied to adjacent reinforcing steel.

I. Concrete that has partially hardened shall not be deposited in the Work.

J. Consolidating/Vibrating: Employ as many vibrators and tampers as necessary to secure the desired results. Minimum: one (1) per each 20 cubic yards of concrete placed per hour, and one (1) backup. Avoid the following practices: Pushing of concrete with vibrator; external vibration of forms; allowing vibrator to vibrate against reinforcing steel where steel projects into green concrete; allowing vibrator to vibrate contact faces of forms. Vibrators shall function at a minimum frequency of 3,600 cycles per minute when submerged in concrete. Supplement vibration by forking, spading, and tamping along the surfaces of the forms, between reinforcing whenever flow is restricted, and around embedded items.

3.13 CURING

A. General: Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures and shall be maintained with minimum moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete.

B. Cure concrete by use of moisture-retaining cover, burlap kept continuously wet, or by membrane curing compound.

C. Initial Curing

1. Initial curing shall immediately follow the finishing operation. Concrete shall be kept continuously moist at least overnight. One of the following materials or methods shall be used: Ponding or continuous sprinkling; absorptive mat or fabric kept continuously wet.

2. Curing compounds conforming to ASTM C309. Such compounds shall be applied in accordance with the recommendations of the manufacturer and shall not be used on any surface against which additional concrete or other cementitious finishing materials are to be bonded, where epoxy flooring is called for, where concrete topping is to receive waterproofing membrane, or on surfaces where such curing is prohibited by the Project Specifications.

D. Final Curing: Immediately following the initial curing and before the concrete has dried, additional curing shall be accomplished by one (1) of the following materials or methods.

1. Continuing the method used in initial curing

2. Cure blankets

3. Other moisture-retaining coverings as approved

E. Duration of Curing: The final curing shall continue until the cumulative number of days or fractions thereof, not necessarily consecutive, during which temperature of the air in contact with the concrete is above 50˚F. has totaled seven (7) days. If high-early-strength concrete has been used, the final curing shall continue for a total of three (3) days. Rapid drying at the end of the curing period shall be prevented.

F. Formed Surfaces: Steel forms heated by the sun and all wood forms in contact with the concrete during the final curing period shall be kept wet. If forms are to be removed during the final curing period, one (1) of the above curing materials or methods shall be employed immediately. Such curing shall be continued for the remainder to the curing period.

3.14 FORM REMOVAL

A. Formwork, falsework, and shoring shall not be removed until the concrete members have acquired sufficient strength to support their weight and the loads to be superimposed thereon safely.

B. Vertical forms shall remain on columns, walls, pilasters, and so on, for at least 7 days.

C. Shoring and falsework under beams, girders, slabs, and so on, shall remain in place for at least 14 days.

D. The Contractor shall request to have field-cured compression test specimens taken for any concrete where it is planned to remove formwork, falsework, or shoring sooner than indicated above.

E. In removing plywood forms, no metal pinch bars shall be used, and special care shall be taken in stripping. Start at top edge or vertical corner where it is possible to insert wooden wedges. Wedging shall be done gradually and shall be accompanied by light taping of the plywood panels to crack them loose. Do not remove forms with a single jerk after it has been started at one end.

F. Forms shall be left in place as long as possible to permit shrinkage away from concrete.

G. Nothing herein shall be construed as relieving the Contractor of any responsibility of the safety of the structure.

H. After stripping, properly protect all concrete to be exposed in the finished Work from damage using boards and building paper to prevent staining, spoiled edges, chips, and so on.

I. Whenever the formwork is removed during the curing period, the exposed concrete shall be cured by one of the methods specified in paragraph 3.12 above.

3.15 CONCRETE FINISHES

A. Concrete finishes in accordance with ACI 301.

3.16 PROTECTION

A. Protect finished Work from injurious action of elements and defacement of any nature during operations. Immediately correct any damage until final acceptance by the Owner.

3.17 GROUTING

A. Grouting Machinery Foundations:

1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any unsuitable material.

2. Set machinery in position and wedge to elevation with steel wedges or use cast-in leveling bolts.

3. Form with watertight forms at least 2 inches higher than bottom of plate.

4. Fill space between bottom of machinery base and original concrete in accordance with equipment manufacturer's recommendations.

3.18 PATCHING AND CLEANING

A. After forms are removed, remove projecting fins, bottles, form ties, nails, etc. not necessary for the Work or cut back 1 inch from the surface. Joint marks and fins in exposed Work shall be smoothed off and cleaned as directed by the Engineer.

B. Form Tie or Through-Bolt Holes: Provide nonshrink grout, Category II, Form-tie holes; after removal of plastic spacers and application of bonding agent, fill space with dry pack dense grout hammered in with steel tool and hammer.

C. Repair all defects in concrete Work exceeding ¼-inch in any direction as directed by the Engineer. Chip voids and stone pockets to a depth of 1 inch or more as required to remove all loose material. Voids, surface irregularities, chipped areas, etc., shall be filled by patching, Gunite, or rubbing, as directed by the Engineer. Repaired surfaces shall duplicate appearance of unpatched Work.

D. Clean exposed concrete surfaces and adjoining Work stained by leakage of concrete to approval of Engineer.

3.19 CLEANUP

A. In addition to the requirements of Special Conditions, clean up all concrete and cement Work on completion of this portion of the Work, except protective coatings or building papers shall remain until floors have completely cured or until interior partitions are to be installed.

3.20 DEFECTIVE WORK

A. Work considered defective may be ordered by the Engineer to be replaced in which case the Contractor shall remove the defective Work at their own expense. Work considered defective shall include, but not be limited to, the following.

1. Concrete in which defective or inadequate reinforcing steel has been placed

2. Concrete incorrectly formed, or not conforming to details and dimensions on the Drawings or with the intent of these Specifications, or concrete surfaces that are out of plumb or level

3. Concrete below specified strength

4. Concrete not meeting the maximum allowable drying shrinkage requirements

5. Concrete containing wood, cloth, or other foreign matter, rock pockets, voids, honeycombs, cracks, or cold joints not scheduled or indicated on the Drawings

6. Defects that allow leakage from any fluid-retaining tank

3.21 CORRECTION OF DEFECTIVE WORK

A. The Contractor shall, at their own expense, make all such corrections and alleviation measures as directed by the Engineer.

B. Concrete Work containing rock pockets, voids, honeycombs, cracks, or cold joints not scheduled or indicated on the Drawings, shall be chipped out until all unconsolidated material is removed.

C. Secure approval of chipped-out areas before patching. Patch in accordance with ACI 301, or as ordered by the Engineer.

D. Leaks shall be repaired by epoxy injection or by other sealing methods approved by the Engineer.

3.22 FIELD QUALITY CONTROL

A. Sampling, Testing, and Quality Control Inspections shall be paid by Owner unless noted otherwise in these Specifications. Re-sampling, re-testing, or re-inspection due to failed results will be paid by Owner and billed to Contractor. Contractor shall be responsible for all costs resulting from procurement or installation of materials that fail to meet the requirements of these Specifications.

B. The Engineer may inspect the batch plant ready mixed concrete to ensure that concrete and Work quality conform to the requirements of Contract Documents.

C. Concrete batch plant weight tags shall be carried to the site by the batch plant truck driver and submitted to the Engineer by the Contractor on the day of delivery for all concrete delivered to the Site.

D. The Owner's testing service shall perform the following sampling and testing for each 50 cubic yards of concrete placed or fraction thereof for each type of concrete placed each day:

1. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.

2. Slump: ASTM C143, one (1) test at point of discharge into construction concrete member forms; additional tests required when concrete consistency seems to have changed. Pumped concrete shall not exceed maximum slump when tested at discharge end of pump hose.

3. Air Content: Determine air content of concrete sample for each strength test in accordance

with either ASTM C231, ASTM C173, or ASTM C138

4. Concrete Temperature: Test hourly when air temperature is 50˚F. (4 degrees Celsius [˚C].) and below, and when 85˚F. (27˚C.) and above; and each time a set of compression test specimens are made.

5. Compression Test Specimen: ASTM C31, take one (1) set of four (4) standard cylinders. Mold and store cylinders for laboratory cured test specimens.

6. Field Cured Compression Test Specimens: ASTM C31, take one (1) set of four (4) standard cylinders, when the Contractor plans to remove formwork, falsework, or shoring sooner than allowed in these Specifications or when post-tensioning of concrete is required. Store field-cured compression test specimens under similar conditions in the field as those that the concrete with early form removal experiences.

7. Compressive Strength Tests: ASTM C39; one (1) specimen tested at 7 days; at 28 days, test quantity in conformance with ASTM C39.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

E. Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

F. Test Results: Test results shall be reported in writing to the Engineer and Contractor within 7 days after tests are made.

1. Test results of less than 60 percent of the full compressive strength at 7 days and less than the full compressive strength at 28 days shall be reported in writing to the Engineer and Contractor within 48 hours after tests are made.

2. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing services, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

G. The Contractor shall make tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Engineer. The Contractor shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, for other additional testing as may be required, and for cost of repairing areas of structure tested when unacceptable concrete is verified.

END OF SECTION

04 Masonry

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SECTION 04 22 00

CONCRETE MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry construction (CMU), including:

a. Standard concrete masonry

b. Masonry mortar

c. Masonry grout

2. Integral water repellent admixture

3. Masonry special inspection

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)/The Masonry Society (TMS):

ACI 530.1/ASCE 6/TMS 602: Specifications for Masonry Structures

2. ASTM International (ASTM):

ASTM C33: Standard Specification for Concrete Aggregates

ASTM C90: Standard Specification for Loadbearing Concrete Masonry Units

ASTM C143: Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C144: Standard Specification for Aggregate for Masonry Mortar
ASTM C150; Standard Specification for Portland Cement

ASTM C207: Standard Specification for Hydrated Lime for Masonry Purposes

ASTM C270: Standard Specification for Mortar for Unit Masonry
ASTM C404: Standard Specification for Aggregates for Masonry Grout

ASTM C426: Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units

ASTM C476: Standard Specification for Grout for Masonry

ASTM C1019: Standard Test Method for Sampling and Testing Grout

ASTM C1093: Standard Practice for Accreditation of Testing Agencies for Masonry

ASTM C1314: Standard Test Method for Compressive Strength of Masonry Prisms

ASTM C1357: Standard Test Methods for Evaluating Masonry Bond Strength
ASTM C1384: Standard Specification for Admixtures for Masonry Mortars

ASTM E514: Standard Test Method for Water Penetration and Leakage Through Masonry

3. Masonry Standard Joint Committee (MSJC):

   a. Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602); referred to herein as MSJC Specification.

4. National Concrete Masonry Association (NCMA):

   NCMA TEK 2-3A: Architectural Concrete Masonry Units

   NCMA TEK 3-4B: Bracing Concrete Masonry Walls During Construction

   NCMA TEK 8-2A: Removal of Stains from Concrete Masonry

   NCMA TEK 8-3A: Control and Removal of Efflorescence

5. Building code:

   a. International Code Council (ICC):

      i. International Building Code and associated standards, 2021 Edition including all California amendments, referred to herein as 2022 California Building Code (CBC).

6. Concrete masonry unit manufacturer shall be licensed or qualified, in writing, by manufacturer of integral water repellent admixture to produce masonry units containing manufacturer's admixture.

   a. Concrete masonry unit manufacturer shall have a minimum of 5 years' experience producing masonry units containing manufacturer's admixture.

B. All masonry units of any 1 particular type, color or face style shall be from the same production run.

   1. Special shapes shall be factory fabricated unless noted otherwise.

1.3 DEFINITIONS

A. Definitions to be in accordance with Standard Unit Nomenclature Table 1, NCMA TEK 2-3A.

B. Coarse grout and fine grout are defined by the aggregate size used in accordance with ASTM C476.

C. Coarse aggregate and fine aggregate are defined in ASTM C404, Table 1.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification “Section 01 33 00 Submittal Procedures” for requirements for the mechanics and administration of the Submittal process.

2. Product technical data including:

   a. Manufacturer's information on aggregate and cement type used in manufacture.

   b. Data sheet on each type of masonry unit

3. Proposed mortar mix design

4. Proposed masonry grout mix design

5. Drawings:

   a. Scaled (minimum 1/8 inch per foot) Drawings showing proposed locations of masonry control joints.

   b. Wall elevations and sections, indicating special shapes, shape part numbers, applicable dimensions.

   c. Detail drawings for:

      i. Precast concrete lintels.

         (a) Show profiles, cross-sections, reinforcement, and steel components.

6. Certifications:

   a. Certification that concrete-masonry units meet or exceed requirements of standards referenced

   b. Certification that fire-resistive rated units meet the requirements of the Building Code

   c. Certification that integral water repellent admixture will not affect the use of coloring processes or alter the actual colors of factory colored masonry units

   d. Data sheets on integral water repellent admixture being used in masonry unit manufacturing

   e. Technical bulletins on cleaning masonry containing integral water repellent

   f. Certification of integral water repellent admixture dosage rates from concrete masonry unit producer

   g. Concrete masonry producer shall certify that integral liquid water repellent admixture has been provided at dosage rate recommended by admixture manufacturer for use in exterior wall construction

h. Certification that concrete-masonry units meet all requirements for strength, absorption, density, moisture content and dimensions when tested according to ASTM C140

7. Test and inspection results for all masonry, grout, and mortar testing

B. Samples:

1. Concrete Masonry Finish Samples: Manufacturer's complete offering of colors and textures for each type of masonry specified.

a. Minimum 3-inch square samples for initial selection.

b. Provide two (2) 8-inch square samples if each type of masonry selected for final approval.

c. Coordinate with Owner for color and finish selection

C. Informational Submittals:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the Submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.

B. Protect units from damage.

C. Inspect units upon delivery for damage, to ensure color match or approved samples, dimensional quality, and trueness of unit.

1. Remove damaged or otherwise unacceptable units from the Project Site.

D. Store units in accordance with manufacturer's recommendations.

E. Store cementitious materials on elevated platforms, under cover, and in a dry location.

1. Do not use cementitious materials that have become damp.

F. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

G. Deliver preblended, dry mixes in moisture-resistant containers.

1. Store preblended, dry mixes in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Standard masonry units:

   a. Any manufacturer capable of meeting the requirements of this Specification Section.

2. Ground-face masonry units:

   a. Concrete Materials

   b. Clayton Concrete Block

   c. Dillon and Co.

   d. Oldcastle Architectural

   e. Trenwyth Industries, Inc.

   f. Or Approved Equal

2.2 MATERIALS

A. Portland Cement:

1. ASTM C150, Type II

2. No air entrainment

3. Maximum percent of alkalis: 0.60 in accordance with ASTM C150, Table 1A

B. Aggregate:

1. CMU: ASTM C33

2. Mortar: ASTM C144, free of gypsum

3. Grout: ASTM C404

C. Hydrated Lime:

1. ASTM C207, Type S

2. Type SA not acceptable

3. Lime substitutes not acceptable

D. Reinforcing Bars:

1. Refer to Specification “Section 03 30 00 Cast-in-place Concrete”

E. Mortar:

1. Mortar shall comply with MSJC Specification and Building Code.

2. Type "S" mortar shall be used:

a. Comply with ASTM C270, Table No. 1, Cement-Lime Mortar.

b. Do not use masonry cement or mortar cement.

c. No fly ash additives will be accepted.

d. Mix materials minimum of three (3) minutes and maximum of five (5) minutes.

e. Adjust consistency to satisfaction of mason.

f. Do not use admixtures unless otherwise indicated.

g. Provide integral water repellent admixture in mortar used for:

i. Exterior concrete masonry Work.

ii. Interior concrete masonry Work in wet areas.

h. Do not use integral water repellent admixture in mortar for brick.

F. Masonry Grout:

1. Grout shall comply with MSJC Specification and Building Code.

2. ASTM C476

a. Minimum 28-day compressive strength: 2,000 psi.

b. Slump: 8 to 11 inch.

3. Mix 5 minutes minimum.

4. No admixtures allowed.

5. At Contractor's option, premixed or preblended grout meeting the above minimum requirements may be used.

G. Integral Concrete Masonry Water Repellent:

1. Liquid polymeric admixture ASTM C1384

2. Grace "DRY-BLOCK" or Approved Equal

3. Verify compatibility with liquid water repellent admixture being used in the fabrication of concrete masonry units, mortar, and grout

2.3 2.03 MANUFACTURED UNITS

A. General:

1. Fire resistive units: Fabricated to meet the California Building Code most recent addition

2. Fabricated in the manufacturing plant

3. Provide square corners unless noted otherwise.

B. Concrete Masonry Units:

1. Modular units: ASTM C90.

a. Normal weight units: Minimum of 125 LB/CF

b. Light weight or medium weight units are not acceptable.

2. Color:

a. Interior units: Standard gray

b. Exposed exterior units: As selected by Engineer from manufacturer's standard color selection

3. Design compressive strength: f'm=2,500 psi

4. Special shapes and faces:

a. Corner units.

i. Corner units used in veneer wythe shall have a finished return leg one-half the length of a standard modular stretcher unit.

ii. Corner units shall maintain regular modular masonry coursing.

b. Finished end units

c. Other special shapes as indicated on Drawings or necessary to maintain coursing

C. Ground-face Masonry Units (GFMU **8-inch x 8-inch x 16-inch**):

1. Factory ground-faces on modular concrete block

2. Manufacturer's standard factory applied clear sealer

3. Provide single face units with special lintels, corners, caps, jamb returns sloped top units and scored units as indicated on the Drawings or as required for wall conditions.

4. Provide square corners.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that anchors and flashings are correct.

B. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints.

1. Properly locate openings, movement type joints, returns, and offsets.

3.2 INSTALLATION

A. General:

1. Perform all cutting using masonry saw blades.
2. Drill holes using masonry drill bits or core drill.
    a. Holes made by chipping unit will not be accepted.
3. Install field units in running bond, unless noted otherwise.
4. Cut as required to maintain bond pattern.
5. Use solid units where cutting or laying would expose holes and as noted on Drawings.
6. Avoid use of less than half size units, whenever possible.
7. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
8. Provide units of uniform color, within the range demonstrated on the approved mock-up.
9. Do not wet concrete masonry units.
10. Build chases and recesses as indicated and required for Work of other trades.
    a. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses unless detailed otherwise on the Drawings.

B. Concrete Masonry Units - Grout:
1. Grout solid all cells containing steel reinforcing and as indicated on Drawings.
2. Use grout within 1½ hours maximum after initial mixing.
3. Use no grout after it has begun to set.
4. Do not retemper grout after initial mixing.
5. Place grout in lifts not exceeding 4 feet.
6. Use coarse grout in spaces with least dimension over 2 inch.
7. Consolidate all grout while installing.
    a. Consolidate grout pours 12 inch or less in height by mechanical vibration or by puddling.
    b. Consolidate grout pours exceeding 12 inch in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

C. Concrete Masonry Units - Mortar:
1. If standard gray mortar begins to stiffen, it may be retempered by adding water and remixing unless prohibited by water repellent admixture manufacturer.

2. Standard gray mortar shall not be retempered more than once.
3. All mortar must be used within 2½ hours maximum after initial mixing per MSJC Specification.
4. Engineer reserves right to alter mix design based on initial rate of absorption of masonry units.
5. Set Prefaced masonry using type S mortar.
    a. Rake mortar from joint as recommended by the unit manufacturer.
    b. Tuckpoint raked joints and scored joints using pointing grout.
        i. Install pointing grout in accordance with ANSI A108.10 and masonry unit manufacturer's published instructions.
        ii. Use polymer modified sanded pointing grout for joints in:
    c. Exterior masonry
    d. Interior dry areas
        i. Use epoxy pointing grout for joints in interior areas subject to exposure to corrosive or caustic chemicals.

D. Laying and Tooling:

1. Lay masonry units with completely filled bed and head joints.
    a. Provide full mortar bed on all block cross webs and completely fill head joints.
        i. Do not slush head joints.
        ii. Protect cells requiring grout fill from mortar droppings.
        iii. Omit mortar from head joint at weep joint opening.
2. Maintain nominal 3/8-inch joint widths.
    a. Cut joints flush where concealed.
    b. Tool exposed joints concave.
    c. Compress mortar in below ground joints and in joints concealed by insulation in cavity wall construction.
    d. Provide wider joints where noted on Drawings.
        i. In no case shall any mortar joint be more than 3/4-inch wide.
    e. Where masonry sits on top of steel support omit the mortar joint on top of the support and sit masonry directly on top of the thru wall flashing or the steel support member unless a mortar joint is required to maintain coursing.

3. During tooling of joints, enlarge any voids or holes, and completely fill with mortar.
4. Point-up all joints at corners, openings, and adjacent Work to provide neat, uniform appearance.
5. Remove masonry disturbed after laying.
    a. Clean and relay in fresh mortar.
    b. Do not pound units to fit.
    c. If adjustments are required, remove units, clean, and reset in fresh mortar.
6. Where Work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
    a. Remove loose units and mortar prior to laying fresh masonry.
7. As Work progresses, build in items indicated on Drawings and specified.
    a. Fill in solidly with mortar around built-in items.
    b. Where built-in items are to be embedded in cores of hollow masonry units, place grout screen in joint below and fill core solid with mortar.

E. Reinforcing Masonry:

1. General:
    a. Provide continuous horizontal joint reinforcing in all concrete masonry wall construction.
        i. Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8 inch on exterior side of walls and 1/2 inch at other locations.
        ii. Lap reinforcement minimum of 12 inch at ends.
            (a) Remove cross wires on 1 side of the lap splice and bend the side rods slightly so the lap is provided with 12 inch of uninterrupted wire lap occurring in the same plane.
        iii. Do not bridge control joints with horizontal joint reinforcing.
        iv. Do not bridge expansion joints with horizontal joint reinforcing.
        v. At corners and wall intersections use prefabricated L and T horizontal joint reinforcing sections.
        vi. Cut and bend, as necessary.
    b. Install reinforcing where indicated on Drawings.
    c. In concrete masonry, install additional horizontal joint reinforcing on each jamb of openings for full height of joint or opening.

i. Alternate with normal wall horizontal joint reinforcing.

ii. Extend reinforcing minimum 32 inches beyond joint or jambs of opening.

d. In concrete masonry, reinforce masonry openings over 12 inches wide with horizontal joint reinforcing placed in 3 horizontal joints above lintel.

i. Extend minimum of 32 inches beyond jambs of opening.

2. Reinforcing concrete masonry:

a. Install reinforcing bars where indicated on Drawings.

i. Provide means necessary to ensure position of vertical steel reinforcing meets requirements of Building Code.

3. Repair all galvanized coatings damaged as a result of welding.

F. Tolerances:

1. Maximum variation from plumb in vertical lines and surfaces of columns, walls, and arises:

a. ± 1/4 inch in 10 feet

b. ± 3/8 inch in 20 feet

c. ± 1/2 inch max

2. Maximum variation from plumb for external corners, expansion joints, and other conspicuous lines:

a. 1/4 inch in any story or 20 foot maximum

b. 1/2 inch in 40 feet or more

3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:

a. 1/4 inch in any bay or 20 feet

b. 1/2 inch in 40 feet or more

4. Maximum variation from plan location of related portions of columns, walls, and partitions:

a. 1/2 inch in any bay or 20 feet

b. 3/4 inch maximum

5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on Drawings:

a. Minus 1/4 inch

b. Plus 1/2 inch

6. Maximum variation in mortar joint thickness:

a. Bed joints: 1/8 inch

b. Head joints:

i. Minus 1/4 inch

ii. Plus 3/8 inch

G. Protect against weather when Work is not in progress.

1. During inclement weather conditions, cover top of walls with translucent waterproof membrane.

3.3 FIELD QUALITY CONTROL

A. Bracing Concrete Masonry Walls During Construction:

1. At a minimum, provide bracing in accordance with NCMA TEK 3-4B.

2. Contractor is responsible for adequately bracing all masonry during construction.

B. Remove and replace loose, stained, damaged and other unacceptable units as directed by Engineer.

1. Provide new units to match.

2. Install in fresh mortar.

3. Point to eliminate evidence of replacement.

C. Special Masonry Inspection:

1. Masonry inspection services will be provided during the following construction activities:

a. Cost of masonry inspection services will be paid by Owner.

b. During laying of units:

i. During the first day of the masonry construction; inspect proportions of site prepared mortar; construction of mortar joints; location of all reinforcing and connectors; size and location of structural elements; type, size, and location of anchors; protection of masonry during cold weather.

ii. Inspection to be continuous the first full day of masonry construction that requires special inspection.

(1) Thereafter, a minimum of 3 hours every third day of construction until the concrete masonry Work is complete.

iii. Inspection while laying masonry units may be made concurrently with other inspection duties provided all inspection duties are adequately performed.

iv. When deficiencies are found, additional inspection shall be provided as required until deficiencies have been corrected.

v. If masonry crews change, an additional full day of inspection is required during the first day the new crew is on site.

c. Placement of reinforcing steel:

i. Verify all reinforcing including size, grade, lap lengths, and type.

ii. Inspection may be periodic as required to verify all reinforcing.

iii. Inspector to be present during the concrete pour in which any dowels connecting concrete to masonry are cast.

(1) Inspector to verify proper location of dowels.

d. Prior to each grouting operation, verify that grout space is clean, reinforcing is clean, and connectors are properly placed, proportions of site-prepared grout are correct and mortar joints have been properly constructed.

i. Inspection may be periodic as required to verify proper grout space.

e. Verify compliance with Building Code and Specifications continuously during all grouting operations.

f. Provide special inspection in accordance with the Building Code Section 1705.4, including observation of masonry Work for conformance to the Contract Documents:

i. Provide inspection reports to the Engineer, Building Official and Owner.

(1) Notify Contractor of discrepancies for correction.

(2) Notify Engineer, Building Official and Owner, in writing when discrepancies have been satisfactorily corrected.

ii. Submit final signed report stating that Work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the Contract Documents and the applicable workmanship provisions of the Building Code.

2. Masonry Mortar and Grout Testing and Inspection:

a. Testing and inspection services will be provided by the Owner's special masonry inspector.

i. Do not include in the bid price the cost of these services.

b. Testing and inspection shall include, but is not limited to:

i. Observe proportions of site-prepared mortar and grout.

ii. Observe grout space prior to grouting.

iii. Grout compressive strength sampling, testing, and reporting per ASTM C1019.

(1) One (1) strength test shall be the average of 3 specimens from the same sample, tested at 28 days.

ii) Grout slump test sampling, testing, and reporting per ASTM C143

iv. Frequency of sampling: 1 sample (3 specimens) collected each grouting operation during masonry construction.

c. Reporting: Special inspector to submit test results and inspection reports per Specification “Section 01 33 00 Submittal Requirements”.

3.4 CLEANING

A. Clean concrete masonry as the wall is being constructed using fiber brushes, wooden paddles, and scrapers.

1. Do not use metal tools or wire brushes.

2. No acid-based cleaning solutions shall be used unless approved in writing by Engineer.

B. Ground-face Masonry Units:

1. Maintain walls clean during installation; remove all mortar splatters immediately using soft damp rag.

2. Do not allow excess mortar to harden on faces.

3. Wipe face of units often with sponge and clean water.

4. No acid-based cleaning solutions shall be used unless approved in writing by the Engineer.

5. Refer to unit manufacturer's printed cleaning recommendations.

C. Remove dirt and stains in accordance NCMA TEK 8-2A.

D. Remove primary efflorescence in accordance with NCMA TEK 8-3A.

E. After wall construction has been completed, completely clean wall using detergent recommended by ground-face unit manufacturer.

F. Apply manufacturer's recommended field-applied acrylic sealer to all ground-face masonry units.

END OF SECTION

08 Openings

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SECTION 08 36 13

ROLL UP DOORS

PART 1 GENERAL

1.1 DESCRIPTION

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.

1.2 RELATED SECTIONS

A. Section 09 90 00—Painting and Coating

1.3 SUBMITTALS

A. In accordance with the procedures and requirements set forth in “Section 01 33 00–Submittal Procedures” submit the following:

1. Manufacturer's literature and installation instructions.

2. Drawings showing details of the products, connections to adjoining materials, and schedules showing sizes and types.

3. Finish and color samples.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original and unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Store materials carefully in an area that is protected from the elements, and in a manner that will prevent damage or marring of the door.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTUERS

A. Subject to compliance with these specifications provide products from one of the following manufacturers:

1. The Cookson Company

2. R & S Manufacturing

3. Overhead Door Corporation

4. Or Approved Equal

2.2 MATERIALS

A. Door Curtains

1. Galvanized steel sheet: heavy duty industrial quality to ASTM A653/A653M with Z275 zinc coating. Minimum sheet thickness to be 24 gauge.

2. Insulation: CFC free, foamed in-place polyurethane to meet design requirements.

B. Guides

1. Form from galvanized structural steel angles with a minimum 3/16-inch thickness. Provide windlock bars as required to meet design windload. Attach guides to jamb with not less than 3/8-inch steel bolts anchored not more than 30 inches on center.

2. Provide silicone finished compressed insulation for gap between wall and guide. Provide manufacturer's recommended product.

C. Counterbalance Assembly

1. Counterbalance by means of adjustable steel helical torsion springs, mounted around a steel shaft and mounted in a spring barrel and connected to the door curtain with the required barrel rings. Use grease -sealed ball bearings or self-lubricating graphite bearings for all rotating members.

   a. Fabricate spring barrel of hot-formed, structural-quality carbon steel, galvanized welded or seamless pipe, of sufficient diameter and wall thickness to support the roll-up of curtain without distortion of slats and limit barrel deflection to not more than .03 inches per foot of span under full load.

   b. Fabricate spring balance of one or more oil-tempered, heat-treated steel helical torsion springs.

   c. Fabricate torsion rod for counterbalance shaft of case-hardened steel, of required size to hold the fixed spring ends and carry the torsional load.

   d. Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate with bellmouth guide groove for curtain.

D. Door Hoods

1. Formed of 20-gauge galvanized steel with baked on polyester primer. Form to enclose coiled curtain at opening head. Reinforce top and bottom edges. Provide closed ends for surface mounted units. Provide intermediate supports as required to prevent excessive sag.

E. Operation: Manual

1. Endless hot-dip galvanized hand chain of length so bottom of chain is 24 inches above finished floor. Provide sprockets and reduction gears for ease of operation and a maximum pull of 25 pounds.

F. Weatherstripping

1. Provide edge and end guides with weatherstripping to seal exterior face of door curtain.

Equip hood with neoprene air baffle to close top of hood with curtain.

G. Finish

1. Premium powder coat system. Galvanized steel to be chemically cleaned and shop primed. Parts inaccessible after installation shall be given an additional coat in the shop. Color shall be selected by Owner from full range of colors.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine substrates and adjoining conditions, where roll-up door is to be installed. Correct unsatisfactory conditions prior to proceeding with the work.

3.2 INSTALLATION

A. Install units and operating equipment complete with necessary hardware, jamb, and head moldings, anchors, inserts, hangers and equipment supports in accordance with final approved shop drawings, manufacturer's printed instructions and as specified herein.

B. Field touch-up shop applied finishes of surfaces scratched or abraded during installation.

C. Do all cutting, drilling, fitting and other work of similar character required for fitting and setting units in connection with this work and adjoining work of other trades.

3.3 PROTECTION, CLEANING AND ADJUSTMENT

A. Protect units prior, during and after installation.

B. After installation, lubricate, test and adjust to operate easily and freely from warps, twists or distortion and weathertight fit.

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09 Finishes

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SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

A. This section includes painting and coating for mechanical, architectural, plumbing, piping, and all other components.

1.2 SCOPE

A. All new steel, iron, and ferrous metal shall be coated unless otherwise specified.

B. Aluminum, stainless steel, and other non-ferrous surfaces shall be coated only where indicated in the Specifications or Drawings. Aluminum in contact with concrete shall be heavily coated with bituminous paint.

C. Architectural painting including concrete and masonry surfaces and gypsum wallboard shall be as shown on the Drawings.

1.3 REFERENCES

A. The following standards may be referenced in this section:

1. American Water Works Association (AWWA):

a. AWWA C203—Coal-Tar Protective Coatings and Linings for Steel Water Pipelines– Enamel and Tape–Hot-Applied

b. AWWA C209—Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

c. AWWA C214—Tape Coating Systems for the Exterior of Steel Water Pipelines

2. NSF/American National Standards Institute (ANSI):

a. NSF/ANSI 61—Drinking Water System Components-Health Effects

3. Occupational Safety and Health Act (OSHA)

4. Society for Protective Coatings (SSPC)/NACE International (NACE):

a. SSPC Guide 15—Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates

b. SSPC PA2—Measurement of Dry Coating Thickness with Magnetic Gages

c. SSPC PA3—Guide to Safety in Paint Applications

d. SSPC PA Guide 10—Guide to safety and health requirements for industrial painting projects

e. SSPC SP0188—Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

f. SSPC SP 1—Solvent Cleaning

g. SSPC SP 2—Hand Tool Cleaning

h. SSPC SP 3—Power Tool Cleaning

i. SSPC SP 5—White Metal Blast Cleaning

j. SSPC SP 6—Commercial Blast Cleaning

k. SSPC SP 7—Brush-Off Blast Cleaning

l. SSPC SP 10—Near-White Blast Cleaning

m. SSPC SP 11—Bare Metal Power Tool Cleaning

n. SSPC SP-12—Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating

o. SSPC SP 13—Surface Preparation of Concrete

B. All products that will come in contact with potable water must have NSF approval for contact with potable water.

1.4 DEFINITIONS

A. Terms and acronyms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon

2. CPVC: chlorinated polyvinyl chloride

3. F: Fahrenheit

4. FRP: fiberglass reinforced plastic

5. HCI: hydrochloric acid

6. MDFT: minimum dry film thickness, mils

7. MDFTPC: minimum dry film thickness per coat, mils

8. mil: thousandth of an inch

9. PA: paint application

10. PPDS: Paint Product Data Sheet

11. PSDS: Paint System Data Sheet

12. PVC: polyvinyl chloride

13. PVDF: polyvinylidene fluoride

14. SFPG: square feet per gallon

15. SFPGPC: square feet per gallon per coat

16. SP: surface preparation

1.5 SUBMITTALS

A. Refer to “Section 01 33 00 Submittal Procedures:” Requirements for submittals.

B. Product Data:

1. Data Sheets:

a. For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.

b. For each product, furnish a Paint Product Data Sheet (PPDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PPDS form is appended to the end of this section.

c. Provide technical and performance information that demonstrates compliance with Specifications.

d. Furnish copies of paint system submittals to the coating applicator.

e. Indiscriminate submittal of only manufacturer's literature is not acceptable.

2. Detailed chemical and gradation analysis for each proposed abrasive material.

3. For architectural paints (doors, interior and exterior walls, trim, building walls) submit colors with data sheets for Owner approval.

C. Informational Submittals:

1. Applicator's Qualifications:

a. Proof of current State of California Painting and Decorating Contractor licensure (C-33 Classification)

b. List of references substantiating minimum 5 years’ practical experience

2. Coating manufacturer's Certificate of Compliance

3. Factory-Applied Coatings: Manufacturer's certification stating factory-applied coating system meets or exceeds requirements specified

4. Manufacturer's written verification that submitted material is suitable for the intended use

5. Finish coating manufacturer's written confirmation that materials are compatible if the manufacturer of finish coating differs from that of shop primer

6. Manufacturer's written instructions and special details for applying each type of paint

1.6 CLOSEOUT SUBMITTALS

A. Refer to “Section 01 70 00 Execution and Closeout Requirements.”

B. Two copies of coating quality control test records.

1.7 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Certified Painting and Decorating Contractor in the State of California (C-33 Classification)

2. Minimum 5 years' practical experience in successful application of specified products

B. Contractor shall provide a supervisor to be at the Work site during cleaning and application operations.

C. Thickness Testing:

1. Thickness of coatings and paints shall be tested with a non-destructive film thickness gauge in conformance with SSPC-PA 2.

2. Structural members, piping, and other irregular surfaces shall be tested with frequency and locations as directed by the Engineer.

D. Holiday Testing:

1. Coating integrity of ALL interior coated surfaces shall be tested with an approved inspection device. All pinholes shall be marked, repaired in accordance with the manufacturer’s printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

E. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended allowable maximum or minimum.

2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees Fahrenheit above dew point of ambient air.

3. Dust, dirt, oil, grease, or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved commercial cleaning solution, rinsed with clean water, and wiped dry with clean rags.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where pre-coated items are to be shipped to the site, protect coating from damage. Batten coated items to prevent abrasion.

2. Protect shop-painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.

2. Primed surfaces shall not be exposed to weather for more than 2 months before being top coated, or less time if recommended by coating manufacturer.

1.9 PROJECT CONDITIONS

A. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.

2. Perform surface preparation and painting in accordance with recommendations of the following:

a. Paint manufacturer's instructions

b. SSPC PA Guide 10: Guide to safety and health requirements for industrial painting projects

c. Federal, state, and local agencies having jurisdiction

3. Perform painting in accordance with the local air quality monitoring district regulations.

4. Contractor is responsible for identifying and obtaining any required permits for field painting or abrasives.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions

B. Minimum of 5 years' verifiable experience in manufacture of specified product

C. The following manufacturers are capable of supplying most of the products specified herein:

1. PPG Industries

2. Tnemec

3. Carboline

4. Benjamin Moore

5. Sherwin Williams

6. or Approved Equal

2.2 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.3 PAINT MATERIALS

A. General:

1. Use manufacturer's highest quality products suitable for intended service.

2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.

3. Thinners, cleaners, driers, and other additives shall be as recommended by coating manufacturer.

B. Colors:

1. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

2. Coordinate with Owner for finish colors of doors, interior and exterior walls, and trim.

3. Equipment Colors:

a. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.

b. Paint non-submerged portions of equipment the same color as the piping it serves, except as itemized below:

i. Dangerous Parts of Equipment and Machinery: OSHA Orange

ii. Fire Protection Equipment and Apparatus: OSHA Red

iii. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow

4. Pipe Identification Painting:

a. Color code non-submerged metal piping, except electrical conduit. Painted fittings and valves shall be the same color as pipe, except equipment isolation valves.

b. Pipe color coding shall be as shown in table below (Paragraph E).

c. On exposed stainless-steel piping, apply color 24 inches in length along pipe axis at connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along piping not greater than 9 feet on center.

d. Pipe supports shall be painted light gray. Do not paint stainless-steel supports.

e. Polyvinyl chloride (PVC) pipe located inside of buildings and enclosed structures will not require painting, except as noted or scheduled.

5. Pipe System Color Code:

Pipe System	Color
Drains/Overflows	Black
Potable Water	Light Blue

Product	Definition
Acrylic Latex	Single component, finish as required
Acrylic Sealer	Clear acrylic
Alkyd (Semigloss)	Semigloss alkyd
Alkyd (High gloss)	High gloss alkyd
Alkyd Enamel	Optimum quality, gloss or semi-gloss finish as required, medium long oil
Bituminous Paint	Single-component, coal-tar pitch based
Block Filler	Primer-sealer designed for rough masonry surfaces,100% acrylic emulsion
Coal-Tar Epoxy	Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service
DTM Acrylic Primer	Surface tolerant, direct-to-metal water borne acrylic primer
DTM Acrylic Finish	Surface tolerant, direct-to-metal water borne acrylic finish coat
Elastomeric Polyurethane	100% solids, plural component, spray applied, high build, elastomeric polyurethane coating, suitable for the intended service
Epoxy Filler/Surfacer	100% solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete and masonry. Approved for potable water contact and conforming to NSF 61, where required
Epoxy Nonskid (Aggregated)	Polyamidoamine or amine converted epoxies aggregated; aggregate may be packaged separately

2.4 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.

2. No partial batches will be permitted.

3. Do not use multiple-component coatings that have been mixed beyond their pot life.

4. Furnish small quantity kits for touchup painting and for painting other small areas.

5. Mix only components specified and furnished by paint manufacturer.

6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at the site.

2.5 SHOP FINISHES

A. Shop Blast Cleaning: SSPC SP 6.

B. Shop Coating Requirements:

1. When required by equipment Specifications, such equipment shall be primed, and finish coated in shop by manufacturer and touched up in field with identical material after installation.

2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

C. Pipe:

1. Ductile Iron Pipe:

a. Use SSPC standards as a guide for desired prepared surface. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.

b. The surface preparation and application of the primer and finish coats shall be performed by pipe manufacturer.

c. For high-performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.

d. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.

e. For conventional (alkyd) coatings, clean asphalt varnish supplied on pipe and apply 1 full coat of a tar stop before two full coats of the color coats specified.

PART 3 EXECUTION

3.1 GENERAL

A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation Work and coating application Work.

B. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer or their representative.

C. Perform the Work only in presence of Engineer or their representative

D. Application of all coating systems shall be in conformance with the manufacturer's recommendations.

3.2 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Engineer before repairing damaged factory finished items delivered to site.

2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply. Do not apply coating to prepared surfaces until they have been inspected and approved by the Engineer.

3.3 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.4 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.

2. Refer to coating systems for degree of abrasive blasting required.

3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Metal Surface Preparation:

1. Where indicated in the Protective Coatings Schedule or according to the coating manufacturer's application instructions, meet requirements of the applicable SSPC specifications.

2. The words "solvent cleaning," "hand tool cleaning," "wire brushing," and "blast cleaning," or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC specification.

3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.

4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.

5. Hand tool clean areas that cannot be cleaned by power tool cleaning.

6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.

7. Welds and Adjacent Areas:

    a. Prepare such that there is:

        i. No undercutting or reverse ridges on weld bead

        ii. No weld spatter on or adjacent to weld or any area to be painted

        iii. No sharp peaks or ridges along weld bead

    b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

8. Preblast Cleaning Requirements:

    a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.

    b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.

    c. Clean small, isolated areas as above or solvent clean with suitable solvent and clean cloth.

9. Blast Cleaning Requirements:

    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.

    b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.

    c. Use only dry blast cleaning methods.

    d. Do not reuse abrasive, except for designed recyclable systems.

e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.

10. Post-Blast Cleaning and Other Cleaning Requirements:

a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.

b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

C. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.

2. Remove oil and grease by wiping or scrubbing surface with suitable solvent, rag, and brush. Use clean solvent and clean rag for final wiping to avoid contaminating surface.

3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

D. Concrete Surface Preparation:

1. Do not begin until 30 days after concrete has been placed.

2. Meet requirements of SSPC SP 13.

3. Remove grease, oil, dirt, salts, or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.

4. Brush-off blast clean to remove loose concrete and laitance and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed.

5. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.

6. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

E. Plastic Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.

2. Large areas may be power-sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

F. Existing Painted Surfaces to be Repainted Surface Preparation:

1. Detergent wash and freshwater rinse.

2. Clean loose, abraded, or damaged coatings to substrate by hand or power tool, SSPC SP 2 or SSPC SP 3.

3. Feather surrounding intact coating.

4. Apply 1 spot coat of specified primer to bare areas, overlapping prepared existing coating.

5. Apply 1 full finish coat of specified primer to entire surface.

6. If an aged, plural-component material is to be top coated, contact coating manufacturer for additional surface preparation requirements.

7. For ductile-iron pipe with asphaltic-varnish finish not specified to be abrasive blasted, apply coat of tar stop prior to application of cosmetic finish coat.

8. Application of Cosmetic Coat:

   a. It is assumed that existing coatings have oxidized sufficiently to prevent lifting or peeling when overcoated with paints specified.

   b. Check compatibility by application to a small area prior to starting painting.

   c. If lifting or other problems occur, request disposition from Engineer.

9. Perform blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet requirements of SSPC.

3.5 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.

2. Abrasive shall be either wet or dry blasting sand, grit, or nutshell.

3. Select various surface preparation parameters, such as, size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.

4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

5. Engineer will review acceptable trial blast-cleaned area and use area as a representative sample of surface preparation.

6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can: 1-part commercial muriatic acid reduced by 2-parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.

2. Application:

a. Rate shall be approximately 2 gallons per 100 square feet.

b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.

c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.

d. After bubbling subsides (10 minutes), hose down remaining slurry with high-pressure clean water.

e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.

f. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.

3. Ensure surface is completely dry before application of coating.

4. Apply acid etching to obtain a "grit sandpaper" surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.

2. Meets requirements of SSPC SP 1.

3.6 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior, and exterior masonry, concrete, and metal, and submerged metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces, unless specifically indicated.

2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless-steel internals, unless otherwise specified.

3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.

4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to ensure thorough drying of previously applied paint.

5. Sand wood lightly between coats to achieve required finish.

6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

7. Coat units or surfaces shall be bolted together or joined closely to structures or to one another prior to assembly or installation.

8. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.

9. Keep paint materials sealed when not in use.

10. Where more than 1 coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.

2. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Porous Surfaces, Such As, Concrete and Masonry:

1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.

2. Prime Coat: may be thinned to provide maximum penetration and adhesion.

3. Type and amount of thinning shall be determined by paint manufacturer and dependent on surface density and type of coating.

4. Surface specified to receive water base coating: Damp, but free of running water, just prior to application of coating.

D. Film Thickness and Coverage:

1. Number of Coats:

a. Apply the minimum required without regard to coating thickness.

b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

2. Application Thickness:

a. Do not exceed coating manufacturer's recommendations.

b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.

3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:

a. Perform with properly calibrated instruments.

b. Recoat and repair as necessary for compliance with Specification.

c. Coats are subject to inspection by Engineer and coating manufacturer's representative.

4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.

5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper thickness in mils in these areas.

6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.7 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting Work in question.

B. If a discrepancy between these Specifications and the manufacturer's recommendations for surface preparation and coating thicknesses, the manufacturer's recommendations shall be followed.

C. System No.6 Exposed Metal-Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
SSPC[a] SP 6, Commercial Blast Cleaning	Rust-Inhibitive Primer	1 coat
	Alkyd Enamel	2 coats

a. SSPC: Society for Protective Coatings

1. Use on the following items or areas:

   a. Exposed metal surfaces, new, located inside or outside of structures or exposed to weather, including metal doors and frames, vents, louvers, exterior metal ductwork, flashing, sheet metalwork, and miscellaneous architectural metal trim.

   b. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

   c. Not to be used on exposed piping, fittings, valves, or piping appurtenances.

D. System No.7 Concrete Encased Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SSPC[a] SP 6, Commercial Blast Cleaning	Coal-Tar Epoxy	2 coats, 16 MDFT[b]

a. SSPC: Society for Protective Coatings
b. MDFT: minimum dry film thickness

1. Use on the following items or areas:

   a. Use on concrete encased ferrous metals including wall pipes, pipe sleeves, gate guides, and thimbles.

E. System No. 8 Buried Metal-General:

Surface Prep.	Paint Material	Min. Coats, Cover
SSPC[a] SP 10, Near White Blast cleaning	Standard Hot Coal Tar Enamel/ -OR- Coal-Tar Epoxy	AWWA[b] C203 2 coats, 16 MDFT[c]
	For Highly Abrasive Soil, Brackish Water: Tape Coat System	AWWA C214 with Double Outer Wrap

a. SSPC: Society for Protective Coatings
b. AWWA: American Water Works Association
c. MDFT: minimum dry film thickness

1. For steel pipe and fittings, follow AWWA C209 and AWWA C214.

2. Use on the following items or areas:

   a. Buried, below grade portions of steel items, except buried stainless steel or ductile iron.

F. System No. 25 Exposed PVC:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with "Section 3.4.E Plastic Surface Preparation"	Acrylic Latex Semigloss	2 coats, 320 SFPGPC[a]

a. SFPGPC: square feet per gallon per coat

1. Use on the following items or areas:

   a. All PVC surfaces that are exposed to UV radiation

G. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
SSPC[a] SP 1, Solvent Clean	Prime in accordance with manufacturer's recommendations	
	Bituminous Paint	1 coat, 10 MDFT[b]

a. SSPC: Society for Protective Coatings
b. MDFT: minimum dry film thickness

1. Use on aluminum surfaces embedded or in contact with concrete including access hatch frames.

H. System No. 28 Gypsum Wallboard and Plywood: Architectural

Surface Prep.	Paint Material	Min. Coats, Cover
SSPC[a] SP 2	Latex Primer, Mildew Resistant	1 coat
	Acrylic Interior Latex, semigloss or glossy	2 coats, 320 SFPGPC[b]

a. SSPC: Society for Protective Coatings
b. SFPGPC: square feet per gallon per coat

1. Use on gypsum wallboard and plywood within buildings

I. System No. 29 Interior/Exterior CMU Walls:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 3	Acrylic Block Filler	1 coat
	Epoxy	2 coats, 320 SFPGPC

3.8 FIELD QUALITY CONTROL

A. Application Equipment:

1. The Contractor's equipment shall be designed for application of materials specified and shall be maintained in good working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. Blotter test shall be accomplished at each start-up period and as deemed necessary by the Engineer. Contractor's equipment shall be subject to approval of the Engineer. This approval does not relieve the Contractor's responsibility for the safe operation of the equipment or its performance.

2. Cleanliness of compressed air supply shall be verified daily, and as deemed necessary by Engineer, by directing a stream of air, without abrasive, from the blast nozzle onto a white blotter or cloth for 20 seconds. If oil or water appears on the blotter or cloth, all traps and separators shall be blown down until 2 subsequent 20-second tests show no further oil or water.

B. Thickness Testing:

1. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct thickness in mils. Do not make measurement before a minimum of 8 hours after application of coating.

2. Structural members, piping and other irregular surfaces shall be tested with frequency and locations as directed by the Engineer.

C. Holiday Testing:

1. Coating integrity of ALL interior coated surfaces shall be tested with an approved inspection device. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

2. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.

3. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface, and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.

3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.

2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.

3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

4. After repaired and recoated areas have dried sufficiently, retest each repaired area.

3.9 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.10 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Paint System Data Sheet (PSDS)

2. Paint Product Data Sheet (PPDS)

END OF SECTION

PAINT SYSTEM DATA SHEET (PSDS)

Complete this PSDS for each coating system include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.): _____

Paint System Title (from Spec.): _____

Coating Supplier: _____

Representative: _____

Surface Preparation: _____

Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

PAINT PRODUCT DATA SHEET (PPDS)

Complete and attach manufacturer's Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	73/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendation for the following:

Mixing Ratio:_____

Maximum Permissible Thinning:_____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

Heating, Ventilation, and Air Conditioning

23

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SECTION 23 31 00

EXHAUST FANS AND LOUVERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall mount exhaust fans, dampers, and louvers for ventilating the pump stations. Provide appropriate wall penetrations, flashing, and sealant for a watertight penetration. Provide exhaust fans, insect screen, dampers, and louvers. Provide rain and insect proof door grilles for pump station doors. Provide all necessary controls, electrical connections/hookup, fittings, and appurtenances to complete installation of exhaust system.

B. Related Sections:

1. Section 04 22 00: Concrete Masonry

2. Section 26 00 00: Electrical

1.2 SUBMITTALS

A. Shop Drawings: Not Required

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations

2. Storage and handling requirements and recommendations

3. Installation instructions

C. Operation and Maintenance Data: Required

D. Manufacturer's Certificate:

1. Certify that products meet or exceed specified requirements.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the wall opening requirements of this section with the installation of concrete masonry; sequence work so that installation of louvers coincides with installation of exhaust fan materials without causing delay to the Work.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years' experience manufacturing similar equipment

B. Installer Qualifications: Minimum 2 years' experience installing similar equipment

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.7 WARRANTY

A. Provide manufacturer's standard one-year limited warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Required

PART 2 PRODUCTS– NOT USED

2.1 EXHAUST FANS

A. Wall-Mount Exhaust Fan:

1. Manufacturers:

a. Greenheck, Model SE1-12-432-A4X-QD as a basis of design

b. Or approved equal

2. Electrical Ratings:

a. 1/4 HP

b. 120V, 1 Ph, 60 Hz

3. Fan:

a. 12-inch

b. Direct Drive

c. Aluminum propellers

d. Galvanized steel frame

e. Designed for continuous operation

4. Accessories:

a. Wall housing, damper, and 45-degree Exhaust Weatherhood

b. Provide speed (30% turndown) and cooling-style thermostat controls by exhaust fan manufacturer. Basis of Design: Greenheck Vari-Green Temp Control. Fan shall turn on/off when space temperature is above 90F. Coordinate location and controls with electrical plans.

2.2 GABLE LOUVERS

A. Manufacturers:

1. Greenheck Model ESD-435 as a basis of design

2. Or approved equal

B. Construction: all aluminum construction, including frame, blades, and bird screen, 6063-T5

C. Frame: 4-inch deep channel

D. Blades: 0081-inch nominal wall thickness positioned at a 37.5-degree angle, with integral front drain gutter, spaced 3 inches to 4-inches on center

E. Mullions: Architecturally styled and hidden

F. Size: 18 inches x 18 inches

G. Anchors and Fasteners: Stainless Steel

H. Flashings: match frame

I. Finish: Mill

J. Accessories

1. Bird Screens:

a. Aluminum: ½-inch mesh

b. Frame: Aluminum

c. Mounting: inside

2.3 DOOR LOUVERS

A. Manufacturers:

1. Anemostat SRDL as a basis of design

2. Or approved equal

B. Construction: all aluminum construction, including frame, blades, and insect screen; 0.063-inch nominal wall thickness

C. Size: 18 inches x 18 inches for 1¾-inch thick steel door

D. Performance:

1. 300 cfm at no more than 400 fpm
2. Stormproof design

E. Finish:

1. Apply alkyd prime coat following chemical cleaning and pretreatment
2. Primer preparation for field painting
3. Field apply final coating coordinated with doors, color by owner

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify engineer of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction. Test for proper operation and adjust until satisfactory results are obtained.

B. Do not operate fans until bearings are lubricated, and fan has been test-run under observation.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before substantial completion.

END OF SECTION

SECTION 23 81 26

SPLIT SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.1 SUMMARY

A. Section contains split system air conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Equipment is to maintain adequate interior air temperature for pump station mechanical and electrical system operation.

1.2 RELATED WORK

A. Section 01 70 00—Execution and Closeout Requirements

B. Section 01 78 23—Operations and Maintenance Data

C. Section 03 30 00—Cast In Place Concrete

D. Section 26 00 00—Electrical

1.3 SUBMITTALS

A. Refer to Section 01 33 00—Submittal Procedures for Submittal Requirements

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

C. Show Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

D. Operations and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

E. Warranty

F. Startup Reports

G. Maintenance Materials: Filters: One extra set for each air-handling unit.

1.4 STANDARDS

A. EPA Clean Air Act

B. 2022 California Energy Commission Building Energy Efficiency Standards

C. Air Conditioning, Heating, and Refrigeration Institute (AHRI)

1. AHRI 1230

D. ASHRAE: Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases or provide post-installed anchors. Concrete, reinforcement, and formwork are specified in "Section 03 30 00 Cast-in-Place Concrete."

B. Coordinate wall unit placement and anchorage with affected trades. Provide core drilled penetrations in concrete masonry unit wall and coordinate to clear reinforcement.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: Five year(s) from date of Substantial Completion.
      b. For Parts: One year(s) from date of Substantial Completion.
      c. For Labor: One year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL

A. Manufacturers:
   1. LG
   2. Mitsubishi
   3. Or approved equal

B. Basis of Design: LG Single Zone HSV5 Series

C. Split system shall be factory fabricated matching indoor and outdoor units.

D. Units shall be single zone, high efficiency

E. Split system shall meet the following requirements:
   1. Minimum Cooling Capacity: 18,000 Btu/hr (British thermal units per hour)
   2. Minimum SEER: 13 (AHRI 1230)
   3. Power Supply: 220V 60 Hz 1-Phase. Indoor unit powered by outdoor unit.
   4. Refrigerant System:
      a. R410A refrigerant.
      b. Outdoor unit with factory installed components, including a refrigerant strainer, four-way reversing valve, electronic controlled expansion valve (EEV), high and low side charging ports, service valves, and interconnecting piping.
   5. Field Piping:
      a. Provide outdoor to indoor unit piping (vapor, liquid, drain) and wiring (power and signal). Coordinate piping sizing with manufacturer's published instructions.

6. Outdoor unit must operate when exposed to temperature listed below.
   a. Cooling: 111 degrees Fahrenheit ambient air

F. Equipment and refrigerant must comply with applicable EPA and California Building Energy Efficiency Standards.

G. Accessories:
   1. Provide insulated line set cover.
   2. Provide hardwired controller at man door and route control wires per electrical plans.
   3. Filter shall be provided by manufacturer.
   4. Drain pan shall be factory insulated galvanized steel.

PART 3 EXECUTION

3.1 STORAGE

A. Units shall be stored on wooden pallets or rails prior to installation. Units shall be covered with polyethylene (or similar), taped in place.

3.2 INSTALLATION

A. Units shall be installed at the locations shown on the Drawings. Notify Engineer immediately if conflicts exist.

B. Install units according to manufacturer’s published installation instructions and manuals.

C. The drawings show a general intent of connections. The contractor is responsible for a complete system installed in compliance with the manufacturer’s published installation instructions and manuals.

D. Install wall units using manufacturer's standard mounting devices securely fastened to building structure. Provide anchorage to block wall per manufacturer instructions.

E. Outdoor units shall be mounted and anchored in accordance with manufacturer recommendations unless otherwise specified in the Drawings.

F. Provide condensate drain and route to disperse condensate away from structure.

3.3 STARTING AND TESTING

A. Complete installation and startup checks according to manufacturer’s written instructions.

B. Perform equipment startup and testing in accordance with "Section 01 70 00 Execution and Closeout Requirements."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Remove and replace malfunctioning units if needed and retest as specified above.

C. Prepare test and inspection reports.

3.5 OPERATION

A. The equipment shall not be operated during construction and shall be tested only after all major dust-generating activities at the pump station interior or exterior are completed.

END OF SECTION

Electrical 26

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SECTION 26 00 00

ELECTRICAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Install, ready for use, the electrical system as specified herein and shown on the Contract drawings. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as necessary to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, test equipment, incidentals and services to provide a complete and operational electrical system as shown on the Contract "E"-series Drawings, included in these Specifications, or necessary for fully operating facility.

C. Examine the specification and Drawings for mechanical equipment and provide all starters, circuit breakers, switches, pushbuttons and appurtenances which are not specified to be with the mechanical equipment. Erect all electrical equipment not definitely stated to be erected by others, furnish and install conduit, wire and cable and make connections required to place all equipment in complete operation. Use Device Indexes and Contract Drawings typical installation details for mounting detail requirements to be provided for equipment listed.

D. The major areas in the scope of work shown on E-series Contract drawings and as designated on the Division 26 and 40 Index Spreadsheet which includes both the furnishing and installation are:

1. Alderpoint Booster Pump Station
    a. New electrical service, automatic transfer switch, Motor Control Center, panelboard RTU Control Panel.
    b. Programmable Logic Controller hardware for monitoring the motors, and other miscellaneous device.
    c. Reuse existing I/O radio and antenna to communicate to Robertson Repeater.
    d. Autodialer.
    e. Stationary generator.
2. Alderpoint Tank
    a. Replace existing I/O radio.

3. Tobin Well
    a. Manual transfer switch.
    b. Portable generator.
4. Wallan Road Tank
    a. New solar panels, batteries, antenna system and I/O radio. Solar power system to be sized for 10 days continued used without sun.
5. Wallan Road Pump Station
    a. Motor Control Pedestal, panelboard and RTU Control Panel.
    b. New I/O Repeater Radio and antenna to communicate with Wallan Road Tank.
    c. Autodialer.
    d. Generator Receptacle
6. Robertson Repeater
    a. New solar panels, batteries, antenna system and I/O repeater radio. Solar power system to be sized for 10 days continued used without sun.
7. Programming for new PLCs, and Operator interfaces shall be by Contractor.
8. Modifications to existing PLCs, and OI shall be by Contractor.
9. Radio system and communications commissioning.
10. Instruments and devices supplied under Section 40 70 00 Instrumentation for Process Systems.
11. Conduits, grounding system and the field interconnection wiring between the instruments, field devices, electrical enclosures, etc. as shown on plans.
12. All necessary miscellaneous shut off, sample and calibration valves to sensors.
13. Trenching, backfilling, compaction and resurfacing for all underground conduit routes, concrete pads and pull boxes.
14. Provide all necessary hardware, fittings, and devices to connect the designated equipment and wiring.
15. Transformer pad, primary and secondary conduits & wire, bollards, pull boxes, etc. per PG&E Engineered Drawings for the new utility power service at multiple sites. All work associated with power Utility Service not performed by Utility Company.
16. Equipment for the new utility power services.
17. Site electrical devices, lights and receptacles.
18. Installation, mounting supports, interconnection drawings, wiring, start-up, testing and warranty for all equipment and systems.
19. SCADA graphic screen & Autodialer configuration and modifications to existing system.

E. It is the Contractor's responsibility for obtaining PLC, and OI configuration software, manuals and disks necessary for the Contractor to program and configure the PLC, and OI.

F. No items for panels or MCCs shall be shipped loose for later field installation in MCC, control panel, enclosures, etc. without prior written approval of the Owner. Incomplete panels or MCC arriving at the jobsite shall be returned by the Contractor to the shop to complete fabrication at no additional cost to the Owner when directed by the Owner

G. The following specifications incorporate specific equipment and devices that are preferred by the Owner because of their serviceability, because of the local availability of labor, parts and materials, or because of the ability of the Owner to umbrella the equipment under existing maintenance contracts; however, favorable alternatives proposed in writing during the submittal process will be reviewed by the Owner as whether it is acceptable as an approved equal.

H. All electrical equipment and materials, including installation and testing, shall conform to the applicable codes and standards listed in this and other Sections. All electrical work shall conform with the National Electrical Code (NEC) 2020 issue, and the California Electric Code (2019 issue). The project shall be built per Sonoma Water standards. Nothing on the Drawings or in the Specifications shall be construed to permit work or materials not conforming to these codes and standards.

I. Contractor should notify their Electrical Contractor to attend the pre-bid job walk and it is highly recommended Electrical Contractor shall have accomplished the following:

1. Thoroughly examine existing conditions before submitting his bid proposal to perform any work. He shall compare site conditions with data given on the plans or in these Specifications. No allowance shall be made for any additional costs incurred by the Electrical Contractor due to his failure to have examined the site or to have failed to report any discrepancies to the Owner prior to bid.
2. Verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work shown on the Drawings and measurements at the site.

J. It is the Contractor's responsibility to be fully familiar with the existing conditions and local requirements and regulations. New MCCs may be installed in areas with limited space. MCC and other equipment footprints were developed based on best available information. Contractor shall be responsible for any additional conduits, wires, construction costs, engineering design requirements, etc. to accommodate MCCs that are larger than that shown on Contract Documents.

K. Any major deviations in location and conduit routing that the Contractor makes without the express written review or direction of the Owner, shall be considered to have been made at the Contractor's sole responsibility. Such deviations made by the Contractor shall be reflected on the Contractor supplied "Record Drawings" and

"Conduit and Wire Routing Schedule". The Owner will deduct an amount equal of reimbursement from the Contractor's contract for all engineering, drafting, and clerical expenses associated with updating the Record Drawings and Conduit and Wire Routing Schedule due to any major unauthorized changes.

L. The term "Owner" in Division 26 and 40 is the Garberville Sanitary District. When "Contractor" is listed in these documents, it is to mean the "Prime or General Contractor."

1.2 CODES AND STANDARDS

A. All electrical/instrumentation equipment and materials, including installation and testing, shall conform to the following applicable codes and standards:

1. ANSI American National Standards Institute, Inc.
2. CEC California Electrical Code, 2019 Edition
3. EIA Electronics Industries Association.
4. ETL Electrical Testing Laboratories.
5. FM Factory Mutual.
6. GO128 General Order No. 128, Rules for Construction of Underground Electrical Supply and Communication Systems, Public Utilities Commission of the State of California.
7. IEEE Institute of Electrical and Electronics Engineers.
8. ICEA Insulated Power Cable Engineers' Association.
9. ISA International Society of Automation (ISA) Standards (formerly Instrument Society of America)
10. NEC National Electrical Code, 2020 Edition.
11. NEMA National Electrical Manufacturers Association.
12. NETA Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, International Electrical Testing Association.
13. NESC National Electrical Safety Code.
14. NFPA National Fire Protection Agency.
15. OSHA Occupational Safety and Health Act Standards.
16. UL Underwriter's Laboratories, Inc.

B. The revisions of these codes and standards in effect on the date of issuance of the Contract Documents shall apply.

C. Codes and standards referenced shall be considered minimum acceptable work.

D. In instances where two or more codes are at variance, the most restrictive requirements shall apply.

E. Nothing on the Drawings or in the Specifications shall be construed to permit work or materials not conforming to the preceding codes and standards.

F. All work shall also be performed in accordance with the City, State, County or Owner standards, and local Utility codes.

G. Furnish, without extra charge any additional material and labor which may be required for compliance with these codes and standards, even though the work is not explicitly mentioned in the Specifications or shown on the Contract E- Series Drawings.

H. Amperage listed on the single-line drawings for motors are per NEC Table 430.250 and may not necessarily match that of the equipment supplied. It is the electrical system supplier and Contractor's responsibility to furnish equipment sized for the motors supplied for this project at no additional cost.

I. All electrical work shall conform with the National Electric Code (NEC) 2020 issue and the latest NFPA 70E. Nothing on the Drawings or in the Specifications shall be construed to permit work or materials not conforming to these codes and standards.

1.3 RELATED WORK IN OTHER SECTIONS

A. The following are covered in other sections in the Contract documents and are part of Division 16 and 40.

1. Section 26 05 19 – Low Voltage Electrical Power Conductors & Cables.
2. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
3. Section 26 05 73 – Power System Studies.
4. Section 26 21 00 – Low Voltage Electrical Service Entrance.
5. Section 26 24 16 - Panelboard.
6. Section 26 24 19 – Motor Control Center.
7. Section 26 32 13.13 – Diesel Engine Drive Generator Set.
8. Section 26 36 23 - Automatic Transfer Switch.
9. Section 40 68 00 – Process Control Software.
10. Section 40 70 00 – Instrumentation for Process Systems.
11. Section 40 97 00 – Variable Frequency Drive

B. The contents of this section apply to all "electrical and instrumentation" equipment suppliers and manufacturers doing work listed in following sections:

1. Division 01 33 00 – Submittals
2. Division 11 - Equipment.

3. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment.

4. Division 44 – Pollution and Waste Control Equipment

5. Division 46 – Water and Wastewater Equipment.

1.4 ELECTRICAL CONTRACTOR QUALIFICATIONS

A. It is the intent of this Division that the complete responsibility for management and installation of the electrical and instrumentation required for this project be by the Electrical Subcontractor. This responsibility includes, but not limited to, supervision and coordination of work performed by all suppliers of Division 16 and 40.

B. Uncertified electricians shall not perform electrical work for which certification is required per Labor Code Section 3099. Electricians shall be required to carry proof of certification on their person at all times. Electricians found on the jobsite without proof of certification will be asked to leave, prohibited from working on-site until proof of certification has been provided and may be reported to the Contractors State License Board (CSLB).

C. The Electrical Subcontractor shall meet the following minimum qualifications:

1. Has a current C-10 Electrical Subcontractor's License.

2. Has regularly engaged in similar electrical contracting for the Municipal Water and Wastewater Industry.

3. Has successfully performed work of similar or greater complexity on at least two previous projects under one company name and under the present company name.

4. Has all persons performing work as electricians certified by the California Apprenticeship Council per California Labor Code Section 3099.

5. Has been actively engaged in the type of electrical and instrumentation work specified in this Division for a minimum of two years.

1.5 SYSTEM SUPPLIER QUALIFICATIONS

A. General

1. It is the intent of this Division that complete responsibility in the supplying of the MCC/PLC, PLC programming and all instrumentation listed for Division 26 and 40 in Section 40 70 00 Appendix "A" Device Index and other equipment required for this project be supplied by one System Supplier. This responsibility includes, but not limited to, all work necessary to select, furnish, program, supervise installation, calibrate, and place into operation all transmitters, instruments, controllers, alarm equipment, monitoring equipment, and accessories as specified herein.

2. The system supplier shall have an on staff project engineer with prior experience on similar sized projects. This project shall coordinate the technical

aspects of this project and prepare the submittals and drawings. This project engineer's name, address and phone number shall be provided within the first week after notice to proceed. The system supplier project engineer shall attend all coordination meetings and be on-site when requested by the Owner.

B. Pre-Qualified System Suppliers

1. The Suppliers listed below have been determined to meet minimum qualifications specified in this Division and are pre-qualified by the Owner for providing supplier bids as system suppliers on the project.

   a. Tesco (phone 916 395-8800).

   b. Primex Controls (phone 707 449-0341)

   c. Control Systems West (phone 707 763-1108)

   d. Technical Services, Inc. (TSI) (phone 530 710-3325)

C. Non Pre-Qualified Suppliers

1. System Suppliers not pre-qualified by the Owner shall submit the information listed herein 14 calendar days prior to bid, and if approved by the Owner, will be listed in a Contract addendum prior to bid opening.

2. Each System Supplier <u>not</u> pre-qualified shall submit they meet the following minimum qualifications:

   a. Has regularly engaged in similar instrumentation systems for the Municipal Water and Wastewater Industry.

   b. Has successfully performed work of similar or greater complexity on at least five previous projects under one company name and under the present company name.

   c. Has been actively engaged in the type of PLCs and instrumentation work specified in this Division for a minimum of five years.

   d. Employs personnel on this project who have successfully completed ISA or equal training courses on general purpose instrumentation.

   e. Has a permanent, fully staffed and equipped service facility within 150 miles of the project site for a minimum of 1 year prior to bid date. Service facility shall be under same company name as System Supplier and same company shall be staffed with personnel and equipment required to maintain, repair and calibrate the instrumentation system. Subletting warranty to third party is not acceptable.

3. Non-pre-qualified System Suppliers shall submit detailed information of the following to the Owner for determination of pre-qualification:

   a. Company history.

   b. List of five (5) completed projects of similar size and nature.

      1) Provide completion dates of projects.

      2) References of Owner Representative in charge of project, including contact name and telephone number.

c. List of projects in progress.

1) Description of scope of projects.

2) Dollar amount of projects.

d. Complete 2023 Year End Financial statement prepared by a Certified Accountant or complete 2023 Company Tax Returns listing assets and liabilities.

4. Additional information for clarification as requested by the Owner in writing shall be provided by the System Supplier asking for the pre-qualification or pre-qualification will automatically be denied.

5. System Supplier providing financial statements lacking detail or stating that detailed financial records are proprietary will be disqualified as a pre-qualified System Supplier and is grounds alone for disqualification.

6. Any pre-qualification package deemed incomplete or lacking sufficient information to determine pre-qualification will result in System Supplier not being pre-qualified. No reason will be released on why a System Supplier was not pre-qualified.

D. No reason will be released on why a System Supplier was not prequalified.

1.6 CONTRACT DOCUMENTS

A. The Contract drawings and specifications are intended to be descriptive of the type of electrical system to be provided; any error or omissions of detail in either shall not relieve the Contractor from the obligations thereunder to install in correct detail any and all materials necessary for a complete operational system, at no additional cost.

B. The Contract drawings are generally diagrammatic; exact locations of electrical products shall be verified in the field with the Owner. Except where special details on drawings are used to illustrate the method of installation of a particular piece or type of equipment or materials, the more restrictive of the two shall take precedence in the event of conflict.

C. Conflicts between the Contract drawings and the specifications shall be brought to the attention of the Engineer.

D. The Contract Electrical elementary, elevation and one-line diagrams are the basis of the electrical system to be provided and are for reference only. It is the Contractor's responsibility to adjust and make minor revisions to the diagrams as necessary for operational system at no additional cost to the Owner. Additional isolators, relays, wiring, terminal blocks, etc., shall be provided for an operation system at no additional cost to the Owner.

E. Location at facilities of new equipment, inserts, anchors, panels, pull boxes, conduits, stub-ups, and fittings for the electrical system are to be determined by the Contractor and Owner at time of installation. Contractor shall make minor adjustments to locations of electrical equipment required by existing conditions and coordination with other trades at no additional cost. Minor adjustments are defined as those

adjustments required due to equipment size changes or variations between different equipment suppliers.

F. The Conduit and Wire Routing Schedule, wire fill, and number of conduits are based on the best information available.

1. It is the Contractor's responsibility to modify the conduit schedule based upon Shop Drawings for the actual equipment. Such modifications in conduit sizes and numbers of conductors shall be at no additional cost to the Owner and shall be approved by Owner, if such changes are the direct result of the equipment selected by the Contractor.

2. A copy of the Conduit Schedule and Electrical plans showing conduit routing shall be updated weekly by the Contractor. Progress payments will be withheld if during monthly checks it is found that the contractor fails to maintain the Conduit Schedule updates.

G. Electrical & instrumentation, conduit & wire lengths shown on circuit Drawings are approximate. The Contractor is responsible for determining actual lengths for bidding and installation purposes. Contractor is to be made aware that equipment may be installed on elevated platforms and manufacturer's cable length depends on conduit routing.

H. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. The Owner reserves the right to require minor changes in location of equipment, without incurring any additional costs. These minor changes are changes which would provide adequate clearance and work areas in front of and around equipment.

I. Provide means to furnish equipment and accessories, do the installation, complete connections, submit documentation, perform start-up, and be responsible for the warranty.

J. Where conduits are shown as "home runs" on the Contract drawings or stated to be furnished, but not explicitly shown, as part of the scope of work; provide all fittings, boxes, wiring, etc. as required for completion of the raceway system in compliance with the NEC and the applicable specifications in this Section.

K. No changes from the Contract drawings or specifications shall be made without written approval of the Owner. Should there be a need to deviate from the Contract documents, submit written details and reasons for all changes to the Owner for review within 30 days after the award of the contract.

L. When existing conduits are to be used, it is the Contractor's responsibility to verify conduit size and routing. This includes all potholing or other location methods. Existing conductors and conduits damaged by Contractor during construction shall be repaired or replaced at no cost to Owner.

M. The resolution of conflicting interpretation of the Contract documents shall be as determined by the Owner.

N. Maintain a separate set of neatly and accurately marked set of Record Documents, consisting of spreadsheets, specifications and full size blue-line Electrical (E-Series) and Instrumentation (I-Series) Contract Drawings.

1. These documents are to be used specifically for recording the as built locations and layout of all electrical and instrumentation equipment, routing of raceways, junction and pull boxes, and other diagram or document changes.

2. These Record documents shall be kept up-to-date during the progress of the job, with all "change orders", submittal modifications, and construction changes shown and stamped with “As-Built” at end of job.

3. These Record documents shall not be used for daily construction use and shall not contain any mark-ups that are unrelated to as-built corrections.

4. The following lists the record documents shall be as-built by Contractor:

    a. E-Series Drawings.

    b. Panelboard schedules.

    c. Conduit and Wire Routing Schedule.

        1) A copy of the Conduit and Wire Routing Schedule and Electrical plans showing conduit routing shall be updated weekly by the Contractor. Progress payments will be withheld if during monthly checks it is found that the contractor fails to maintain the Conduit Schedule updates.

    d. Lighting Schedule.

    e. Duct banks and their routing with offset measurement and indicate changes in depth. Duct bank elevations shall not be drawn or penciled in by hand. Provide CAD drawings of duct banks.

5. The following lists the record documents that shall be as-built by System Supplier to be maintained by Contractor:

    a. I-Series Drawings.

    b. Instrumentation Index.

6. Record documents shall be kept current weekly with all "change orders", submittal modifications, and construction changes shown. Record Documents shall be subject to the inspection by the Owner at all times, progress payments or portions thereof may be withheld if Record Documents are not accurate or current.

7. When documents are changed, they shall be marked with erasable colored pencils using the following coloring scheme:

    a. Additions - red

    b. Deletions - green

    c. Comments - blue

    d. Dimensions - black

8. Show the following on the Electrical (E-Series) Record Contract Drawings by dimension from readily obtained base lines:

   a. Exact location, type and function of electrical and instrumentation equipment and devices.

   b. Precise routing and locations of underground conduits, pullboxes, junction boxes, etc. that make-up the raceway system.

   c. Show the dimensions, location and routing of electrical work which will become permanently concealed.

   d. Show complete routing and sizing of any significant revisions to the systems shown.

9. Prior to acceptance of the work, deliver to the Owner one set of record full size drawings neatly marked accurately showing the information required above.

1.7 COORDINATION

A. Coordinate the electrical work with the other trades, code authorities, utilities, and the Owner; with due regard to their work, towards promotion of a rapid completion of the project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provisions, then the Contractor shall bear expense of such changes as necessary to be made in work of others.

B. Examine the architectural, mechanical, structural, electrical and instrumentation equipment provided under other Sections of this Contract in order to determine the exact routing and final terminations for all conduits and cables. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences, and the physical location of wire terminations on equipment. Conduits shall be stubbed up as near as possible to equipment terminals.

C. Manufacturer's directions and instructions shall be followed in all cases where such is not shown on the Contract Drawings or herein specified or have stipulations in order to meet warranty requirements.

D. The electrical and instrumentation modifications and additions are to be made at facilities that need to remain powered at all times. Schedule all the required work with the Owner, including each shutdown period. Each shutdown shall be implemented to minimize disruption of the existing operations. Shutdowns may be required outside of normal working hours when necessary. The work to be provided under this Contract shall not disrupt any of the existing operations without prior approval.

   1. Limit all scheduled shutdown periods to less than 2 hours (120 minutes) and only with prior approval of the Owner.

   2. Carry out scheduled shut downs only after the time, date, and sequence of work proposed to be accomplished during shutdown has been favorably reviewed by the Owner. Submit shutdown schedule and plans at least 10 working days in advance of when the scheduled shutdown is to occur.

   3. Make provisions for portable generators and automatic transfer switches when facilities will be without power.

4. The Owner reserves the right to delay, change, or modify any shutdown at any time, at no additional cost to the Owner, when the risk of such a shutdown would jeopardize the operation of system.

E. Cease work at any particular point, temporarily, and transfer operations to such portions of work as directed, when in the judgment of the Owner it is necessary to do so.

F. Prior to commencing construction, the Electrical Subcontractor shall arrange a conference with the General Contractor, System Supplier and Owner as well as equipment suppliers, and shall verify types, sizes, locations, requirement, controls and diagrams of all equipment furnished by these Contractors. He shall, in writing, inform the Owner that all phases of coordination of this equipment have been covered and if there are any unusual conditions, they shall be enumerated at this time.

G. It is the responsibility of the Contractor to make all equipment approval arrangements and scheduling with the power utility company connected with this project. Schedule within 30 days after award of contract all service installations and connections with the power and telephone utility. Lack of effort by the Contractor to properly schedule Utility service will not be considered valid justification for delays in project completion and no extension in contract time will be given.

H. The Contractor shall be responsible for coordinating PLC design review meetings specified herein.

I. Coordinate with Owner, PLC programmer, SCADA programmer, witnessing Engineer and System Supplier to test the entire system.

J. The Contractor shall be responsible for coordinating PLC/OI design review meetings specified in Section 40 70 00.

K. Coordinate with Owner, witnessing Engineer and System Supplier to test the entire system.

L. Schedule within 20 days after award of Contract all service installations and connections with utilities. Delays due to lack of effort by the Contractor which delay the project completion for lack of utility services will not be considered valid and Contract liquidated damages will be assessed.

M. Coordinate submittals and required meetings with the work, panel fabrication and factor tests so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals.

1.8 SUPERVISION

A. Schedule all activities, manage all technical aspects of the project, coordinate submittals and drawings, and attend all project meetings associated with this Section.

B. The Contractor shall supervise all work in this Section, including the electrical system general construction work, from the beginning to completion and final acceptance.

C. The Contractor shall supervise and coordinate all work in this Section to insure each phase of the project, submittal, delivery, installation, and acceptance testing, etc. is completed within the allowable scheduled time frames.

D. The Contractor shall be responsible for obtaining, preparing, completing, and furnishing all paper work for this Section; which shall include transmittals, submittals, forms, documents, manuals, instructions, and procedures.

1.9 INSPECTIONS

A. All work or materials covered by the Contract documents shall be subject to inspection at any and all times by the Owner. If any material does not conform to the Contract documents, or does not have a favorably reviewed submittal status; then the Contractor shall, within three days after being notified by the Owner, remove said material from the premises; and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by the Contractor.

B. Give the Owner 10 working days' notice of the dates and time for inspection. Date of inspection shall be as agreed upon by both the Contractor and Owner.

C. Work shall not be closed in or covered over before inspection and approval by the Owner. All costs associated with uncovering and making repairs where non-inspected work has been performed shall be borne by the Contractor.

D. Cooperate with the Owner and provide assistance at all times for the inspection of the electrical system under this Contract. Remove covers, provide access, operate equipment, and perform other reasonable work which, in the opinion of the Owner, will be necessary to determine the quality and adequacy of the work.

E. Before request for final inspection is made, submit to the Owner in writing, a statement that the Contractor has made his own thorough inspection of the entire project enumerating punch list items not complete and that the installation and testing is complete and in conformance with the requirements of this Division.

F. The Owner may arrange for a facility inspection by Cal-OSHA Consultation Service at any time. Make the necessary corrections to bring all work in conformance with Cal-OSHA requirements, all at no additional cost to the Owner.

G. Contractor will be Responsible for any Additional Cost for Overtime, Weekend Overtime or Differential Time, Expenses for Inspection of Defective Work that has to be re-inspected.

1.10 JOB CONDITIONS

A. Make all arrangements and pay the costs thereof for temporary services required during construction of the project, such as temporary electrical power and telephone service. Upon completion of the project, remove all temporary services, equipment, material and wiring from the site as the property of the Contractor.

B. Provide adequate protection for all equipment and materials during shipment, storage and construction. Equipment and materials shall be completely covered with two layers of plastic and set on cribbing six inches above grade so that they are protected from weather, wind, dust, water, or construction operations. Equipment shall not be stored outdoors without the approval of the Owner. Where equipment is stored or installed in moist areas, such as unheated buildings, etc., provide an acceptable means to prevent moisture damage, such as a uniformly distributed heat source to prevent condensation.

C. The elevation of the project site is shown on Contract Civil Drawings. All equipment shall be derated, as recommended by the manufacturer or in accordance with ANSI C37.30.

D. The normal outdoor, not in direct sunlight, ambient temperature range of the job site will vary between 20 to 110 degrees Fahrenheit. All equipment shall be rated to operate in these temperature ranges or provisions for adequate heating and cooling shall be installed, at no additional cost to Owner.

E. The jobsite is prone to vandalism and theft. Contractor shall be responsible for securing all materials and equipment against theft and vandalism for the duration of the project.

F. Contractor shall utilize temporary services during construction of the project. No Contractors shall utilize building power, receptacles, etc. during construction.

1.11 SUBMITTAL AND DRAWING REQUIREMENTS

A. General

1. Electrical submittals shall be submitted for favorable review by the Owner per this subsection and Division 1. They shall be complete giving all details of connections, wiring, instruments, enclosures, materials and dimensions. Standard sales literature will not be acceptable.

2. A copy of the appropriate Division Specification Sections, with addendum updates included and with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore, requested by the Contractor, each deviation shall be underlined and denoted by a unique number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications. The submittal

shall be accompanied by a detailed, written justification for each numbered item explaining variance or non-compliance with specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no review.

3. Submittals shall also include all other information as may reasonably be required, in the opinion of the Owner, to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the Contract Documents. Additional submittal requirements are specified in each individual Section of the Specifications.

4. Coordinate submittals with the work so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals.

5. No material or equipment shall be allowed at the job site until the submittal for such items has been reviewed by the Owner and marked “No Exceptions Taken” or “Make Corrections Noted.”

6. The equipment specifications have been prepared on the basis of the equipment first named in the Specifications. Note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required to meet Specifications all at no additional cost to the Owner.

7. The decision of the Owner governs what is acceptable as a substitution. If the Owner considers it necessary, tests to determine equality of the proposed substitution shall be made, at the Contractor's expense, by an unbiased laboratory that is satisfactory to the Owner.

8. No submittal documents shall be labeled as proprietary. Labeling documents as proprietary will be sufficient cause for rejection of entire submittal. The Owner reserves the right to copy or duplicate any and all portions of the documents provided for the project including copyrighted documents as desired.

9. Approval of submittals shall not relieve Contractor of their obligation to perform the work in strict accordance with this Contract and the Contract Documents or of their responsibility to provide a complete and reliable system.

10. Identify all submittals by submittal number on letter of transmittal. Submittals shall be numbered consecutively and resubmittals shall have a letter suffix. For example:

    a. 1st submittal: 1.

    b. 1st resubmittal: 1A.

    c. 2nd resubmittal: 1B, etc.

11. Include in writing on a separate submittal cover sheet any proposed departures from the Contract documents, and the reasons therefore. Incorporate no such departures into the work without prior written approval of the Owner. The approval of departures which substantially deviates from the Contract documents shall be evidenced by a "change order" directive by the Owner. Any cost differential associated with this change order must be negotiated with the Owner to amend the Contract to reflect the costs or savings.

12. Exceptions to the Contract specifications or drawings shall be clearly defined by the equipment supplier.

    a. Data shall contain sufficient details so a proper evaluation may be made by the Owner. Provide separate letter (located in the front of the submittal) detailing specific exceptions to the Contract Specifications or Drawings.

    b. Exceptions that are noted in the marked-up Drawings or Specifications, but not listed on the Exceptions/Clarifications letter, will be considered as non-responsive and not accepted as changes to the Contract Documents.

B. The electrical submittals shall include but not be limited to data sheets and drawings for each product together with the technical bulletin or brochure. The electrical submittals shall include:

1. Product (item) name used herein and on the Contract Drawings.

2. The Manufacturer's complete model number or other designation.

3. Tag name/number per the P & ID drawings, schedules and indexes.

4. Index Binder Tab Dividers.

5. Detailed electrical one line, elementary and loop diagrams and interconnection diagrams showing all wiring requirements for each system.

6. Complete documentation with full description of operation.

7. Complete catalog cuts with full description of equipment. General sales literature will not be acceptable. The part or model number with options to be provided shall be clearly identified. Where more than one item or catalog number appears on a catalog cut, the specific item(s) or catalog numbers(s) proposed shall be clearly identified.

8. Location of assembly at which it is installed.

9. Input-output characteristics.

10. Range, size and graduations, as required.

11. Physical size with dimensions and mounting details. System Supplier submit a letter listing all instrumentation pipe sizes, pipe connections, flange types, and ANSI ratings signed by Contractor and System Supplier to certify coordination for proper installation prior to flow elements being purchased.

12. Enclosure size, fabrication details and color.

13. Enclosure backpan layout and elevation drawings to scale.

14. Quantity and quality requirements for electric power, air, and/or water supply.

15. Materials of construction of components.

16. Nameplate schedule.

17. Interconnection diagrams.

18. Failure to provide submittals with heavy duty permanent plastic labeled index tabs may be grounds for immediate rejection without review.

19. Bill of Materials: A complete Bill of Materials list shall be provided similar in format to the Bill of Material shown in Appendix "A". Submit separate Bill of Materials for electrical components and Generator. The System Supplier shall submit a separate Bill of Material for the panels, Switchboard, ATS, Control Panel, spare parts and another listing all field instruments. Generic names or part numbers used by a distributor or Systems House are not acceptable; originating manufacturer's name and part number shall be listed.

20. A separate instrument data sheet shall be provided for each instrument per ISA S20 standards or approved equal. Data sheets shall be printed on blue or pink paper. Provide an index with proper identification and cross-referencing of each data sheet.

21. Submit USB electronic copies of all submitted drawing in AutoCAD format.

22. For each resubmittal, provide a copy of submittal comments and a separate letter, on Company letterhead, identifying how each submittal comment has been addressed in the resubmittal.

23. Electronic PDF version of submittals shall follow hard copy format of submittal and shall be "bookmarked" at each index, subtab, copy of appropriate check marked Specification Section, bill of materials, copy of submittal comments (for resubmittals), cutsheets, Contractor's response to submittal comments (for resubmittals), drawings, etc. Failure to bookmark PDF may be grounds for immediate rejection without review. Bookmarks shall not be out of order; the English description shall match that listed in the Submittal's Table of Contents.

24. Electronic submissions of submittals may be provided for submittals less than 80 pages and without drawings. Submittals equal to or over 80 pages or those that contain drawings shall be provided in a hardcopy format. Drawings shall be printed at 11 inches by 17 inches. Hardcopy submittals shall be provided in binders as specified herein. The Owner reserves the right to reject submittals that fail to be organized as described herein.

C. Drawing Requirements: All drawings shall be drawn using the latest version of AutoCAD, drawn in a professional manner and submitted on 11" x 17" sheets. Shop Drawings shall be provided with minimum drafting details as illustrated on the Contract "electrical" series drawings. Diagrams shall carry a uniform and coordinated set of wire colors, wire numbers, and terminal block numbers. A Drawing Index shall be provided that lists each Drawing title and drawing number. Each Drawing title and

number shall be unique. The index shall not include drawings listed as "This Page Intentionally Left Blank". The shop drawings shall include:

1. Electrical one line diagrams detailing all devices associated with the power distribution system. The following applicable information or data shall be shown on the one-line diagram: location, size and amperage rating of bus; size and amperage rating of wire or cable; breaker ratings, number of poles, and frame sizes; auto-transfer switch; generator and breaker; utility metering, voltage, amperage, number of wires and phases; ground size and connections; neutral size and connections; voltage, amperage and wattage monitoring instruments; power fail and other protective devices; fuse size and type; distribution transformers; panelboards; starters; contactor size and overload range; motor full load amperage of submitted motor and horsepower; rating for miscellaneous loads; etc. Submit of all equipment motor voltage, phase and full load amps provided for this project for verification of accuracy of submitted one line drawings.

2. Elementary diagrams shall be provided for all relay logic, power supplies, PLC and other wiring not shown on the loop diagrams. All elementary diagrams shall be drawn in JIC EMP/EGP format and standards similar to those shown on the E-series elementary diagrams showing ladder rung numbers and coil & contact cross referencing numbers. Show all panel wiring as solid lines and all field wiring as dashed lines.

3. Analog and digital I/O loop diagrams shall be provided showing the wiring requirements for each instrument loop. Graphic symbols shall conform to ISA S5.4 drawing standards. A loop diagram shall be furnished for each analog and digital I/O process and all PLC I/O cards. Loop diagrams shall include the following as a minimum:

    a. The loop diagram shall be drawn with sufficient detail to express control philosophy. The diagram shall show all components and accessories of the instrument loop, highlighting special safety and other requirements. These diagrams shall be arranged to emphasize device elements and their functions as an aid to understanding the operation of a system and for maintaining or troubleshooting that system.

    b. A separate drawing shall be prepared for each analog card. Each card shall be arranged on the diagram in the same order as the physical arrangement of the card terminations. All termination points on the diagram shall be shown with the actual equipment identification, device and relay terminal number or letter, and I/O point P&ID English descriptor and tag name. A separate drawing shall be prepared for each card.

    c. Energy sources - electrical power, air supply, pneumatic and hydraulic fluid supply, designating voltage, current, pressure, etc. shall be shown in detail on the diagram. Input and output signals (e.g., 1-5 VDC, 4-20 mA DC, 3-15 psig, etc.), power and instrument supplies to devices (e.g. 120 VAC, 24 VDC, 80 psig, etc.) shall be shown.

d. Engineering units shall be shown on the diagram. Each wire label and color code shall be shown. Signal and DC polarities shall be shown.

e. All spare wires, cables and termination points shall be shown. All jumpers, grounding, shielding, power supply details shall be shown.

4. Enclosure and Elevation layout diagrams for all electrical panels and enclosures; show all front panel and backpan devices drawn to scale. Show fabrication methods and details; including material of construction, paint color, support & latching mechanisms, fans & ventilation system, and conduit entrance areas.

5. Interconnection Diagrams - An interconnection diagram shall be furnished for each electrical and instrumentation system, even if one was not shown explicitly on the Contract Drawings. Interconnection diagrams shall show for each piece of equipment all wiring between all devices, panels, cabinets, terminal boxes, control equipment, motor control centers and any other devices and equipment even if they are not provided by the System Supplier. Each interconnection diagram shall include the following as a minimum:

   a. Interconnect Drawings shall be prepared for all equipment by the System Supplier. All conduits listed in the Conduit and Wire Routing Schedule shall have interconnection drawings prepared by the System Supplier.

   b. The diagrams shall be utilized by the electrician during all phases of installation and connection of all conductors to ensure coordination of equipment interconnect.

   c. The diagrams shall show wiring as field labeled at the end of the project when as-builts are submitted.

   d. Each wire labeling code as actually installed shall be shown. The wiring labeling code for each end of the same wire must be identical.

   e. All devices and equipment labeling codes shall be shown.

   f. All Interconnection wires listed in the Conduit and Wire Routing Schedule for each conduit shall be shown only on one interconnect drawing. Interconnection diagrams shall be of the continuous line type with identified lines. Diagrams of the wireless or wire schedule type are not acceptable. Bundled wires shall be shown as a single line with the direction of entry/exit of individual wires clearly shown.

   g. All terminations points on the diagram shall be shown with the actual equipment identification terminal number or letter. This identification of terminations includes terminal blocks, junction boxes, all devices, computer I/O points, etc. “??” in lieu of terminal number is unacceptable

   h. Diagrams shall include raceway numbers, raceway size, raceway type, cable numbers, wire color code, and wire numbers. Wire numbers used on interconnection diagrams shall match wire numbers used on other submitted drawings (i.e. elementary diagrams, I/O wiring diagrams, etc.)

i. Each wire, AWG cable size and color code shall be shown. Each conduit with the conduit label and conduit size and wire fill shall be shown. Wire and cable routing through conduits, wireways, manholes, handholes, junction boxes, terminal boxes and other electrical enclosures shall be shown with the appropriate equipment labels. All spare wires, cable, and termination points shall be shown. Cable shields shall be shown.

j. Labeling codes for terminal blocks, terminals, wires, cables, panels, cabinets, instruments, devices, and equipment shall be shown. Place "øA", "øB", and "øC" label next to each breaker to identify phase connected to.

k. Schematic symbols shall be used for field devices, showing electrical contacts. Signal and DC circuit polarities shall be shown.

l. The diagrams shall show all other Contract and supplier drawing numbers, for reference, that are associated with each device that is interconnected.

m. The diagrams shall show all other Contract and Supplier drawing numbers, for reference, that are associated with each device that is interconnected. Attached to each interconnect, a copy of all the support documents used in preparing interconnects shall be submitted. This includes current issues of panel schematics, elementary diagrams, panelboard schedules, conduit schedules, one-line diagrams, connection diagrams, terminal block diagrams, submittals, Contract Drawings, vendor drawings and all other data used to develop the interconnection diagram as noted in the "Reference Documents" corner of interconnect drawings.

n. Interconnects shall include list of all applicable reference drawings, request for clarifications, field instructions and change orders. All deletions and additions of equipment, conduits, wire, and cables shall be clearly shown.

o. Clearly state why termination data is not available. Statements should point to applicable area and be placed in a bold box.

p. Field wiring shall not start before the interconnection drawing have been submitted by the Contractor and approved by the Owner.

q. Do not show the same wires or jumpers, or panel wiring on the elementary or loop and interconnection diagrams. All jumper, shielding, and grounding termination details not shown on the connection diagrams shall be shown on the interconnection diagrams.

r. Interconnection diagrams shall be submitted and approved by Owner for each electrical and instrumentation system. Do not pull in any wires into conduits that do not have approved interconnects. If the Contractor pulls in wire without Owner approval of associated interconnect drawings, the Contractor will not be reimbursed for labor for re-pulling in wires even if there was an error in wire fill or sizing. Also, if the Contractor pulls in wire without Owner approval of associated interconnect drawings, then all progress payments related

to field wiring for that particular area of work will be withheld until approved interconnect drawings are in use.

s. All interconnection diagrams shall be prepared by a System Supplier under the supervision of or by a State of California Registered Electrical Engineer and shall bear that Engineer's professional stamp and signature for all Interconnection Drawings submitted for approval including as-builts and those used in the field installation. . Engineer's stamp missing from interconnection drawings will be sufficient grounds to reject entire interconnection drawing submittal without review.

t. Example format of Interconnection diagram is shown on Contract "E"-series Drawings or may be obtained from the Owner.

u. Interconnect drawings submitted with wiring of a single conduit run separated onto multiple interconnect drawings will be rejected without review. A single conduit run with wiring shown on separate interconnect drawings will be allowed only after written approval is given by the Owner for each conduit run prior to submitting the associated interconnect drawings.

v. Only field wiring between switchboards, MCCs, Panelboards, Control Panels, and other electrical and instrumentation devices or equipment shall be shown on interconnection drawings. No internal panel wiring shall be shown on interconnect drawings except jumper or other wiring to be installed in field by Contractor.

w. Interconnect Drawings along with the corresponding support documents shall be submitted in a separate submittal package. Interconnect drawings submitted with non-interconnect drawing packages will be rejected. The latest support documents shall be obtained by system supplier from Contractor for all non-division 16 and 40 instruments, panels, and equipment, and included with interconnect drawing submittal. Support documents shall have their submittal number marked in upper right hand corner.

x. Interconnect drawings shall be prepared for all equipment by the System Supplier with the exception of the Telephone System and Security Alarm System who shall produce their own interconnect drawings.

y. Provide a notes section on each interconnect drawing. In the note section list any variances from the Contract conduit schedule necessary for completing the interconnections. Change orders regarding wire fill, conduit schedule and errors in plans regarding conduits and wires will not be processed until interconnect drawings have been received for such work.

z. The field electrician shall mark-up all interconnection diagrams during installation to show accurate as-built wiring, conduits runs, terminations, etc. If interconnection drawings are not properly as-built, the Contractor will have cost deducted from the Contract for the Owner to field verify and prepare as-built interconnection drawings

amount. The amount of the deduction shall be determined on a time and material basis. The cost of such work shall be $120.00 per hour plus expenses.

aa. The System Supplier shall be responsible for collecting all information necessary to complete each interconnection drawing at no additional cost to Owner. This includes making field trips to collect all terminal connection data for new and existing, MCCs, switchboards, panelboards, instruments, equipment and electrical panels.

bb. An index of drawings shall be provided with each Interconnection submittal listing the unique drawing number and the description of the interconnect drawing (e.g. Drawing 4321-IC1004 Pump 1004 Interconnect Drawing).

cc. Provide conduit and interconnect drawing cross reference indexes. Interconnect Conduit Index shall list all conduits listed in the Conduit & Wire Routing schedule and its associated Interconnection Drawing number. An Interconnection Drawing Index shall list all Interconnection drawings and the conduits shown on that specific drawing. These two indexes shall be at the front of all interconnection drawing submittals.

6. Submit for approval the proposed OI graphics Screens, and PLC program listing with complete cross-references listing four weeks prior to start of factory test.

7. Submit full size drawing of all nameplates and tags, as specified herein, to be used on project. The Owner has the right to adjust nameplate engraving titles during submittals at no additional cost to the Owner. Submittal to include the following:

   a. Dimensions of nameplate.
   b. Exact lettering and font for each nameplate.
   c. Color of nameplate.
   d. Color of lettering.
   e. Materials of construction.
   f. Method and materials for attachment.
   g. Drawing showing location of nameplate on each panel.

8. Copying contract drawings and providing them as submittals will be considered unresponsive and the submittal will be rejected without review.

D. Submittal Format - Each submittal shall be bound in a three ring binder, which is sized such that when all material is inserted the binder is not over 3/4 full. Binder construction shall allow easy removal of any page without complete manual disassembly; spiral ring type binders are not acceptable.

1. Each binder shall be appropriately labeled on the outside spine & front cover with the project name, contract number, equipment supplier's name, specification section(s), and major material contained therein.

2. Submittals shall be provided in binders as specified herein. The Owner reserves the right to reject submittals that fail to be organized as described herein.

3. An index shall be provided at the inside of the front cover. This index shall itemize the contents of each tab and subtab section. Also list the project name, contract number and equipment supplier's name, address, phone number, and contact person on the index page. A drawing index shall be provided that lists each drawing title and drawing number.

4. All copies shall be clear and legible. Data sheets shall be provided for each instrument, with an index and proper identification and cross-referencing. Clearly identify calibration ranges for all instruments.

5. Exceptions to the Specifications or Drawings shall be provided at the front part of the submittal.

6. Field equipment shop documents, panel equipment shop documents, drawings, and bill of materials shall be grouped under separate tabs. Shop documents shall be ordered in the same sequence as their corresponding Contract specification subsection.

7. Data summary sheets shall be provided to subtab all shop documents for each individual piece of equipment. Data summary sheets shall be bright yellow or blue for easy identification. The data summary sheets shall have the following information preceding their corresponding shop documents:

    a. Product identification; name used herein and on the Contract Drawings.

    b. The manufacturer's model number, part number or other designation. This shall include the specific numbers of all proposed options

    c. Tag name/number per the drawings or schedules.

    d. Location of assembly at which it is installed.

    e. Range, span, engineering units, input and output characteristics.

    f. Contract specification subsection number.

8. Drawings that are "C" or "D" size shall be folded with the title block visible and placed in reinforced clear plastic pockets.

9. Request for information (RFIs) shall not be included in submittals. RFIs supplied with submittals will not be answered. RFIs shall be submitted following proper channels.

10. Resubmittals shall be provided with a copy of the previous submittal comments and a separate letter, on company letterhead, identifying how each submittal comment has been addressed in the resubmittal.

1.12 POWER SERVICES

A. All fees and charges of the Utility power for service hook-up will be paid by the Owner.

B. Provide all the equipment and materials not provided by the power Utility Company for permanent service at the locations shown on the Contract Drawings. All work shall meet the requirements of the serving power Utility companies.

C. Coordinate all work with the serving Power Utility, Pacific Gas and Electric (PG&E) for the new electrical service. Arrange a pre-construction meeting with the PG&E representative prior to start of any Utility related work. All work shall be performed per the PG&E Engineered drawings and requirements at no additional cost to Owner. Obtain the required inspections.

D. Submit to the power Utility the proposed metering details. Provide a written statement from the Utility that shows approval of the proposed metering.

E. All work associated with material and installation for the Utility power service not paid by the Utility shall be borne by the Contractor.

F. All fees and charges of the Utility power for new service hook-up will be paid by the Owner.

G. Submit to the power Utility the proposed meter enclosure, meter socket, and service entrance drawing details. Provide a written statement from the Utility that shows approval of the proposed metering and service entrance drawings.

H. It is the responsibility of the Contractor to make all equipment approval arrangements and scheduling with the power Utility company connected with this project. Schedule within 30 days after award of contract all service installations and connections with the power Utilities. Lack of effort by the Contractor to properly schedule Utility service will not be considered valid justification for delays in project completion and no extension in contract time will be given.

I. The Utility power service representative for project is with the Pacific Gas & Electric (PG&E).

J. Contractor shall be responsible for obtaining Utility Engineered drawings for primary and secondary conduits, transformer pad, bollards, pole risers, pull boxes, vaults, wire size requirements, pull rope requirements, etc. Conflicts between the Contract drawings and the Utility Engineered drawings shall be brought to the attention of the Owner. Contractor shall meet all Utility requirements at no additional cost to the Owner.

K. Field verify the locations for the underground primary and secondary conduit runs, pull boxes, and transformer pad with Utility representative prior to installation.

1.13 CHANGE ORDER PRICING

A. All change order pricing by Contractor shall be broken out into the following minimum categories:

1. Labor per hour listed per discipline, i.e. Engineer, Drafter, Estimator, Programmer, Secretarial, etc.
2. Materials and equipment itemized per component and quantity.
3. Rentals, travel, per diem, etc.
4. Tax.
5. Shipping.
6. Overhead and profit.

B. Lump sum change order pricing is not acceptable.

C. If Contractor refuses to provide a change order with broken out pricing, the Owner reserves the right to obtain independent estimates from other Contractors or System Suppliers. The Contractor or System Supplier who refused to provide the change order with broken out pricing, will be charged for the preparation of the independent estimates.

PART 2 - PRODUCTS

2.1 QUALITY

A. It is the intent of the Contract specifications and drawings to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. Provide the manufacturer's latest design that conforms to these Specifications.

B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed and braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble free service. Light duty, fragile and competitive grade devices of doubtful durability shall not be used.

C. Products that are specified by manufacturer, trade name or catalog number established a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner prior to installation.

D. Underwriters Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

E. When required by the Contract specifications or requested by the Owner, submit equipment or material samples for test or evaluation. The samples shall be furnished with information as to their source and prepared in such quantities and sizes as may be required for proper examination and tests, with all freight and charges prepaid. All samples shall be submitted before shipment of the equipment or material to the job site and in ample time to permit the making of proper tests, analyses, examinations, rejections, and resubmissions before incorporated into the work.

F. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting or operator interaction when power is restored.

G. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, sourced by a 24 VDC loop supply from the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.

H. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission.

I. It is the System Supplier's responsibility to visit jobsite to collect and document existing equipment and MCC device part numbers in order for all similar new equipment to match existing.

2.2 NAMEPLATES & TAGS

A. Equipment exterior nameplates - Nameplate material shall be rigid laminated black phenolic with beveled edges and white lettering; except for caution, warning, and danger nameplates the color shall be red with white lettering. The size of the nameplate shall be as shown on the drawings. No letters are allowed smaller than 3/16". All phenolic nameplates located outdoors shall be UV resistant. Securely fasten nameplates in place using two stainless steel screws if the nameplate is not an integral part of the device. Epoxy cement or glued on nameplates will not be acceptable. Engrave the nameplates with the inscriptions as approved by the Owner in the submittal.

1. For each major piece of electrical equipment provide a manufacturer's nameplate showing the Contract specified name and number designation, the manufacturer's name, model designation, part number, serial number, and pertinent ratings such as voltage, amperage, # of phases, range, calibration, etc.

2. For each device with a specific identity (pushbutton, indicator, instrument, etc.) mounted on the exterior or deadfront of a piece of equipment provide a nameplate with the inscription as shown in the Contract documents. Where

no inscription is indicated in the Contract documents, furnish nameplates with an appropriate inscription providing the name and number of device.

3. For all receptacles and switches, (including devices located on Switchboard or MCC) provide a faceplate engraved or stamped with the panelboard and circuit number it is fed from. Also, include on faceplate or on a separate nameplate for each light switch identification use such as “OUTSIDE BUILDING LIGHTS”, “PERIMETER LIGHTS”, “MCC ROOM”, etc. Adhesive plastic labels are not acceptable.

4. All field instruments and devices shall be labeled with designation shown on P&ID diagrams.

5. All transformers and panelboards shall have nameplates with ½" high letters and be engraved with designations as shown on one-line Drawings.

6. All safety and disconnect switches shall have nameplates with ½” high letters and be engraved with designations as shown on one-line drawings.

7. Underground Pull Box and Vault Cover Identification: Engrave or bead weld pull box covers with minimum 1/4”thickness and 1/2” letters and covers shall be engraved with designations as shown on Contract drawings or as directed by Owner.

8. Aboveground Pull Box Cover Identification: 316 stainless steel screws attached stamped 316 stainless steel plate nameplates with 1/2” letters and be engraved with designations as shown on Contract drawings or as directed by Owner.

9. Provide engraved nameplate at service entrance equipment (red with white 1” lettering) indicating type and location of standby generator per NEC 702.7 (A).

10. Provide engraved nameplate at service entrance equipment per NEC 702.7(B)

11. Service Equipment Label: Per NEC 110.24 (A) Service equipment shall be legibly marked in field with the maximum available fault current. Field marking shall include date the fault current calculation was performed and be weather & UV rated. Service equipment shall not be hand labeled.

12. All subpanels shall be identified with an engraved phenolic label of the power source location feeding it (i.e. MCC-100, Panelboard LP-1, etc.)

13. Generator receptacles and generator lug panels shall have engraved nameplate with 1” letters (red with white lettering) per NEC 702.7.(C)

14. Specific equipment fed from more than one feeder shall be properly identified (“Fed from Pedestal and the standby generator”)

B. Equipment Interior Nameplates - Nameplate material shall be clear plastic with black machine printed lettering as produced by a KROY or similar machine; except caution, warning, and danger nameplates shall have red lettering.

1. The size of the nameplate tape shall be no smaller than 1/2” in height with 3/8" lettering unless otherwise approved by the Owner. Securely fasten

nameplates in place on a clean surface using the adhesion of the tape. Add additional clear glue to hold the nameplate securely in place when necessary.

2. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate with the inscription as shown in the Contract documents. Where no inscription is indicated in the Contract documents, furnish nameplates with an appropriate inscription providing the name and number of device used on the submittal drawings. Stamp the nameplates with the inscriptions as approved by the Owner in the submittal.

3. Nameplates shall not be attached to wireway covers or to removable devices.

4. For all receptacles and switches (including devices located in Control Panel, provide a faceplate printed with the panelboard and circuit number it is fed from.

B. Equipment Tags - When there is no space or it is impractical to attach an engraved phenolic nameplate with screws, as is the case with most field devices and instruments, attach a tag to the equipment with the same inscriptions as specified above in paragraph A. The tag shall be made from stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Owner. Securely fasten tags in place using 316 stainless steel 0.048 inch diameter wire of the type normally used for this purpose (catalog cut sheet shall be submitted). Stainless steel wire shall be crimp connected. Twisting ends together is not acceptable. Twisting ends together is not acceptable.

C. Engrave or machine print the nameplates and tags with inscriptions as approved by the Owner in the nameplate submittal.

D. Provide temporary labels for all instruments and devices immediately when installed. Temporary labels shall be provided with 1/2" letters minimum and labeled with P&ID tag number.

2.3 COMPONENTS

A. Switches and Pushbuttons

1. Switches (HS) and pushbuttons (HC) for general purpose applications shall be water and oil tight as defined by NEMA 4X, corrosion resistant as defined by NEMA ICS 6-110.58, U.L. listed, standard 30 mm diameter, with round plastic clamp ring. Switches shall be Allen-Bradley 800H, or approved equal.

2. Switches and pushbuttons shall have contacts rated 10 amperes continuous and 600 VAC.

3. Manufacturer's standard size legend plates shall be provided and engraved to specify each switch and pushbutton function. The legend plate color shall be black. Stop and emergency stop pushbuttons shall have red legend plates.

4. Selector switch handles shall be black. Pushbutton caps shall be colors shown on Contract Drawings or approved in submittals.

5. Selector Switch Positions

   a. Hand-off-auto (HOA) applications shall have the hand position to the left, off in center, and auto in the right position.

   b. On/Off shall have the ON position to the right.

   c. Local/Remote shall have the REMOTE position to the right.

   d. Open-Close-Auto applications shall have the open position to the left, close in center, and auto in the right position.

6. Red mushroom operator, two position switch that latches in both "in" and "out" positions.

B. Relays and Timers

1. General: Relays and timers shall be provided with N.O. or N.C. contacts as shown on the Contract drawings. All spare contacts shown shall be provided. Contacts shall be rated 10 amps minimum at 120 VAC, 60 Hz unless otherwise stated. Supply power or coil voltage shall be 120 VAC unless shown otherwise on the Contract drawings or when relay is utilized in 24V DC control circuits. Relays and timers shall be designed for continuous duty. All relays shall be U.L. listed. The following is a summary of abbreviations associated with relays and timers:

   a. CR Control relay

   b. PFR Power Fail Relay

   c. ISR Intrinsic Safe Relay

   d. TR Timing relay

   e. TDOE Time delay on energization

   f. TDOD Time delay on de-energization

2. Control relays (CR) shall be plug-in type with indicating lights and clear see-through sealed or enclosed housing to exclude dust. Sockets for plug-in relays shall be standard industrial type octal 8 or 11 pin with barrier pressure screw terminals. Provide IDEC Type RR, Potter and Brumfield KU, or approved equal. Two form-C contacts (minimum) shall be provided on each relay.

3. The power fail relay (PFR) shall continuously monitor the three phases for power loss, low voltage, phase loss, and phase reversal. The power fail relay shall have a drop-out voltage adjustment, a status indicating LED and two isolated N.O. contacts. Power fail relays shall be Diversified SLA, Time Mark, or approved equal.

4. Time delay relays (TR) shall be solid state plug-in relays with a timer adjustable over the range 1 second to 10 minutes unless other ranges are indicated or required. Provide LED timer energized indicator lamp. Sockets for plug-in timers shall be standard industrial type blade 8 or 11 pin with barriered pressure screw terminals. Time delay relays shall be IDEC, Potter and Brumfield, or approved equal.

5. Provide and install all moisture or temperature protection relays when required for equipment or motor/pump warranty conditions including any additional conduits for low voltage signal wiring. Submitted drawings shall include the wiring and terminations for all of these relays.

C. Indicating Lights

1. Indicating Lights for general purpose applications shall be NEMA 4X, corrosion resistant as defined by NEMA ICS 6-110.58, U.L. listed, with 120 VAC LED lamp and built-in push-to-test switch, standard 30 mm diameter, with round plastic lens and miniature bayonet lamp base. Indication lights shall be Allen-Bradley 800H, or approved equal.

2. Manufacturer's standard size legend plates shall be provided and engraved to specify each light's function. The legend plate color shall be black.

3. Indicating light type and color of lens shall be as shown on the Drawings or specified in the Contract documents. Lamp color will be as follows:

a.	Opened/On	Green
b.	Closed/Off	Red
c.	Alarm	Amber
d.	Power On	White

4. Indicating lights designated "PTT" shall be provided with a push-to-test switch and wiring.

D. Circuit Breakers

1. Circuit breakers shall be of the indicating type, providing ON, OFF and TRIPPED positions of the operating handle. Circuit breakers shall be quick-make, quick-break, with a thermal-magnetic (TM) action, except when protecting motor feeders where motor circuit protector (MCP) breakers with adjustable magnetic trip shall be used. Panelboard circuit breakers shall be the bolt-on on type. The use of tandem or dual circuit breakers in a normal single-pole space to provide the number of poles or spaces specified are not acceptable. All multiple-pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. Circuit breakers and motor circuit protectors shall be manufactured by Eaton, G.E., ITE, or approved equal.

2. Breakers shall be sized and have a minimum interrupting capacity as shown on Drawings and as required for the supplied equipment.

3. Breakers requiring GF trip on E-Series Drawings shall be provided with breakers with integral ground fault trip.

4. Circuit breakers feeding Soft Starters or VFDs shall have true adjustable Long, Short and Instantaneous trip units.

5. Thermal magnetic circuit breakers with frames 250A and above shall be provided with removable interchangeable trip units.

6. Fused disconnects shall not be used in place of breakers.

7. Breaker for HVAC equipment shall have HACR rating.

8. All breakers shall be supplied with the correct sized copper only lugs for wire sizes as listed in "Conduit & Wire Routing Schedule". Provide larger frame breaker or lug adapters as necessary when connecting to the listed oversized wire.

E. Control Power Transformer

1. Control power transformer shall be provided with a time-delay, slow-blow secondary fuse rated to protect the transformer and interrupt 10,000 amperes at 120VAC. Two primary fuses with KAIC interrupt rating of corresponding power connection shall be provided. Transformer size minimum ratings shall be as shown on Contract E-series drawings. When size is not shown on E-series Contract Drawings, then the following lists the minimum control power transformer per NEMA Starter size or VFD/Soft Starter size:

CONTACTOR NEMA SIZE STARTER	VFD/SOFT STARTER AMPS	CTRL PWR XFMR VA RATING (MIN)
SIZE 00	9	150
SIZE 0	18	150
SIZE 1	27	150
SIZE 2	45	150
SIZE 3	90	250
SIZE 4	135	250
SIZE 5	270	250

F. Motor Starters

1. Motor starters (M) shall be magnetically operated, electrically held, full voltage, non-reversing except as shown on the Drawings. NEMA sizes shall be as required for the horsepower shown on the Drawings. Starters that are not NEMA rated are not acceptable. Contactors shall be U.L. rated and listed. Motor starters shall be Eaton Freedom, or approved equal.

2. Each motor starter shall have a 120 volt operating coil rated for continuous operation.

3. Auxiliary contacts shall be provided as shown on the Drawings or as required. Each motor starter shall be furnished with a minimum of 2 spare auxiliary contacts in excess from those shown to be used. Auxiliary contacts shall be convertible, in the field, from normally open to normally closed or vice versa.

4. Overload relays shall be adjustable for trip point and for automatic or manual reset. Each overload shall be ambient compensated and shall trip on 600% of full load current in less than 6 seconds. Each overload relay shall have a test trip pushbutton built-in and an adjustable calibrated trip with indicating dial. Three-phase starters shall have 3 overload relays. Each overload relay shall

have a normally closed holding contact and a normally open isolated contact for overload alarm. Heater elements shall be supplied that match motor nameplate amps. Motor overloads shall be Eaton Freedom or approved equal.

2.4 MOTOR CONTROL PANEL

A. Provide motor control panel with fused disconnect, auxiliary run contact for remote monitoring, HOA selector switch, indicating lights, reset pushbutton, motor overloads, terminal blocks, and interlocks as shown on Contract P&ID Drawings.

B. Motor controls shall be mounted on a backpan and installed in a NEMA 4X enclosure painted gray. Enclosure shall have a padlockable disconnect switch for locking out pump operation.

C. Motor control panel shall be Square D Class 8940, Eaton, or approved equal.

2.5 DISCONNECT SWITCHES

A. Switches shall be provided with the voltage, and amperage rated as shown on the one-line and other Contract Drawings. All switches shall be UL labeled.

B. Switches to be stainless steel NEMA rated as shown on Contract Drawings.

C. The operating handle shall be capable of being padlocked in the "OFF" position. The operator shall be a positive, quick-make, quick-break mechanism. Disconnects shall be of the enclosed knife blade type.

D. Switches shall be provided with defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position. Handle position shall clearly indicate whether the switch is in “ON” or “OFF”. Operating handle shall be an integral part of the enclosure frame and in no way part of the door or cover.

E. Equipment ground kits shall be furnished for each switch.

F. Provide NEMA 4X, stainless steel

G. Disconnect switches shall be Eaton, Square D, Eaton, or approved equal.

2.6 MANUAL TRANSFER SWITCH

A. Switches shall be provided with the voltage, and amperage rated as shown on the one-line and other Contract Drawings. All switches shall be UL labeled.

B. Switches to be stainless steel NEMA 4X rated as shown on Contract Drawings.

C. The operating handle shall be capable of being padlocked in the "OFF" position. The operator shall be a positive, quick-make, quick-break mechanism. Disconnects shall be of the enclosed knife blade type.

D. Switches shall be provided with defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position. Handle position shall clearly indicate whether the switch is in “ON” or “OFF”. Operating handle shall be an integral part of the enclosure frame and in no way part of the door or cover.

E. Each “ON” position shall be labeled with an engraved phenolic nameplate indicated “UTILITY” or ‘GENERATOR”.

F. Equipment ground kits shall be furnished for each switch.

G. Provide engraved phenolic nameplate with 1” letters to meet NEC 702.7(C).

H. Switches shall be Eaton, Square D, Siemens, or approved equal.

2.7 GENERATOR RECEPTACLE

A. Generator receptacle to be a 3 phase, 4 wire, 4 pole, 600VAC, 100A, Appleton ADR1034, 100A aluminum receptacle with spring door, and junction box to match Owner Standard. Provide matching plug.

2.8 SURGE SUPPRESSOR

A. The surge suppressor shall be rated for use on a 3 phase system at voltage shown on Contract One-Line Diagrams. The transient current the surge suppressor shall dissipate 75,000 amps minimum. The surge suppressor shall also have a maximum transient energy (8x20 µsec waveform) per phase of 3,450 joules. Provide fuses feeding the surge suppressor. Locate surge suppressor so that the indicating lights are viewable without removing panels. The surge suppressor shall be Leviton 3200 series, or approved equal.

2.9 ELECTRICAL ENCLOSURES

A. Enclosures and boxes to be wall mounted, minimum 14 gauge, type 316 stainless steel with seams continuously welded & ground smooth, and fast access door latches. A copper ground bus shall be provided in the enclosure. Outer door shall have provisions for locking enclosure with standard padlock. Provide white backpan in box.

B. Provide accessories consisting of breaker to disconnect incoming power, heater, fan, removable metal louvers, and thermostats, where shown on Contract drawings.

C. All fans, vents and louvers shall be provided with removable metal filters.

D. Provide larger enclosure as required to accommodate the supplied equipment at no additional cost to the Owner.

E. Provide metal data pocket within each enclosure and box to hold as-built drawings.

F. All panel doors shall be installed with ground straps.

G. Panels shall be provided with engraved nameplate identifying name of panel, voltage and location of power source feeding it (i.e. MCC-100, Panelboard LP-1, etc.).

H. Enclosure shall be Hoffman, Circle AW or approved equal.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards outlined herein.

B. Employ personnel that are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to the Owner.

E. The Owner reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

F. All cutting and notching shall be laid out carefully in advance. Do not notch any structural member or building surface without specific approval from the Owner. Carefully carry out any 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 neatly to new condition using skilled craftsmen of the trades involved. Refinish damaged surfaces to new condition using skilled craftsmen of the trades involved at no additional cost to the Owner.

G. Keep the premises free from accumulation of waste material or rubbish on a daily basis. Upon completion of work, remove materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment. Refinish damaged surfaces to new condition using skilled craftsmen of the trades involved at no additional cost to the Owner.

H. All equipment installed by the Contractor shall be in accordance with the Drawings and the manufacturer's recommendations & instructions and shall operate to the Owner's satisfaction. Follow all manufacturers' instructions for handling, receiving, installation, and pre-check requirements prior to energization. After energization, follow manufacturer's instructions for programming, set-up and calibration of equipment. The Contractor shall be responsible for, and shall correct by repair or replacement, at his own expense, equipment that, in the opinion of the Owner has been caused by faulty mechanical or electrical assembly by the Contractor. Necessary tests to demonstrate that the electrical and mechanical operation of the equipment is

satisfactory and meets the requirements of these Specifications shall be made by the Contractor at no additional cost to the Owner.

3.2 CONSTRUCTION METHODS, GENERAL

A. All field wires and panel wires shall have wire markers as specified in the “WIRE” Section.

B. All wiring shall be neatly bundled and laced with plastic tie-wraps, anchored in place by screw attached retainer. Where space is available, such as in electrical cabinets, all wiring shall be run in slotted plastic wire ways or channels with dust covers. If space is not available for wireways, then all wiring shall be neatly bundled and laced with plastic tie-wraps, anchored in place by stainless screw attached retainer. Wire ways or channels shall be sized such that the wire fill does not exceed 50%. Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wireways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles. Tie-wraps shall be T&B TY-RAP or approved equal.

C. Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by clear nylon spiral wrap. The hinge loop shall be of sufficient length to permit opening and closing the door without stressing any of the terminations or connections. Spiral wrap shall be Graybar T25N or approved equal.

D. Wireways, retainers, and other devices shall be screw mounted with round-head 316 stainless steel screws or mechanically mounted by push-in or snap-in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series or approved equal.

E. All components associated with a particular compartment’s or enclosure's function shall be mounted in that compartment or enclosure.

F. Spacing and clearance of components shall be in accordance with UL, JIC, and NEC standards.

G. No wires shall be spliced without prior approval by the Owner. Devices with pigtails, except lighting fixtures shall be connected at terminal blocks. Equipment delivered with spliced wires shall be rejected and the Contractor required to replace all such wiring, at no additional cost to the Owner.

H. Where splices are allowed or approved by the Owner they shall conform with the following:

1. Wire splicing devices shall be sized according to manufacturer's recommendations.

2. Splices of #10 and smaller, including fixture taps, shall be made with see-through nylon self-insulated twist on wire joints; T & B "Piggys", Ideal "Wing-Nut" or approved equal.

3. Splices of #8 and larger shall be hex key screw two way connectors, with built in lock washers; T & B "Locktite", O-Z type XW or approved equal, insulated with 3M Scotch Super #88, Plymouth or approved equal.

4. Splices in underground pullboxes or in pump termination boxes shall be insulated and moisture sealed with 3M "Scotchcast" cast resin splice kits, Plymouth splice kits, or approved equal. Do not use splice kits with a date marking for shelf life that has expired.

5. Tape on splices shall not be allowed.

6. Splices for motor leads shall be made with 3M DB series splice kit, or approved equal.

7. Where the T-leads to motors are larger than 10 AWG, use NSI Polaris connectors to terminate to the motor leads.

I. Tapes shall conform to the requirements of UL 510 and be rated: 105 °C, 600V, flame retardant, hot and cold weather resistant. Vinyl plastic electrical tape shall be 7 mil black. Phase tape shall be 7 mil vinyl plastic, color coded as specified. Electrical insulation putty shall be rubber based, elastic putty in tape form. Varnished cambric shall not be used.

J. Connections to terminals shall be as follows:

1. Use connector or socket type terminals furnished with component.

2. Connections to binding post screw, stud, or bolt use:

a. For #10 and smaller wire, T & B "Sta-Kon", Buchanan "Termend", or approved equal, self-insulated locking forked tongue lug.

b. For #8 to #4/0 wire, T & B "Locktite", Burndy QA, or approved equal, lug of shape best suited.

3. Use ratchet type crimping tool which does not release until proper crimp pressure has been applied.

4. Connections for all terminals shall be made with insulation stripped per manufacturer's instructions.

K. Equipment shall be wired and piped by the manufacturer or supplier. Major field modifications or changes are not allowed without the written "change order" authority by the Owner. When field changes are made, the components, materials, wiring, labeling, and construction methods shall be identical to that of the original supplied equipment. Contractor's cost to replace or rework the equipment to match original manufacturer or supplier methods shall be done at no additional cost to the Owner.

L. Mating fittings, bulkhead fittings, plugs, lugs, connectors, etc. required to field interface to the equipment and panels shall be provided by the supplier when the equipment is delivered.

M. All electrical and instrumentation factory as-built drawings associated with the equipment shall be provided with the equipment when it is delivered to the job site.

Drawings for each piece of equipment shall be placed in clear plastic packets of sufficient strength that will not tear or stretch from drawing removal and insertion.

N. All wire and cable lugs shall be copper; aluminum or aluminum alloy lugs shall not be allowed. Supply all lugs to match the quantity and size of wire listed in the Conduit & Wire Routing Schedule.

3.3 EQUIPMENT FABRICATION, GENERAL

A. Panel and enclosure cutouts for devices (i.e. indicating lights, switches) shall be cut, punched, or drilled and smoothly finished with rounded edges. Exposed metal from cutouts that are made after the final paint finish has been applied shall be touched up with a matching paint prior to installing device. Do not paint nameplates, labels, tags, switches, receptacles, conductors, etc.

B. All Panel and enclosure doors shall be fully gasketed with non-shrinkable, water and flame resistant material.

C. Bolts and screws for mounting devices on doors shall be as specified by the manufacturer, otherwise they shall have a flush head which blends into the device or door surface. No fastening devices shall project through the outer surfaces of equipment.

D. No fastening devices shall project through the outer surfaces of equipment.

E. Each component within the equipment shall be securely mounted on an interior subpanel or backpan and arranged for easy servicing, such that all adjustments and component removal can be accomplished without removing or disturbing other components. Mounting bolts and screws shall be front located for easy access and removal without special tools. Access behind the sub panel or backpan shall not be required for removing any component.

F. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250.122, whichever is larger.

G. Minimum wire bending space at terminals and minimum width of wiring gutters shall comply with NEC Tables 312.(A) & (B).

H. Wire sizes shall <u>not</u> be installed smaller than those shown in NEC Article 310 for each circuit amperage rating.

I. Future device and component mounting space shall be provided on the door, backpan, and subpanel where detailed on the Drawings. Where no detail is shown, provide a minimum of 15 percent usable future space.

J. Doors shall swing freely a minimum of 90° and close with proper alignment.

K. All control, power, and signal wireways inside enclosures shall be run in separate plastic wireways.

L. TERMINATIONS: Single wire and cable conductors shall be terminated according to the requirements of the terminal device. All terminations must be made at terminals or terminal blocks. Use of spring or buttsplice connectors are not allowed.

1. Provide 3" minimum separation between wireway and terminal blocks. Installation of wireways too close to terminal blocks will be required to be completely reworked to the satisfaction of the Owner.

2. For captive screw pressure plate type terminals, the insulation shall be removed from the last 0.25 inches of the conductor. The conductors shall be inserted under the pressure plate to full length of the bare portion of the conductor and the pressure plate tightened without excess force. No more than two conductors shall be installed in a single terminal. All strands of the conductor shall be captured under the pressure plate.

3. For screw terminals, appropriately sized locking forked spade lugs shall be used. Lugs shall be crimp on type that form gas tight connections. All crimping shall be done using a calibrated crimping tool made specifically for the lug type and size being crimped.

4. On shielded cables, the drain wire shall be covered with insulating tubing along its full bare length between the cable jacket and the terminal lug or terminal pressure plate.

5. For screwless terminals, wire shall be stripped back and inserted per the manufacturer's instructions. When stripping insulation from conductors, do not score or otherwise damage conductor.

6. Heat shrink shall be placed on ends of shielded cable to cover foil.

7. Additional condulets with terminal blocks shall be supplied for wire termination to devices with leads instead of terminals (i.e. solenoid valves, level probe, etc.).

8. Terminate all status, control, and analog I/O wiring on terminal blocks, including spares. Provide additional relay, DIN rails, terminal blocks and side panels as required.

M. All devices and wiring shall be permanently labeled and secured in accordance with paragraphs NAMEPLATES AND TAGS, WIRE and CONDUITS, RACEWAYS AND WIREWAYS.

N. All components associated with a particular compartment's or enclosure's function shall be mounted in that compartment or enclosure.

O. Spacing and clearance of components shall be in accordance with UL, JIC, and NEC standards.

3.4 DELIVERY

A. Inspect each electrical and instrumentation item delivered to the jobsite.

B. Unpack each item for inspection within two (2) days of arrival.

C. Complete written inventory shall be produced by Contractor and submitted to Owner within (2) days after arrival on jobsite for record keeping prior to any payment for the item.

D. All panels and enclosures be delivered with as-built drawings in clear plastic packets within each panel and enclosure.

3.5 DAMAGED PRODUCTS

A. Damage products will not be accepted. All damaged products shall be replaced with new products at no additional cost to the Owner.

3.6 FASTENERS

A. Fasteners for securing equipment to walls, floors, and the like shall be stainless steel. The minimum size fastener shall be 3/8 inch diameter. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads required.

B. Reinforced concrete pad with stainless steel anchor bolts shall be provided for floor mounted electrical enclosures.

C. Anchor Methods

1. Hollow Masonry: Sleeve type anchors.
2. Solid Masonry: Sleeve type anchors or epoxy anchors bolts.
3. Metal Surfaces: Machine screws, bolts, or welded studs.
4. Concrete Surfaces: Wedge or expansion anchors.
5. Structural Steel: Right angle, parallel and edge type rigid metal clamps. Do not weld or drill structural steel.

D. Equipment Mounting

1. The Contractor shall be responsible for furnishing and setting all anchor bolts required to install his equipment.
2. Electrical equipment shall be unistrut “stand off” mounted a minimum of ½ - inch from the wall in a manner so that the rear of the equipment is freely exposed to air circulation. Unistrut material shall be stainless steel in NEMA 4X areas and galvanized in non-NEMA 4X areas unless called out specifically in details.
3. All equipment enclosures shall be of the NEMA classification noted on the electrical plan Drawings for the area in which the device will be mounted.

4. Reinforced concrete pad with stainless steel anchor bolts shall be provided for each electrical freestanding equipment.

E. Dissimilar metals such as aluminum, stainless steel, steel, galvanized steel between enclosures, devices, etc. and mounting surfaces shall be isolated from each other using insulated tape or nonmetal spacers. Tape and spacers used shall be specifically manufactured for this application.

3.7 INSTALLATION, GENERAL

A. System

1. Install all products per manufacturer's recommendations and the Drawings.
2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections. The following shall be done by the Contractor at no additional cost to the Owner:
    a. Provide additional devices, wiring, conduits, relays, signal converters, isolators to complete interfaces of the electrical and instrumentation system.
    b. Changing normally open contacts to normally closed contacts or vise-versa.
    c. Adding additional relays to provide more contacts as necessary.
    d. Installing additional terminal blocks to land wires.
    e. When generator supplier provides block heaters that do not match Contract Drawings, modify panelboard schedule, circuit breaker sizes, wire sizes, conduit sizes, etc.
    f. Other work implied by contract documents.
3. All programmable devices shall be programmed, set-up and tested by the Contractor prior to startup. This includes PLC, OI, and transmitters. Programming and set-up parameters shall be adjusted or changed as directed by the Owner during start-up and throughout the warranty period, at no additional cost to the Owner.
4. Coordinate with the Owner and setup all alarm, process, and operation setpoints.
5. Keep a copy of the manufacturer’s installation instructions on the jobsite available for review at all times prior to and during any installation of the associated equipment.

B. Panels and Enclosures

1. Install panels and enclosures at the location shown on the Plans or approved by the Owner.
2. Install level and plumb.
3. Provide larger motor termination boxes and lugs as required to accommodate conduit and wires.

4. Seal all enclosure openings to prevent entrance of insects and rodents.

5. All conduits entering outdoor panels and enclosures shall use watertight hubs. These hubs shall be located on sides or bottom only. Top entry of outdoor panels or enclosures is not allowed unless specifically shown on plans.

6. Clearance about electrical equipment shall meet the minimum requirements of NEC 110.26.

7. Additional condulets with terminal blocks shall be supplied for wire termination to devices with leads instead of terminals (i.e. solenoid valves, level probe, etc.).

8. Terminate all status, control, and analog I/O wiring on terminal blocks, including spares. Provide additional relay, DIN rails, terminal blocks and side panels as required.

9. A ground bus shall be provided in each enclosure or cabinet. It shall have provisions for connecting a minimum of ten grounding conductors. Screw type lugs shall be provided for connection of grounding conductors. All grounding conductors shall be sized as shown on plans or in accordance with NEC Table 250.122, whichever is larger.

10. All panels and enclosures be delivered with as-built drawings in clear plastic packets within each panel and enclosure. Provide data pocket holder in each enclosure.

C. Conduits and Ducts

1. Install all conduits and ducts per 26 05 33 – Raceway and Boxes for Electrical Systems.

D. Wiring, Grounding, and Shielding

1. Install wiring inside and outside equipment per Section 26 05 19.

2. It is important to observe good grounding and shielding practices in the generally noisy environment in this application. The shield of shielded cables shall be terminated to ground at one end only, the origination end. The shield at the other end shall be encased in an insulated material to isolate it from ground.

3. Special cables shall be provided when required by manufacturer or necessary to correct noise or distortion interference at no additional cost to Owner.

4. Field wiring shall not begin until interconnection drawings have been submitted by the Contractor and approved by the Owner, as specified herein.

5. Ground all swinging gates and fences using UL approved ground clamps specifically designed for the grounding purpose. Strap metal is not acceptable for grounding.

E. Conduit and Wire Routing Schedule

1. Conduit material, wire size, and quantity listed in schedule take precedence over Division 26 and 40 Specifications.

2. All of the entries for each line in the conduit schedule apply to each conduit when multiple quantity of conduits (quantity of which are indicated by number entered in conduit no. column in schedule) are listed in the schedule.

3. Wire sizes listed are in AWG or Kcmil and are copper conductors.

4. Extra wire was intentionally placed in the "Conduit & Wire Routing Schedule" which shall be labeled on both ends with a unique wire label.

5. Contractor to supply and install all conduits and wiring as shown on Utility Engineered Design drawings. Utility primary and secondary conduit and wiring shown in "Conduit and Wire Routing Schedule" is for bid purposes only. A credit or add-on will be provided by Contractor based on the actual work performed by Contractor for the Utility service.

6. All control and signal wiring terminations shall have the correct wire label applied prior to making connection.

7. Conduit entries listed as "GRS-PVC" in the Conduit & Wire Routing Schedule are to be "Galvanized Rigid Conduits with PVC coating" the entire length.

F. Cutting and Patching

1. Do all cutting and patching required to install his work. Any cutting which may impair the structure shall require prior approval by the Owner. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

G. Seals

1. Seal around all conduits, wires, and cables penetrating between walls, ceilings, and floors in all buildings with a fire stop material.

   a. Provide seals on all penetrations between panels. Seal shall be made at both ends of the conduit with a fire stop putty.

   b. Seal shall have a minimum two hour rating.

   c. Fire stop sealing shall be International Protective Coatings Flamesafe, or approved equal.

2. Seal around conduits entering outside to inside structures and around bottom of free standing enclosures to maintain watertight integrity of structure.

3. Place conduit type seal in each underground conduit riser into panels and enclosures to prevent entrance of insects and rodents.

4. Conduit entrances: Seal each conduit entrance from below grade into the panel and other electrical enclosures with plugging compound sealant to prevent the entrance of insects and rodents. Conduits between the enclosures shall be sealed with plugging compound sealant on each end. Plugging

compound sealant shall be PRC-DeSoto (formerly Courtaulds) Aerospace Semco PR-868 or approved equal.

5. Seal conduits entering any electrical instrument. Install conduit drain boxes and plug conduit interior to form an effective barrier to keep out water traveling into equipment or instrumentation from conduit installed higher than equipment or instrumentation.

H. Housekeeping Pads

1. Concrete housekeeping pads are required for all free standing electrical equipment. Housekeeping pads shall be 3-1/2" inches above surrounding finished floor or grade unless otherwise shown and shall be 3 (minimum) inches larger in width and depth around equipment. Housekeeping pads shall be installed for future units as shown on the Contract Drawings.

2. Housekeeping pad shall be high quality concrete with rebar woven into floor rebar network. Concrete shall be precisely leveled so that equipment set in place will not require shimming.

3. Housekeeping pad shall be Class "A" concrete with rebar crossway network. The minimum size rebar allowed is #3. Concrete shall be precisely leveled so that equipment set in place will not require shimming.

I. Cleaning and Touch-up

1. Prior to start up and at the completion of the work, prior to final acceptance all parts of the installation, including all equipment, exposed conduit, and fittings, shall be thoroughly cleaned of and given touch-up by Contractor as follows:

   a. Remove all grease and metal cuttings.

   b. Any discoloration or other damage to parts of the building, the finish, or the furnishings, shall be repaired.

   c. Thoroughly clean any of his exposed work requiring same.

   d. Vacuum and clean the inside of all panels and electrical enclosures prior to applying power and a second time immediately prior to the final acceptance inspection. Removing debris with an air blower is not permitted.

   e. Clean all above and below ground pull boxes, junction boxes, and vaults from all foreign debris prior to final acceptance.

   f. Special "Soft–Jaw" type pipe clamps shall be used to prevent damage to PVC-coated conduit while field threading and cutting to length.

   g. Paint all scratched or blemished surfaces with the necessary coats of quick drying paint to match existing color, texture and thickness. This shall include all prime painted electrical equipment including but not limited to enclosures, poles, boxes, devices etc.

   h. Remove all decals and lettering from both sides of support plates.

i. Repair damage to factory finishes with repair products recommended by Manufacturer.

j. Repair damage to PVC or paint finishes with matching touchup coating recommended by Manufacturer.

3.8 SAFETY LOCKOUTS

A. Provide safety lockout tags on the breakers for all switchboards, MCCs and panelboards and other electrical enclosures. Safety tags shall not be the same as those used by the Owner. All padlocks used for this purpose shall be keyed differently from any of the Owner's padlocks. Padlocks shall remain in place by the Contractor until operation of the portion of work is turned over to the Owner with the responsibilities noted on the acceptance form.

B. The following is the procedure for transferring each portion of work over to the Owner prior to completion of the entire project:

1. Inform the Owner when a portion of the work is complete, ready for inspection and available to be placed into operation.

2. The Owner will schedule the inspection and substantiate that the work is complete and operational.

3. Correct any deficiencies.

4. The Owner will prepare a Partial Utilization form in which that portion of the project will be turned over the Owner with the responsibilities noted on the acceptance form. The Contractor then shall remove his safety lockouts and tags.

C. Safety lockout tags shall be rigid vinyl with write-on surface and brass grommet. Safety tags shall be secured in place with cord of sufficient strength to prevent accidental removal or displacement. Safety lockout tags shall be Panduit Write-on Safety Tags, model PVT-98 or approved equal

3.9 OPERATION AND MAINTENANCE MANUALS

A. Provide Operation and maintenance manuals bound in a three ring binder (Binder shall be sized such that when all material is inserted the binder is not over 3/4 full) with one set made up completely with original manuals per this subsection & Division 1. O&M shall contain the following as a minimum:

1. A comprehensive index in each volume for all volumes.

2. A complete "Record" set of favorably reviewed electrical submittals as provided under subsection Submittal and Drawing Requirements. Include as-built one-line, elevation, loop, elementary and interconnection drawings.

3. A complete list of the equipment supplied, including serial numbers, ranges, catalog cuts, and pertinent data.

4. Full specifications on each item.

5. Detailed service, maintenance and operation instructions for each item supplied. Schematic diagrams of all electronic devices shall be included. A complete parts lists with stock numbers shall be provided on the components that make up the assembly. All of these shall be originals, no copies.

6. Record of the following:

   a. Each motor nameplate data including manufacturer, full part number, size, voltage, amps, service factor, bearings, etc.

   b. Each breaker and overload heater element including manufacturer, full part number, size, setting etc.

   c. Spread sheet listing all setpoints and programmable parameters entered for this project for VFD, UPS, HIM, etc.

7. Safety precautions and procedures.

8. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

9. Complete listing of as-built PLC setup and programming listings and OI documentation.

10. Provide and submit original software operations and maintenance manuals for PLC hardware and software, no copies. Include documentation for firmware modules and major software items.

11. Spread sheet listing all setpoints and programmable parameters entered for this project for VFD, PLC application program, all instrumentation and transmitters, etc.

12. Include all completed and signed test data and forms from factory and field testing.

13. No photo copies are allowed of standard published manuals available from manufacturers, such as for the VFD. All of the manuals shall be originals.

14. Factory & Field test results.

15. Warranty certificate with start dates, duration and contact information.

16. Troubleshooting instructions.

17. Record of all settings or parameters for all programmable devices.

B. At the end of the project manuals shall be updated to show "as-built" conditions.

C. Provide four (4) each USB drives with lanyards and two sets of DVDs containing all documents in both PDF format and unlocked AutoCAD - DWG format, latest version, including:

   1. As-built Contract electrical and instrumentation drawings prepared for this project.

2. As-built sets of other computer generated documents prepared for this project, including PLC ladder logic files, and Bill of Materials prepared for this project.

   a. As-Installed Software ladder logic programs.

   b. As-Installed Software OI programs

   c. As-installed software VFD/ SSS configuration settings.

   d. Radio Configuration settings

3. Electronic PDF version of O&M manual. Version format shall follow the hard copy submittal of the O&M, including index, equipment record sheet, warranty information, theory of operation, maintenance instruction, etc. PDF shall be "bookmarked" at each index, subtab, transmittal letter, equipment record sheet, warranty information, theory of operation, maintenance instruction, etc. Failure to bookmark PDF may be grounds for immediate rejection without review. Bookmarks shall be descriptive of actual document, tab, etc. Bookmarks shall not be out of order; the English description shall match that listed in the Submittal's Table of Contents.

4. These files shall be the property of the Owner, for its use on this and future projects.

5. Label drives with site name using with clear plastic with black machine printed lettering as produced by a KROY or similar machine. The size of the nameplate tape shall be with 3/8-inch lettering unless otherwise approved by the Owner. Securely fasten nameplates in place on the USB drive using the adhesion of the tape.

3.10 TESTING

A. General Requirements

1. It is the intent of these tests to assure that all equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design plans and specifications.

2. All equipment setup and assembled by the Contractor shall be in accordance with the design plans and Drawings and the manufacturer's recommendations and instructions and shall operate to the Owner's satisfaction. Follow all manufacturer's instructions for handling, receiving, installation, and pre-check requirements prior to energization. After energization, follow manufacturer's instructions for programming, set-up and calibration of equipment. The Contractor shall be responsible for, and shall correct by repair or replacement, at his own expense, equipment which, in the opinion of the Owner, has been caused by faulty mechanical or electrical assembly by the Contractor. Necessary tests to demonstrate that the electrical and mechanical operation of the equipment is satisfactory and meets the requirements of these Specifications shall be made by the Contractor at no additional cost to the Owner.

3. The testing shall not be started until the manufacturer has completed fabrication, wiring, and setup; performed satisfactory checks and adjustments; and can demonstrate the system is complete and operational. Certification of completion of Contractor's in-house tests shall be submitted prior to scheduling of factory testing.

4. Testing Procedures and Submittals:

    a. Provide separate submittals and test procedures for the following:

        1) Factory Tests

        2) Pre-Energization Field Tests

        3) Powered Field Tests

    b. Submittals shall be provided at least six weeks prior to the start of the tests.

    c. Testing shall not commence until the test procedures have been reviewed and approved by the Owner.

    d. Each testing sheet shall have a title giving the type of test and entry spaces for the name of the person who performed the test, name of the person who witnessed the test, and the date.

    e. Test forms shall be provided as illustrated in Appendix "A".

    f. All tests shall be witnessed by the Owner and/or Owner personnel. The test forms shall be completed by the testing person for field checkout, testing, and calibration of all equipment and instruments.

        1) All filled in test forms shall be given to the Owner the day of the test. Fill in two sets of test forms if Contractor wants to keep a copy.

        2) All tests shall be documented in writing by the supplier and signed by the Owner as satisfactory completed. The supplier shall keep a detailed log of all tests that failed or did not meet specifications, including date of occurrence and correction.

        3) Completed forms with proper signatures and dates shall be included and become a component of the Operations and Maintenance Manual for each of the respective systems.

5. Factory Test Scheduling:

    a. The testing shall not be started until:

        1) The manufacturer has completed fabrication, wiring, and setup; performed satisfactory checks and adjustments; and can demonstrate the system is complete and operational.

        2) Submittals associated with the equipment have been approved by the Owner

        3) PLC Design review meetings have taken place to the satisfaction of the Owner.

        4) Certification of completion of Contractor's in-house tests shall be submitted prior to scheduling of factory testing.

5) Factory test procedures and forms have been reviewed and approved by the Owner. Test forms shall be provided as illustrated in Appendix “A”.

b. If factory test equipment is significantly different from submittal drawings, this shall be grounds for cancellation and rescheduling of factory tests at no additional costs to Owner or extension of Contract time.

c. Owner reserves the right to postpone the factory test, at no additional cost to the Owner, until the submittal associated with the factory test has been reviewed by the Owner and marked "No Exceptions Taken" or "Make Corrections Noted." No extension of Contract time will be allowed.

d. Notify the Owner of the Supplier's readiness to begin all factory and field tests in writing (a minimum of ten working days prior to start), and shall schedule system checkout on dates agreed to by the Owner in order that the testing be scheduled and witnessed.

e. Fill in and submit for approval, the “Scheduled Test Request Form” located in Appendix “A” for each requested inspection, factory and field test.

6. Test equipment used for testing shall be of suitable quality so as not to mask performance deficiencies. All test equipment shall be traceable to National Bureau of Standards and have been calibrated within six months of test date.

B. Failure to Meet Test

1. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported to the Owner. Replace the defective material or equipment and have tests repeated until test proves satisfactory to the Owner without additional cost to the Owner.

2. If the results of any of tests are unacceptable to the Owner, make corrections and perform the tests again until they are acceptable to the Owner; these additional tests shall be done at no additional cost to the Owner.

3. If testing, installation or configuration work performed is deemed inadequate by Owner, provide a qualified technician to meet these requirements. No extension of Contract time will be allowed.

4. If the “system setup” is found to be not fully and completely ready for factory testing by the Owner, the Contractor shall be responsible for paying for the Owner to return for the factory testing. Factory testing is to ensure that there are no defects. The hardware and software shall be tested for compliance with the plans and Specifications included herein and for the ability to perform the control functions.

C. Safety

1. Testing shall conform to the respective manufacturer's recommendations. All manufacturers’ safety precautions shall be followed.

2. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and ensure personnel safety. Absolutely no tests shall be performed that endanger personal safety.

3. The Contractor shall have two or more personnel present at all tests.

4. Two non-licensed portable radios are to be made available by the Contractor for the Contractor to conduct tests.

5. California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA): The Contractor is cautioned that testing and equipment shall comply with ESO and OSHA as to safety, clearances, padlocks and barriers around electrical equipment energized during testing.

6. Field inspections and pre-energization tests shall be completed prior to applying power.

D. Electrical Factory Tests

1. The System supplier shall conduct a thorough and complete factory test by qualified factory-trained personnel witnessed by Owner per the criteria specified herein. Factory test shall be held within 150 miles of project location.

2. The "system set-up" for testing shall consists of, but is not limited to:

   a. Utility Meter Panels
   b. MCC
   c. Motor Control Panels
   d. Automatic Transfer Switch
   e. Manual Transfer Switch
   f. RTU Control Panels
   g. Pedestals
   h. Panelboards
   i. Disconnect switches.
   j. Electrical Panels.
   k. VFDs
   l. All control components shall be installed and PLCs programmed with full functional logic.
   m. Any miscellaneous associated electrical equipment.

3. Temporary wiring and equipment shall be setup during these tests to simulate the complete assembled system.

4. Original PLC/OI/SCADA programmer shall be present during the entire Factory Test for modifying or adjusting all PLC registers, OI application and setpoints to test the system. If original PLC/OI/SCADA programmer is not present during the Factory Test, the Factory Test will be immediately cancelled and the Contractor shall be responsible for paying for the Owner to return for the factory testing.

5. The length of the factory testing for the system setup shall be a minimum of six (6) working days (8 hours per day). If in the opinion of the Owner or Engineer the factory testing is not completed at the end of the working day, the testing shall be extended, at no additional cost to the Owner or extension in Contract time. The Contractor shall agree that the sum set forth hereafter is a reasonable amount to be charged as liquidated damages; and it is therefore agreed that the Contractor will pay the Owner the sum of fifteen hundred dollars ($1500.00) in liquidated damages for each and every calendar day beyond the time prescribed above for the completion of factory testing for the system setup. Liquidated damages will be assessed to the Contractor each and every day past the time allotted for factory testing.

6. All factory tests shall be conducted at the Supplier's facility. All factory tests shall be completed prior to shipment of any of the "system setup" to the jobsite. The "system setup" shall be fully assembled, programmed and connected as it will be installed in the final configuration.

7. All components of the system setup shall be completely assembled and thoroughly pre-tested by the supplier or manufacturer before start of factory test.

8. Provide a complete, clean copy of System Supplier drawings for Owner's use during Factory Test. These drawings shall reflect the equipment being tested. If Owner determines that these drawings do not adequately reflect the actual equipment being tested or differs substantially from the approved equipment submittal, the Owner reserves the right to cancel the Factory Test as the equipment is found to be not fully and completely ready for factory testing. Equipment that differs substantially from the approved equipment submittal shall be resubmitted. Factory test will be rescheduled after revised submittals have been reviewed by the Engineer and marked "No Exceptions Taken" or "Make Corrections Noted". No extension of Contract time will be allowed. Cancellation and rescheduling of factory tests shall occur at no additional costs to Owner.

9. Factory testing sheets shall be provided by System Supplier and submitted for approval. Factory testing sheets shall contain the following:

    a. A separate set of factory testing sheets for all defined "PLC I/O" that includes:

        1) A list of all PLC I/O tag names with description sorted by type (analog input, analog output, digital input, and digital output) shown on Contract I-Series Drawings.

        2) Predefined column entry spaces adjacent to each tag name for logging the result of the test as failed or passed, comments, and date of corrective action (used when test failed initially, and problem subsequently corrected to pass test).

        3) For "analog input" blocks provide column entry spaces for the simulated test values (i.e., 1, 3, and 5 VDC) and displayed test value responses (i.e., 0, 50, and 100% of engineering units span).

b. A separate set of "alarm" factory testing sheets for all defined alarms that includes:

1) A list of all alarm names.

2) Predefined column entry spaces adjacent to each cell for logging the result of the test as failed or passed, comments, and date of corrective action (used when test failed initially, and problem subsequently corrected to pass test).

10. The associated factory tests for each of the factory testing sheets that are to be performed by the supplier and witnessed by the Owner shall include the following system setup as a minimum:

a. Inspections of the panels as follows:

1) Vacuum and clean the inside of all MCC and electrical and instrumentation enclosures prior to start of factory test.

2) Visual and Mechanical:

a) Inspect for physical damage, proper support, and wiring.

b) Check all starters, breakers, and other components for proper sizes.

c) Compare equipment nameplate data with design one line diagrams.

d) Complete test form TF4 located in Appendix “A”.

b. Testing of the Equipment as follows:

1) Each line of control logic on the elementary or loop diagrams shall be checked. After a line of control logic is tested, the person performing test shall initial or highlight the corresponding line on the elementary diagram. When the complete elementary diagram has been checked, it shall be signed and dated by testing person and person witnessing test.

2) I/O points to terminal blocks shall be simulated for the complete checkout of PLC interfaces.

3) The tests, as a minimum, shall simulate all operating conditions including steady state, transients, upsets, startup, shutdown, power failure, and equipment failure conditions (for control logic).

4) Complete each test and fill in the I/O test form TF13 located in Appendix “A”.

c. Testing of Control as follows:

1) To facilitate testing and system simulation of the “System Set-up”, the Supplier shall connect a separate toggle two position on-off switch to each status and alarm digital input. Three digital multi-meters (minimum +/- 0.2% accuracy) with clip-on leads shall be supplied and utilized during testing for measurement of digital and analog outputs. The supplier shall

use simulated input signals to replicate varying field device signals during the factory tests in order to verify the proper functioning of hardware and software.

d. The structured factory tests to be performed by the System Supplier and witnessed by the Owner shall include the following as a minimum:

1) Control Checkout Tests: Simulate the digital or analog signals (or combination thereof) at the MCC field terminals using the test hardware to verify that each control is functional and properly configured. Verify that all parameters (i.e., relay logic operations, relay timing, controller setpoints, etc.) of the control system are defined and operate according to the design documents. Each line of control logic on the elementary and loop diagrams shall be checked. After a line of control logic is tested, the person performing test shall initial the corresponding line on the elementary or loop diagram. When the complete elementary or loop diagram has been checked, it shall be signed and dated by testing person and person witnessing test.

2) Alarm Checkout Tests: Simulate the digital or analog signals (or combination thereof) at the MCCs using the test hardware to verify that each PLC I/O point is functional and properly configured. Verify that all parameters (i.e., description, engineering units, span, enable/disable, setpoints, runtimes, totalization, logic type, etc.) of the alarms are defined and operate according to the Specifications. Multiple alarm states (i.e., LO, LO-LO, HI, HI-HI, etc.) shall be checked by varying the input signal.

3) PLC Program Tests: Each line of control shall be checked. After a line of control logic is tested, the person performing test shall initial the corresponding line on the control strategy. When the complete control strategy has been checked, it shall be signed and dated by testing person and person witnessing test.

e. Unstructured factory tests are required as part of the factory testing phase. These additional tests shall include any and all unstructured tests as directed by the Owner. The various unstructured tests shall include, but are not limited to, the following:

1) Verify the correct inventory of hardware, etc. All spare parts shall be included in the inventory.

2) Simulate the equipment failure and power fail/restart of PLC. Check the effects of each failure on maintaining operations with the remaining equipment.

3) The factory tests, as a minimum, shall simulate all normal and abnormal operating conditions, including steady state, change of state, variable changes, fluctuations, transients, upsets, start-up, shutdown, power failure, and equipment failure conditions.

4) Verification of proper scanning, collection rate, update refresh, and data acquisition of all status, alarm, and data points from all PLCs.

5) Measure and test all power supplies for correct voltage. Operate UPS under its own power to test UPS run duration and alarms.

6) Spare parts for the system shall also be tested during this test period. The System Supplier shall prove by temporarily connecting the spare hardware to the system that any or all of the spare parts function in a manner equivalent to the original equipment under test.

11. Acceptance and witnessing of the factory tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.

12. The testing personnel shall provide all material, equipment, labor and technical supervision to perform such tests and inspections.

13. During the testing period, under the supervision of the supplier, the Owner shall have unlimited and unrestricted access to the usage and testing of all hardware and software in the system.

14. Spare parts for the system shall also be tested during this test period. The supplier shall prove by temporarily connecting the spare hardware to the system that any or all of the spare parts function in a manner equivalent to the original equipment under test.

15. The System Supplier shall pay all expenses incurred by his personnel who includes labor, material, transportation, lodging, daily subsistence, and other associated incidental costs during the factory testing.

16. Faulty and/or incorrect hardware operation of major portions of the system may, at the discretion of the Owner, be cause for suspension or restarting of the entire factory test, at no additional cost to the Owner or extension in contract time.

17. The factory test will be considered complete only when the system setup has successfully passed all tests both structured and unstructured to the satisfaction of the Owner and the Factory Test checkout form TF11 has been signed & dated by Owner. No equipment shall be installed without authorization from the Owner that the factory test has been completed. Equipment that were shipped to the jobsite without authorization shall be shipped back to the System Supplier for witness testing at no additional cost to Owner.

18. All modifications to drawings and documentation as a result of the factory tests shall be corrected and completed before shipment of drawings with equipment and the submittal and delivery of “operation and maintenance” manuals.

19. Copies of the completed and witnessed factory testing forms shall be placed in the Operation and Maintenance Manual.

E. Electrical Field Tests

1. Prior to any field testing, Interconnection Drawings and Operation & Maintenance Manuals shall have been submitted by the Contractor and approved by the Owner.

2. Engage and pay for the services of an approved qualified testing company for the purpose of performing inspections and tests as herein specified. The testing company shall provide all material, equipment, labor and technical supervision to perform such tests and inspections.

3. Complete and submit "Schedule Test Request Form," as illustrated in Appendix "A," for each electrical field test.

4. The Contractor shall be at the jobsite to assist with all Electrical Field Tests.

5. All test forms shall list all test equipment used to perform calibration and date of last calibration.

6. The first set of tests to be performed shall determine the suitability for energization and shall be completed with all power turned off and complete prior to the start of any of the Post-Energization Tests. The Contractor shall have qualified personnel on the job site for all Pre-Energization and Post-Energization tests.

7. The following test forms shall list all test equipment used to perform calibration and date of last calibration:

   a. TF1 Power and Control Conductor Test Form
   b. TF2 Instrumentation Conductor Test Form
   c. TF3 Grounding System Test Form
   d. TF5 Panelboard Test Form
   e. TF8 MCC Device Test Form
   f. TF9 Breaker Device Test Form
   g. TF10 Motor Test Form1
   h. TF12 Harmonic Measurements Test Form
   i. TF13 I/O Point Checkout Test Form
   j. TF14 Instrument Data Sheet and Calibration Record Test Form
   k. TF15 VFD or Soft Starter Program Parameter Record Sheet
   l. TF17 Radio Test Report

8. Pre-Energization Tests: These tests shall be completed prior to applying power to any equipment.

   a. Field Inspections

      1) Visual and Mechanical

         a) Vacuum and clean the inside of all MCC and electrical and instrumentation enclosures prior to start of factory test.

b) Inspect for physical damage, proper anchorage, and grounding.

c) Compare equipment nameplate data with design plans and starter schedule.

d) Compare overload setting with motor full load current for proper size.

2) Performed NETA acceptance testing for each piece of equipment.

3) The Testing Company shall compile, by visual inspection a record of all motor nameplate data, the following minimum data shall be neatly tabulated in spreadsheet form and submitted to Owner:

a) Manufacturer

b) Part and model number

c) Equipment driven

d) Motor horsepower

e) Nameplate amperes, volts and phase

f) Service factor

g) Temperature ratings

h) Overload catalog number

i) Overload current range and setting

j) Circuit breaker rating

k) Circuit breaker trip setting, for magnetic only circuit breakers.

4) Complete, for each piece of equipment, Test Form TF4 located in Appendix "A".

b. Torque Connections

1) All electrical, mechanical and structural threaded connections inside equipment shall be tightened in the field after all wiring connections have been completed. Every worker tightening screwed or bolted connections shall be required to have and utilize a torque screwdriver/wrench at all times. Torque connections to the value recommended by the equipment manufacturer. If they are not available, use NEC 110-14 as guidelines.

c. Wire Insulation & Continuity Tests

1) All devices that are not rated to withstand the 500V megger potential shall be disconnected prior to the megger tests.

2) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for ten seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor to conductor and conductor to ground. These tests shall be made

on cable after installation with all splices made up and terminators installed but not connected to the equipment.

3) Each megger reading shall not be less than 10 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms. Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 10 Meg-ohms shall be replaced.

4) Each instrumentation conductor twisted shielded pair shall have the conductor and shield continuity measured with an ohmmeter. Conductors with high ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

5) Complete test forms Power and Control Conductor Test Form TF1 and Instrumentation Conductor Test Form TF2 located in Appendix "A".

d. Grounding System Tests

1) Visual and Mechanical Inspection.

a) Verify ground system is in compliance with drawings and specifications.

2) Electrical Tests

a) Before making connections to the ground electrodes, and before placement of sidewalks, landscape and paving, measure the resistance of each electrode to ground using a ground resistance tester. Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated.

b) After all individual ground electrode readings have been made, interconnect as required and measure the system's ground resistance.

c) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

d) The grounding test shall be in conformance with IEEE Standard 81.

e) Plots of ground resistance shall be made and submitted to the Owner for approval.

f) The current reference rod shall be driven at least 100 feet from the system under test.

g) Measurements shall be made at 10 feet intervals beginning 25 feet from the test electrode and ending 75 feet from it in a direct line between the system being tested and the test electrode.

h) The resistance between the main grounding electrode and ground shall be no greater than five ohms for commercial or industrial systems for generating or transmission station grounds per IEEE Standard 142.

3) Test Values

a) Investigate point-to-point resistance values that exceed 0.5 ohms.

b) Complete Grounding System Test Form TF3 located in Appendix "A"

e. Panelboard Test

1) Visual and Mechanical Inspection:

a) Inspect for physical damage, proper anchorage and grounding.

b) Compare equipment nameplate data with design plans and starter schedule.

c) Compare breaker legend for accuracy.

d) Check torque of bolted connections.

2) Complete Panelboard Test Form TF5 located in Appendix "A".

9. Post Energization Tests

a. MCC Control System Tests

1) Component Tests

a) Measure insulation resistance of starter phase to phase and phase to ground with the starter contacts closed and the protective device open. Test voltage and minimum acceptable values shall conform to NETA Section 3 "Test Values." Measure insulation resistance of each control circuit with respect to ground.

b) Motor overload units shall be tested by injecting primary current through overload unit and monitoring trip time.

c) Test the motor circuit protectors and thermal breakers as specified herein.

2) Control Tests

a) Remove motor overload heaters from each motor starter or disconnect pump/motor coupling. In case the motor overload heaters are fed by current transformers, the motor conductors shall be removed and insulated away from the load lugs of the motor starter.

b) Verify the pump control circuits are wired and operate as shown on the elementary diagrams. Check the indicator lights, alarm lights, local & remote selector

switches, alarm contacts, power fail relays, overloads, etc., for proper operation.

c) Reinstall all heaters and all wiring removed for this test.

3) Complete Operational Device Checks and Tests Form TF6 and MCC Device Test Form TF8 located in Appendix “A”.

b. Breaker Test

1) All MCPs and breakers shall be checked for proper mounting, conductor size, and feeder designation. Operate circuit breaker to ensure smooth operation. Inspect case for cracks or other defects. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

2) All Thermal magnetic (TM) breakers 100 amps and above shall be tested. Time current characteristic tests shall be performed bypassing three hundred percent (300%) rated current through each pole separately. Trip time and amps shall be determined. Instantaneous pickup current shall be determined by run up or pulse method. Clearing times should be within four (4) cycles or less. At end of test the thermal breakers shall be set by Contractor for proper coordination.

3) All MCPs breakers shall be tested by current injection method. Time current characteristic tests shall be performed bypassing rated current of trip setting value through each pole separately. At end of test the MCP breakers shall be set by Contractor to the proper multiple of the full load motor amp.

4) The ground fault protection system shall be performance tested when first installed on site per NEC 230.95(C). The test shall be conducted per manufacturer’s instructions.

5) Contact and Insulation Resistance: Contact resistance shall be measured and be compared to adjacent poles and similar breakers. Deviations of more than 50% shall be reported to Owner. Insulation resistance shall be measured and shall not be less than 50 megohms. All trip times shall fall within NETA Table values. Instantaneous pickup current levels should be within 20% of manufacturer's published values.

6) Complete MCC Device Test Form TF8 and Breaker Test Form TF9 located in Appendix “A”.

c. Phase Rotation Tests

1) Check connections to all equipment for proper phase relationship. During this test, disconnect all devices which could be damaged by the application of voltage or reversed phase sequence. Three phase equipment shall be tested for the phase sequence "ABC" front to back, left to right, and top to bottom.

2) All three phase motors shall be tested for proper phase rotation. Revise wire color codes to indicate correct phase color if wires are swapped.

3) Complete Phase Rotation Test Form TF7 located in Appendix "A".

d. Motor Testing

1) Record the amperage draw on all phases of each motor operating under full load. Ensure that these values do not exceed the motor nameplate full load amperage.

2) Record the voltage between all phases of each motor operating under full load. If the voltage balance is not within plus or minus 5 percent of nominal, request the Utility power company or other responsible party to correct the problem.

3) Compile, by visual inspection of equipment installed for each motor, the following data in neatly tabulated form and be placed in the O&M manual:

a) Equipment driven.

b) Motor horsepower.

c) Nameplate amperes.

d) Service factor.

e) Temperature rating.

f) Overload catalog number.

g) Overload current range and setting.

h) Circuit breaker rating.

i) Circuit breaker trip setting, for magnetic only circuit breakers.

4) Complete Motor Test Form TF10 located in Appendix "A".

e. Control System Tests

1) All the new I/O points for the PLC shall be tested by the supplier in the field for proper operation of alarms, status, analog, control, and operator display functions. Each of the control strategies listed in Section 40 70 00 shall be tested and demonstrated to Owner for compliance by the System Supplier. Testing shall be accomplished using simulated inputs only with prior written approval of the Owner.

2) All the I/O points for the PLC shall be tested by the Owner with assistance from Contractor for proper panel wiring. Where practical, the final element shall be used, i.e., trip the intrusion switch or change levels. During this task the Contractor shall have:

a) Qualified field technician with experience in the startup of similar systems to operate the PLC and other field devices.

b) Test instruments as required.

c) A pair of radios for communication.

3) Electrical Tests

a) Perform operational tests by initiating control devices to affect proper operation.

4) Complete “I/O point Checkout Test Sheet” TF13 located in Appendix “A”.

f. Instrumentation Tests

1) Instrumentation tests shall be conducted per the following criteria:

a) As a minimum, all the tests indicated/specified on the test form TF14 in appendix "A" shall be performed by the Contractor for each of the instruments listed in Section 40 70 00- Instrument & Device Index:

b) The overall accuracy of each instrument loop shall be checked to ensure that it is within acceptable tolerance.

2) Calibration stickers shall be supplied for all equipment and instruments. Calibration stickers shall list the following information:

a) Tag number.

b) Calibrated by whom (name), firm, city and telephone number.

c) Date calibrated.

d) Calibration range.

e) Comments.

3) Provide a minimum of two (2) hours of field acceptance testing for each instrument. If any instrument has not been fully tested during its allotted time, the Contractor shall provide additional hours for finishing testing of the instrument, to be paid by the Contractor.

g. Program Parameter Record

1) Complete “VFD” or Soft Starter “SSS” Program Parameter Record Sheet” TF15 for each VFD/SSS provided on this project. These parameter record sheets shall be filled out by a qualified System Supplier field technician when power in field is first applied to each VFD/SSS. Completion of VFD/SSS record sheets shall be witnessed by Owner and copies proved to Owner on day records are filled in by Contractor. A copy of all completed VFD/SSS parameter record sheets shall be placed in O&M manual.

h. VFD measurement and tests:

1) Measure the voltage and current 5th, 7th, 9th, 11th harmonics at the load side of the ATS with a harmonic analyzer with the each combination of pumps or as designated by Owner at start-up in operation on the utility source and Generator source. Measure and record the results, per the Harmonic Measurements Test Form TF12.

i. Radio Tests

1) Install the radio and antenna system per the radio manufacturer's Installation Operation and Field Maintenance Manual. Pay for the services of radio manufacturer's trained and qualified Radio Technician to perform the following Setup and Field Tests and perform any of the manufacturer's recommendations based on the results of the tests. Notify the Owner or the Owner's representative one week in advance of the test in order to have all setup, tests, and adjustments performed by the Radio Technician witnessed by the Owner. Complete Radio Test Form TF17 located in Section 26 00 00 Appendix A and submitted to the Owner. The Radio Technician shall perform the following as a minimum for the radio system:

a) System address - Configure the radio using the diagnostic software to use a system address (other than the default address the radio is shipped with) as directed by Owner. The station radio operating mode shall be as a remote.

b) Data rate - The communication's data rate shall be set to match existing radios.

c) Radio DC voltage check - Measure the supply voltage and adjust to the voltage rating with the transmitter keyed. During normal operation, re-measure the power supply voltage, and ensure that it does not drop below the minimum or above the maximum radio rating when switching between receive and transmit.

d) Transmitter power output - Under Section 15.247 of the FCC Rules, the radio power must be reduced to a level that results in an effective isotropic radiated power (EIRP) signal of the radio license. The EIRP is dependent on the radio transmit output power, the antenna feedline loss, and the antenna gain. Antenna gain shall be measured in the field utilizing the VSWR or forward/reflected power method. Follow the Manufacturer's recommended procedure to adjust the power output of the radio. Under no circumstances should the radio's system EIRP exceed the radio license.

F. Operational Testing

1. After all the previous tests in this subsection are complete, conduct operational testing.

2. During operational testing avoid surging discharge to the water distribution system.

3. Demonstrate operation of each part of the electrical, control and instrumentation systems to the satisfaction of the Owner. Tests shall be repeated by the Contractor at no additional cost to the Owner and at the discretion of the Owner to resolve whether the system has been demonstrated that it will operate under all modes of operations and varying conditions.

4. For the operational testing the new equipment shall be activated to automatically run for 5 days, 24 hours per day, Monday through Friday. During this five day period the Owner will run the different combinations of the pump control options. If equipment failure occurs during the 5 days of operational testing, repair or replace the defective equipment and shall begin another 5 day operational test, Monday through Friday. This shall be continued until the new equipment functions acceptably for 5 consecutive days.

5. The Contractor, any relevant subcontractors, testing firm and System Supplier shall re-visit the jobsite as often as necessary until all field tests, start-up and operation tests are completed and approved.

G. Final Acceptance Trial Period

1. The system shall not be "final" accepted unless the system functions without hardware failures or software problems during a 30 day trial period, to the satisfaction of the Owner. The Owner reserves the right to restart the 30 day trial period, at their discretion, when a major hardware failure has occurred or a software problem has been identified. The Owner will notify the Contractor when the 30 day trial period has been satisfactory completed.

H. The completion of the above tests does not relieve the Contractor from warranties specified herein.

3.11 SPARE PARTS

A. Supply all spare parts prior to start of field tests. All parts shall be sealed in plastic bags and delivered to the site in a heavy duty plastic storage bag. Bag shall be clearly labeled with part name & number and the corresponding equipment tag name.

B. Make available any replacement parts that are not manufacturer's normal stock items for immediate service and repair of all the instrumentation equipment throughout the warranty period.

C. The following spare parts shall be provided to the Owner prior to start of field test as part of this Contract:

1. Ten (10) fuses for each type of fuse.
2. Twenty (20) lamps for each type of removable indicating light.
3. Two (2) relays with bases for each type of control, and time delay relay.
4. One (1) power fail relay.
5. One (1) spare PLC, and AI & AO module for each type supplied.

3.12 TRAINING

A. All training sessions shall be held on dates and times agreeable to Owner. A total of 6 or less Owner personnel shall be trained. Training sessions shall not take place on dates when field testing is occurring.

B. After Operation Testing has started provide a period of not less than 8 hours training for instruction of operation and maintenance personnel in the use of all the new control and instrumentation systems. Make necessary arrangements with manufacturer's representative. Provide product literature and application guides for user's reference during instruction.

C. The following training sessions shall be provided:

1. Arc Flash Training: The Supplier shall train Owner personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures shall be in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces and shall be provided in the equipment manuals.
2. Provide forty (40) hours minimum of “Operator” hands on Operator Interface training. Training shall also include training on the new Operator Interfaces.
3. 2 hours – “ATS” operating and maintenance procedures by System Supplier.
4. 2 hours – “Power Monitor” operating and maintenance procedures by System Supplier.
5. Provide 4 hours “VFD Setup” operating and maintenance procedures by System Supplier.
6. The "diagnostic and calibration" training, eight (8) hours minimum, shall demonstrate PLC hardware diagnostic routines, test equipment, PLC communication setup, and test procedures as required to enable the personnel to detect and isolate system faults to the circuit board or module level and to implement repairs by replacing failed circuit boards or modules. Demonstrate uploading and downloading software to make backups and restore programs.

D. Acceptable Operation and Maintenance Manuals shall be on site and available when training sessions are implemented.

3.13 WARRANTY

A. Warrant all electrical and instrumentation equipment & software for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.

B. Provide all labor and material to troubleshoot, replace, or repair any hardware or software that fails or operates unpredictable during the warranty period, at no additional cost to the Owner.

C. Provide a staff of experienced personnel available to provide service on 2 working days' notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the hardware & software and implementing corrective measures.

D. If the Contractor "fails to respond" in 2 working days, the Owner at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. "Fail to respond" shall be defined as: The Contractor has not shown a good faith effort and has not expended adequate resources to correct the problem. The use of other resources, as stated above, shall not change or relieve the Contractor from fulfilling the remainder of the warranty requirements.

E. Prior to "final acceptance", furnish to the Owner a listing of warranty information for all manufacturers of materials and equipment used on the project. The listing shall include the following:

1. Manufacturer's name, Material and equipment description, equipment number, part number, serial number, and model number.
2. Manufacturers service contact person, phone number, and address.
3. Warranty expiration date.

F. Each time the Supplier's repair person responds to a system malfunction during the warranty period, he or she must contact the designated Owner maintenance supervisor for scheduling of the work, access to the jobsite, and permission to make repairs. Operation of facilities necessary to test equipment shall only be performed by or under the direction Owner staff. Owner reserves the right at its sole discretion to deny operations requested by the Supplier. A written description of all warranty work performed shall be documented on a field service report to be given to Owner prior to the repair person leaving job site. This field service report shall detail and clearly state problem, corrective actions taken, additional work that needs to be done, data, repair person name and company.

3.14 FINAL ACCEPTANCE

A. Final acceptance will be given by the Owner after the equipment has passed the "final acceptance trial period", each deficiency has been corrected, final documentation has been provided, and all the requirements of design documents have been fulfilled.

B. Upon completion of the project, prior to final acceptance, remove all temporary services, equipment, material, and wiring from the site.

C. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Supplier shall provide the following to the Owner:

1. Remove all temporary services, equipment, material, and wiring from the site.
2. Verify Service equipment has been legibly marked in field with the maximum available fault current per NEC 110.24 (A). Field marking shall include date the fault current calculation was performed and be weather & UV rated. Service equipment shall not be hand labeled
3. Two sets of all keys for locks supplied on this project. Submit each key with matching duplicate. Wire all keys for each lock securely together. Tag and plainly mark with lock number or equipment identification, and indicate physical location, such as panel or switch number.
4. Verify that as-installed drawings, in reinforced clear plastic pockets, have been placed in all panels
5. Resubmit all Electrical System Analysis studies with all calculations rerun, data and graphs updated to reflect as-left conditions. Provide new Arc Flash labels to reflect as-constructed equipment and as-left circuit breaker settings.
6. Provide the following final documentation to the Owner:
    a. A list of names, addresses and phone numbers of service personnel to be contacted for warranty work.
    b. Two (2) Electrical Systems Analysis DVDs of as-built set of studies, reports, settings, etc. and source files per Section 26 05 73.
    c. Operations and Maintenance Manual – Each "operation and maintenance" manual shall be modified or supplemented by the Supplier to reflect all field changes and as-built conditions.
    d. Record full size drawings neatly marked accurately showing the information required herein.
    e. Two (2) disk copies of all final documentation to reflect as-built conditions.
    f. Four (4) USB drives with copies of all final documentation to reflect as-built conditions.
    g. At least one set of manuals, all software, disks and required programming cables shall be turned over to the Owner's SCADA/Electrical division.

SECTION 26 00 00

APPENDIX "A"

TEST FORMS

Index of Forms:

BILL OF MATERIAL

PROJECT: ______________________________ **DATE** ___/___/___
LOCATION: ______________________________ **PAGE** ________

SPECIFICATION SECTION	QTY	DESCRIPTION	MFG.	PART NUMBER	TAG No.

SCHEDULED TEST REQUEST FORM

COMPANY PERFORMING TEST: _____
TESTING PERSONNEL : _____ _____
PHONE NUMBER OF COMPANY: _____
TEST PROCEDURE SUBMITTAL: _____ APPROVED : ___/___/___
SCHEDULED TEST DATE : _____ DATE : ___/___/___

TIME	DESCRIPTION OF TEST
8:00	
9:00	
10:00	
11:00	
12:00	
13:00	
14:00	
15:00	
16:00	

NOTES:

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

POWER AND CONTROL CONDUCTOR TEST FORM

TEST FORM (TF1)

EQUIPMENT

NAME : _____ LOCATION : _____

CALIBRATION EQUIPMENT DATE: _____

DESCRIPTION _____

CONDUCTOR NUMBER	INSULATION TESTS					
	PHASE TO GROUND			PHASE TO PHASE		
	A	B	C	AB	BC	CA

NOTES:

Record insulation test values in meg-ohms.

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

INSTRUMENTATION CONDUCTOR TEST FORM

TEST FORM (TF2)

EQUIPMENT

NAME : _____ LOCATION : _____

CALIBRATION EQUIPMENT DATE: _____

DESCRIPTION : _____

CONDUCTOR PAIR NUMBER	CONTINUITY TESTS		INSULATION TESTS		
	CONDUCTOR TO CONDUCTOR	CONDUCTOR TO SHIELD	CONDUCTOR TO CONDUCTOR	CONDUCTORS TO GROUND*	SHIELD TO GROUND

NOTES:

Record continuity test values in ohms.

record insulation test values in meg-ohms.

* With both conductors tied together

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

GROUNDING SYSTEM TEST FORM

TEST FORM (TF3)

CALIBRATION EQUIPMENT DESCRIPTION : DATE: _____

FALL IN POTENTIAL TEST

MAIN GROUND LOCATION	APPLIED VOLTAGE V	MEASURED POINT 1 VOLTAGE	MEASURED POINT 2 VOLTAGE	MEASURED POINT 3 VOLTAGE	CALCULATED RESISTANCE OHMS

TWO POINTS TESTS

EQUIPMENT NAME	EQUIPMENT #	CIRCUIT #	APPLIED CURRENT	MEASURED VOLTAGE	CALCULATED RESISTANCE OHMS

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

VISUAL AND MECHANICAL INSPECTION FORM

TEST FORM (TF4)

EQUIPMENT

NAME : _____ LOCATION : _____

NAMEPLATE DATA

MFGR. :	_____	SERIES # :	_____
MODEL # :	_____	U.L. # :	_____
VOLTAGE :	_____	PHASE :	_____
AMPERAGE :	_____	SERVICE :	_____
BUS TYPE :	_____	BUS BRACING:	_____
VERT. BUS :	_____	HORZ. BUS :	_____
GND. BUS :	_____	NEU. BUS :	_____
ENCLOSURE :	_____		_____
	_____		_____

INSPECTION CHECK LIST

ENTER: A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

TIGHTEN ALL BOLTS AND SCREWS	_____
TIGHTEN ALL WIRING AND BUS CONNECTIONS	_____
VERIFY ALL BREAKERS AND FUSES HAVE PROPER RATING	_____
CHECK BUS BRACING AND CLEARANCE	_____
CHECK MAIN GROUNDING CONNECTION AND SIZE	_____
INSPECT GROUND BUS BONDING	_____
CHECK EQUIPMENT GROUNDS	_____
CHECK CONDUIT GROUNDS AND BUSHINGS	_____
INSPECT NEUTRAL BUS AND CONNECTIONS	_____
CHECK HEATERS AND THERMOSTATS	_____
CHECK VENTILATION AND FILTERS	_____
CHECK FOR BROKEN OR DAMAGED DEVICES	_____
CHECK DOOR AND PANEL ALIGNMENT	_____
INSPECT ANCHORAGE	_____
CHECK FOR PROPER CLEARANCES AND WORKING SPACE	_____
REMOVE ALL DIRT AND DUST ACCUMULATION	_____
INSPECT ALL PAINT SURFACES	_____
CHECK FOR PROPER WIRE COLOR CODES	_____
INSPECT ALL WIRING FOR WIRE LABELS	_____
CHECK FOR PROPER WIRE TERMINATIONS	_____
CHECK FOR PROPER WIRE SIZES	_____
INSPECT ALL DEVICES FOR NAMEPLATES	_____
CHECK IF DRAWINGS MATCH EQUIPMENT	_____
CHECK ACCURACY OF OPERATION & MAINTENANCE	_____
	_____

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

PANEL-BOARD TEST FORM

TEST FORM (TF5)

PANEL NAME: _____ LOCATION : _____

NAMEPLATE DATA

MFGR. :	_____	SERIES # :	_____
MODEL # :	_____	U.L. # :	_____
VOLTAGE :	_____	PHASE :	_____
AMPERAGE :	_____	SERVICE :	_____
BUS TYPE :	_____	BUS BRACING:	_____
VERT. BUS :	_____	HORZ. BUS :	_____
GND. BUS :	_____	NEU. BUS :	_____
ENCLOSURE :	_____	MAIN BKR :	_____

CALIBRATION EQUIPMENT DATE: _____
DESCRIPTION :

INSULATION RESISTANCE TESTS - MEGOHMS					
A-GND	B-GND	C-GND			

INSPECTION CHECK LIST

ENTER: A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

TIGHTEN ALL BOLTS AND SCREWS	_____
TIGHTEN ALL WIRING AND BUS CONNECTIONS	_____
VERIFY ALL BREAKERS AND FUSES HAVE PROPER RATING	_____
CHECK BUS BRACING AND CLEARANCE	_____
CHECK MAIN GROUNDING CONNECTION AND SIZE	_____
INSPECT GROUND BUS BONDING	_____
CHECK EQUIPMENT GROUNDS	_____
CHECK CONDUIT GROUNDS AND BUSHINGS	_____
INSPECT NEUTRAL BUS AND CONNECTIONS	_____
CHECK FOR BROKEN OR DAMAGED DEVICES	_____
CHECK DOOR AND PANEL ALIGNMENT	_____
INSPECT ANCHORAGE	_____
CHECK FOR PROPER CLEARANCES AND WORKING SPACE	_____
REMOVE ALL DIRT AND DUST ACCUMULATION	_____
INSPECT ALL PAINT SURFACES	_____
CHECK FOR PROPER WIRE COLOR CODES	_____
INSPECT ALL WIRING FOR WIRE LABELS	_____
CHECK FOR PROPER WIRE TERMINATIONS	_____
CHECK FOR PROPER WIRE SIZES	_____
INSPECT ALL DEVICES FOR PROPER LEGEND NAMEPLATES	_____
	_____

CALIBRATION TEST EQUIPMENT PART NO.	DATE CALIBRATED:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

OPERATIONAL DEVICE CHECKS AND TESTS FORM

TEST FORM (TF6)

NAME : _____ LOCATION : _____

CUB. #	EQUIPMENT NAME	EQUIP #	LOCAL SITE DEVICE CHECKS AND TESTS							REMOTE SITE DEVICE CHECKS & TESTS		
			SELECTOR SWITCH	INDICATOR LIGHTS	PUSHBUTTON & LOS	METERING & INDICATORS	OVERLOAD RESET	INTERLOCKS & CONTROL	ALARM & STATUS	SELECTOR SWITCH	INDICATOR LIGHTS	PUSHBUTTON & LOS

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY : _____

NOTES:

PHASE ROTATION TEST FORM

TEST FORM (TF7)

EQUIPMENT NAME	EQUIPMENT #	CIRCUIT #	PHYSICAL PHASE LOCATION	PHASE COLOR CODE	MEASURED PHASE ROTATION

NOTES:
Use phase tester to verify all circuits and equipment have a clockwise A-B-C phase rotation.
Physical phase locations: Left to Right - LR or Top to Bottom - TB
Phase color codes: Brown, Orange, & Yellow -BOY
Black, Red, & Blue -BkRBe

CALIBRATION EQUIPMENT DATE : ____/____/____
DESCRIPTION: _____

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

MCC DEVICE TEST FORM

TEST FORM (TF8)

MCC # : _____ CUBICLE : _____

EQUIP NAME: _____ EQUIP # : _____

MOTOR DATA		CONTACTOR DATA			
H.P. :		MFGR. :		PART # :	
F.L.A. :		NEMA SIZE :		COIL VOLT :	

CALIBRATION EQUIPMENT DATE: _____

DESCRIPTION : _____ _____

OVERLOAD TESTS

MFGR. : _____ HEATER # : _____ RANGE : _____

PART # : _____ FINAL OVERLOAD SETTING: _____

TEST AMPS	MEASURE TRIP TIME @ TEST AMPS			MFGR LISTED TRIP TIME	AMBIENT COMPENSATION
	PHASE A	PHASE B	PHASE C		

BREAKER TESTS

MRGR. : _____ PART # : _____ FRAME # : _____

CONTACT RESISTANCE TESTS - OHMS			INSULATION RESISTANCE TESTS-MEGOHMS		
PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

MFGR TRIP TIME @300% MIN:_____ BREAKER RATING / RANGE: _____

MFGR TRIP TIME @300% MAX:_____ FINAL BREAKER SETTING: _____

MFGR INST. PICKUP AMPS: _____

TIME-CURRENT TEST					
TRIP TIME IN SECONDS @ 300% AMPS			INSTANTANEOUS TRIP TEST - AMPS		
PHASE A	PHASE B	PHASE C	PHASE A	PHASE B	PHASE C

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

BREAKER DEVICE TEST FORM

TEST FORM (TF9)

FEEDER : _____ LOCATION : _____
EQUIP NAME: _____ EQUIP # : _____
EQUIP H.P. : _____ EQUIP KVA : _____

MFGR. : _____ PART # : _____ FRAME # : _____
VOLTAGE : _____ INTERRUPT RATING : _____ CHARACTER CURVE: _____

CALIBRATION EQUIPMENT DATE: _____
DESCRIPTION : _____ _____

CONTACT RESISTANCE TESTS - OHMS INSULATION RESISTANCE TESTS - MEGOHMS

PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

MFGR TRIP TIME @300% MIN : _____ BREAKER RATING / RANGE: _____
MFGR TRIP TIME @300% MAX: _____ FINAL BREAKER SETTING : _____
MFGR INST. PICKUP APMS:

TEST-CURRENT TESTS
TRIP TIME IN SECONDS @ 300% AMPS

PHASE A	PHASE B	PHASE C

INSTANTANEOUS TRIP TEST - AMPS

PHASE A	PHASE B	PHASE C

ADDITIONAL TESTS AND SETTING AS APPLICABLE

FUNCTION	PICKUP RANGE	PICKUP SETTING	DELAY-TIME RANGE	DELAY-TIME SETTING	
LONG TIME					
SHORT TIME					
GROUND FLT.					

NOTES:

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

MOTOR TEST FORM

TEST FORM (TF10)

EQUIPMENT

NUMBER : _____ NAME : _____

CALIBRATION EQUIPMENT DATE: _____

DESCRIPTION : _____ _____

NAMEPLATE DATA - FIELD RECORDED

MANUFACTURER		MODEL #		SERIAL #		FRAME #	
H.P.	R.P.M	F.L.A	VOLTS	PHASE	FREQ.	P.F.	S.F.
CODE	N.E.M.A.	INSUL.	ENCLOSR.	DUTY	DESIGN		

CALIBRATION EQUIPMENT

DESCRIPTION : __ _____ DATE: _____

INSULATION TESTS PHASE TO GROUND MEG-OHMS			MOTOR FRAME GROUNDING SYSTEM TEST			MOTOR HEATER	MOTOR THERMAL
			APPLIED	MEAS.	CALC.	MEAS.	TRIP
A	B	C	VOLTS	AMPS	OHMS	AMPS	TEST

MOTOR TESTS - MEASURED VALUES

AMPERAGE			VOLTAGE			POWER	
A	B	C	AB	BC	CA	FACTOR	WATTAGE

NOTES:

VOLTAGE, AMPERAGE, POWER FACTOR, & WATTAGE SHALL BE RECORDED WITH A TRUE RMS METER.

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

FACTORY TEST
MCC/CONTROL PANEL CHECKOUT FORM (TF11)

Manufacturer: _____ **Location:** _____

Tel: _____ _____

Test Equipment: Description _____ Calib Date: _____

MCC / Control Panel: _____ **TEST RESULT**

	Pass	Fail
OVERALL PANEL INSPECTION		
1. All front panel and back panel components mounted securely.....	☐	☐
2. All wiring terminated and labeled correctly.....	☐	☐
3. All components, wiring, and labeling accurately reflected on the drawings..	☐	☐
POWER-UP INSPECTION		
1. Voltage levels on load side of circuit breakers.....	☐	☐
2. Voltage levels at the DC terminals of the power supply.....	☐	☐
3. Voltage levels at the DC power distribution terminals.....	☐	☐
POWER DISTRIBUTION AND GENERAL COMPONENT TESTING		
1. Power distribution to the appropriate components.....	☐	☐
2. Operation of the ancillary components such as receptacles, work lights, etc.	☐	☐
CONTROL COMPONENTS CHECKS		
1. Operators (push buttons, selector switches, pilot lights).....	☐	☐
2. Inputs from External Sources.....	☐	☐
3. Outputs to External Sources.....	☐	☐
4. Relay Logic.....	☐	☐
5. PLC I/O and Program Verification.....	☐	☐
6. O/I Display Verification.....	☐	☐

Notes:

1. For relay logic checks, each rung of the elementary or loop diagram is to be highlighted in yellow as they are verified for correct control functions.
2. For PLC I/O and program verification, the control strategies shall be highlighted in yellow as each logic function is tested.

Tested by: _____ **Witnessed by:** _____

Date: _____

HARMONIC MEASUREMENTS

TEST FORM (TF12)

CALIBRATION EQUIPMENT DATE: _____

DESCRIPTION : _____ _____

PUMP # ____ RUNNING

VFD SPEED	100%	90%	80%	70%	60%	50%
TIME						
AVG. VOLTS						
TOTAL AMPS						
TOTAL KW						
TOTAL KVA						
TOTAL KVAR						
PF						
dP						
VOLTAGE THD						
AMPS THD						
5th						
7th						
11th						
13th						

PUMP # ____ RUNNING

VFD SPEED	100%	90%	80%	70%	60%	50%
TIME						
AVG. VOLTS						
TOTAL AMPS						
TOTAL KW						
TOTAL KVA						
TOTAL KVAR						
PF						
dP						
VOLTAGE THD						
AMPS THD						
5th						
7th						
11th						
13th						

I/O POINT CHECKOUT TEST FORM

TEST FORM (TF13)

I/O TYPE : _____ LOCATION : _____

TEST EQUIPMENT : _____ CAL. DATE : _____

I/O POINT TAGNAME	I/O POINT ADDRESS	TEST INPUT VALUE %			DISPLAY VALUE %			PLC REGISTER VALUE	TEST RESULT FAIL OR PASS COMMENTS	DATE OF CORRECTIVE ACTION
		0	50	100	0	50	100			

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

INSTRUMENT DATA SHEET AND CALIBRATION RECORD
TEST FORM (TF14)

Component Description	Manufacturer	Location
	Name	Site
Component Tag Name	Model	Equip
	Serial #	

	Range	Unit
Indicator Range		
Input Range		
Output Range		

Test Equipent	
Description:	
Calibration Date:	

General Notes

1) Attach Calibration Curves for dp Flowmeters

2) Include mounting elevations for level Instruments

3) All entries within solid box to be typed in prior to start of test

Designed Calibration			Measured Calibration		
Input Signal	Output	Eng. Value	Input	Output	Comments

Notes

Tested by (Print Name) Witnessed by (Print Name)

Signature Signature

Date / / Date / /

VFD OR SOFT STARTER PROGRAM PARAMETER RECORD SHEET

TEST FORM (TF15)

EQUIPMENT

NAME : _____ LOCATION : _____

PARAMETER NUMBER	PARAMETER DESCRIPTION	DEFAULT SETTING	FIELD SETTING

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

RADIO TEST REPORT

TEST FORM (TF17)

RADIO FREQUENCY : _____ RADIO MANUFACTURER : _____
RADIO MODEL # : _____ SERIAL # : _____
LOCATION : _____

PARAMETER	INITIAL VALUE	FINAL VALUE
CHANNEL/HOP PATTERN		
SYSTEM ADDRESS		
OPERATING MODE		
DATA RATE		
BUFFER		
CTS TIMER		
TIME-OUT TIMER		
LOOPBACK CODE		
SOFTWARE REVISION		
HOPPER BOARD REVISION		
FREQUENCY LOCKOUTS		
DC VOLTAGE WHEN TRANSMITTING		
RADIO POWER OUTPUT (WATTS)		
MATCH EFFICIENCIES		
RETURN LOSS		
ANTENNA VSWR (REFLECTED POWER)		
EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)		

NOTES: CHECK OUT ALL COMPONENTS FOR PROPER GROUNDING.

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

END OF SECTION

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall assemble, ready for use, the electrical and instrumentation system with wires, fuses and terminal blocks as specified herein.

B. Furnish all required labor, materials, tools, test equipment, incidentals, and services to provide a complete and operational electrical and instrumentation system with wire and electrical devices as shown on the Drawings, included in these Specifications, or required for fully operating facilities.

C. Work includes that specified in Section 26 00 00 - Electrical.

1.2 SUBMITTALS AND DRAWINGS

A. Provide submittals and drawings as specified in Section 26 00 00 - Electrical, SUBMITTAL AND DRAWING REQUIREMENTS.

1.3 QUALITY ASSURANCE

A. All materials selected for the manufacture of the hardware shall be the best available for the purpose for which they are used, considering strength, ductility, durability and the best engineering practice.

B. All like parts shall be interchangeable.

PART 2 - PRODUCTS

2.1 WIRING AND ELECTRICAL DEVICES

A. General

1. The electrical and instrumentation system vendor shall provide the wiring and electrical devices specified below and install these field and internal panel wiring as shown on the Contract Drawings. This section applies to all wires or conductors used internal (non-field) for all electrical equipment or external for field wiring. Wire quantity and size shall be per “Wire Routing and Conduit Schedule.”

2. All wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and manufacturer's name.

3. All wires shall be properly fused or protected by a breaker at the amperage rating allowed by the NEC.

4. Extra wire was intentionally placed in the “Conduit & Wire Routing Schedule” and shall be labeled on both ends with a unique wire label as spares.

B. Power Distribution

1. Each electrical and instrumentation panels shall be equipped with a 120 VAC main power disconnect circuit breaker and power distribution circuit breakers. The main power disconnect breaker shall be a one pole breaker rated at panelboard feed breaker amps. Distribution circuit breakers shall be single pole. The circuit breakers shall be mounted on a standard DIN rail, and shall be Allen - Bradley Channel Mounting Type, or equal.

2. For each power distribution circuit breaker, a neutral return terminal block shall be installed at the bottom of the breaker rail. The neutral return terminal block shall be standard DIN rail mounted, and shall be rated to carry up to 20 amperes and accept up to two 12 AWG wires.

3. Each control and instrumentation device shall have a separate fuse for 120 VAC power supply connection.

4. A spare duplex outlet wired to a separate panelboard circuit shall be provided in each control and instrumentation panel. This outlet shall be labeled “CONVENIENCE RECEPTACLE” and shall not be used to power any other equipment. Label receptacle with panelboard and circuit number fed from.

C. Analog Signals

1. Analog signal transmission between electric or electronic instruments shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Provide isolated current amplifiers wherever the loop load resistance exceed the current signal transmitter's rating. Associated shunt resistors shall be located on rail-mounted terminal blocks. Exposed resistor leads shall be insulated with heat-shrink tubing.

D. Low Voltage Wire and Cable

1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits. This Section applies to all wires or conductors used internal for all electrical equipment or external for field wiring. Wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and manufacturer's name.

2. Control and Power Wiring:

   a. NEMA standards WC70 and UL requirements.

   b. Class B stranding. Solid wire conductor prohibited.

c. Conductors shall be copper with a minimum of 98% conductivity.

d. ASTM B8, soft drawn copper, maximum 12 months old.

e. Insulation type for conductors smaller than #6 AWG shall be moisture and heat resistant thermoplastic NEC Type THHN/THWN, rated 90 °C in dry locations and 75 °C in wet locations, or approved equal. Conductors #8 AWG and larger shall be XHHW insulation rated 90 °C in dry locations and 75 °C in wet locations.

f. Insulation of all conductors shall be rated 600 volt or higher.

g. Field wire minimum AWG sizes:

1) #12 for wires used for individual conductor circuits 100 volt and above, except for PLC I/O which may be #14 AWG.

2) #14 for wires used for individual conductor circuits below 100 volt.

h. Non-field or equipment wire minimum AWG sizes if properly protected by fuse or breaker:

1) #14 for wires used for individual conductor circuits 100 volt and above, except for PLC I/O wiring which may be #16.

2) #18 for wires used for individual conductor circuits below 100 volt.

3. Instrument Cable

a. All 4-20mA and 1-5VDC inside instrument and control panel cables wiring shall conform with the following:

1) Signal wiring shall be shielded twisted pair with #18 AWG tinned copper stranded conductors and shield drain conductor.

2) Conductor insulation shall be polyethylene rated 300VAC, 90° C and outer jacket shall be PVC.

3) A metal foil shield shall completely surround the signal conductors.

4) Multiple pair cables with individually shielded pairs may be used only with prior approval of the Owner.

b. All field 4-20mA instrument cables shall conform with the following:

1) Signal wiring shall be shielded twisted pair with a minimum #16 AWG, tinned copper stranded conductors and shield drain conductor.

2) Conductor insulation shall be polyethylene rated 600VAC, 90° C and outer jacket shall be PVC and be “Tray Cable” rated.

3) A metal foil shield shall completely surround the signal conductors.

4) Multiple pair cables with individually shielded pairs may be used only with prior approval of the Owner.

c. Instrument Cables shall be Belden, or approved equal. Note, multi-pair T.S.PR. Cables may be reduced in size to that listed in Conduit and Wire Routing Schedule.

4. Special Purpose Wiring

a. Manufacturer Supplied Cables: Cables and wiring for special systems shall be provided by the manufacturer with the equipment and installed per the manufacturer's recommendations.

b. Generator Lead Cables: Generator lead cable have very flexible Class K (30 awg) stranding with PVC insulation and jacket. Cable shall be rated for 600 volt, 90 deg C. and be oil and gas resistant. Cable shall be Carol Diesel Locomotive Cable or approved equal.

c. VFD rated wire: All VFD load side power wiring shall have rated blended composite semi-conductive, tray cable rated, UL type TC 90°C insulation and 100% shielding with foil tape & tinned copper braid. Wire shall be Olflex – VFD CT or approved equal.

d. CAT 6 Cable

1) CAT 6 communication cable in underground (UG) conduit shall meet the following requirements:

a) TIA/EIA-568-D Category 6 100 MHz specifications.

b) #24 AWG solid bare copper conductor, 4 or 25 pair shielded twisted pair per “Conduit & Wire Routing Schedule”.

c) Rated for direct burial application.

d) 600V rating.

e) Insulation: Solid Polyolefin.

f) Filling compound: 80°C extended thermoplastic rubber.

g) Outer Jacket: Black, water and UV resistant polyethylene.

h) Electrically continuous aluminum shield.

i) Communication cable shall be Superior Essex OSP Broadband Category 6 Outside Plant Cable or approved equal.

2) Indoor CAT 6 communication cable meet the following requirements:

a) TIA/EIA-568-D Category 6 100 MHz specifications.

b) #24 AWG solid bare copper conductor, 4 twisted pairs.

c) Polyolefin insulation.

d) Shielded bulk cable.

e) PVC jacket.

f) Nominal Impedance: 100 ohms.

g) Nominal capacitance: 15 pf/ft. maximum.

h) UL listed.

i) Non-plenum usage rated when routed in conduit.

j) Plenum usage rated when routed in plenum spaces.

k) Cable shall be rated for water.

E. Color Code

1. The color code of all wire shall conform with the following table:

WIRES COLOR CODE TABLE

DESCRIPTION	PHASE/CODE LETTER	FIELD WIRE OR TAPE COLOR	NON-FIELD WIRE COLOR
480 V, 3 PHASE	A	BROWN	BROWN
	B	ORANGE	ORANGE
	C	YELLOW	YELLOW
240 V or 208 V, 3P	A	BLACK	-
	B	RED (ORANGE if high leg)	-
	C	BLUE	-
240 / 120 V, 1 P	L1	BLACK	BLACK
	L2	RED	-
12V POSITIVE	12P	DARK BLUE	DARK BLUE
12V NEGATIVE	12N	BLACK/RED STRIPE	BLACK/RED STRIPE
24V POSITIVE	24P	PINK	PINK
24V NEGATIVE	24N	BLACK/WHITE STRIPE	BLACK/ WHITE STRIPE
AC CONTROL		VIOLET	RED (YELLOW FOR FOREIGN CIRCUITS)
DC CONTROL		LIGHT BLUE	LIGHT BLUE
NEUTRAL	N	WHITE	WHITE
GROUND	G	GREEN	GREEN
SHIELDED PAIR	+	CLEAR (WHITE)	CLEAR (WHITE)
	-	BLACK	BLACK

2. All wires #8 and below shall have wire insulation the color specified. Wires #6 and larger may be black with color tape.

3. No other colors shall be used without prior approval of the Owner.

4. The same color shall be connected to the same phase throughout the panel.

5. All wires shall be properly fused or protected by a breaker at the amperage rating allowed by the NEC.

6. Neutral wires used for AC Control shall be White per NEC.

F. Wire Marking

1. Wire identification - all wires, field and interior to equipment, shall be identified with machine printed sleeve markers. Hand lettered wire labels and clip-on markers are not acceptable and shall be replaced at the Contractor's expense. The wire labeling code for each end of the same wire shall be identical. Tubing shall be sized for the wire and shrunk into place with the properly sized heat gun. Labels shall not be wrap around or snap-on type.

2. The wire identification code for field and panel wiring shall be the number/letter designated on the "Contract elementary" and "Supplier loop" diagrams. Wire labels shall be T&B SM series, Pass & Seymour CAB3, or approved equal.

3. Wire labeling may be omitted on locally interconnected neutral wires such as jumpers between adjacent auxiliary relay coil neutral terminals. "Locally" is defined as wires no longer than 8".

4. Wire labels for lighting and receptacles shall be installed and consist of the panelboard and circuit number (i.e., Panelboard “LP1”, circuit breaker #3 would have wire label line “LP1-L3” and neutral “LP1-N3”).

5. All spare wires shall be labeled with equipment number followed by X1, X2, etc. (i.e., P11001-X1 for first spare wire).

6. Ethernet patch cables and fiber cables shall be labeled with primary devices it is connected to (i.e. “PLC”, “OI”, “PLC-2” etc.). Label shall be white plastic with black machine printed lettering as produced by a KROY or similar machine with lettering no smaller than 3/8”. Securely attach to cable with clear tape.

G. Terminal Blocks and Fuses

1. Control Panel Terminal Blocks:

   a. Terminal blocks to be clamp type, 6mm spacing, 600 volt, minimum rating of 30 amps, and mounted on DIN rail, Entrelec M4/6 colored. DIN rail shall be same type as used for the relays. Install an extra DIN rail on each type of terminal strip with 20% spare terminals for future additions.

   b. Provide terminal blocks with "follower" plates that compress the wires and have wire guide tangs for ease of maintenance. Terminal blocks that compress the wires with direct screw compression are unacceptable. All power, control and instrument wires entering and leaving a compartment shall terminate on terminal blocks with wire numbers on terminals and on both ends of the wires.

   c. Terminal Tags and Markers: Each terminal strip shall have a unique identifying alphanumeric code at one end (i.e.: TB1, TB2, etc.). On each terminal strip, terminal numbers shall be assigned starting with #1 at one end, incrementing in alphanumerical order (i.e.: 1,2,3,4....). Numbers shall be assigned to all blocks except grounding blocks. Fuse

blocks shall be assigned unique tag numbers such as FU1, FU2. No two fuses shall be assigned the same tag number.

d. Plastic marking tabs shall be provided to label each terminal block. These marking tabs shall have a unique number/letter for each terminal which is identical to the "elementary" and "loop" diagram wire designation. Numbers on these marking strip shall be machine printed and 1/8 inch high minimum.

e. Terminal blocks shall be physically separated into groups by the level of signal and voltage served. Power and control wiring above 100 volts shall have a separate group of terminal blocks from terminal blocks for wiring below 100 volts, intermixing of these two types of wiring on the same group of terminal blocks is not allowed.

f. Provide a ground terminal or connection point for each grounding conductor.

g. Provide a separate terminal block for every two neutral terminations or as coordinated with the interconnect diagrams.

2. MCC – Motor Starter Cubicles Terminal Blocks

a. MCC cubicle terminal blocks shall be pull apart as supplied standard by MCC manufacturer.

3. Power Termination Blocks shall be rated for 600V main power connection. The power termination blocks shall be rated to accept Copper or Aluminum cable rated as shown on Contract one-line diagrams. The power termination block shall be capable of being mounted anywhere in a termination box. Each termination block shall be provided with lug shield to prevent contact with power connections. The power termination blocks shall be Connectron or approved equal.

H. Fuses

1. Fuses used in circuits 200 VAC and above shall be time- delay type FNQ or approved equal, 13/32" x 1-1/2", and have an interrupting rating of 10,000 AIC at 500 VAC. Fuse holders shall be of the barrier type and rated 600 VAC.

2. Fuses used in 120 VAC circuits shall be time-delay type MDL or approved equal, 1/4" x 1-1/4", and have a rating of 250 VAC. Fuse-holders shall be of the terminal block type.

3. Fuses used in signal and 24 VDC circuits shall be 5mm x 20mm and have a rating of 250 VAC. Fuse-holders shall be of the terminal block type.

4. Fuses shall be sized in conformance with the NEC.

I. Ferrules

1. All motor power wires landed on terminal blocks in the MCCs and field panels shall have wires terminated with appropriate sized ferrules with insulation collars. Failure to provide ferrules may be grounds for immediate rejection without review.

J. Panel Ground

1. Each electrical, control and instrumentation panel shall be provided with a 1 inch x 0.25 inch x 8 inch (minimum size) solid copper grounding bus bar, mounted on the inside of the enclosure. The grounding bar shall be mounted on insulated standoffs so that no electrical connection is made between the ground bar and the cabinet through the mounting. The ground bar shall be drilled and tapped for a 0.25-20 screws at 0.5 inch interval along its entire length.

2. An un-insulated solid copper #8 AWG ground wire shall be attached between the ground bar and the panel enclosure, and between the ground bar and the mounting panels. The ground connection to the enclosure and panel shall be made by sanding the paint finish off a small area, drilling a hole for a 0.25 inch bolt and mounting a 0.25-20 bolt to the panel to serve as grounding stud. The grounding stud shall be attached with a nut and flat washers on both sides of the enclosure/panel, and with an inside tooth star lock washer next to the panel surface. The star lock washer shall be on the inside surface of the enclosure, and the front surface of the mounting panel. The grounding wire shall be secured to the stud with a nut and inside tooth star lock washer. These grounding points shall be located within 12 inches of the bottom to the grounding bar. Each terminal strip rail shall be individually grounded by means of a #12 AWG wire to the ground bus. The PLC rack, power supply, lightning arrestor shall be similarly grounded according to the manufacturer's recommendations.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 26 00 00 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the installation of wire electrical devices, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to Owner.

3.2 INSTALLATION

A. System

1. Install all products per 26 00 00 - Electrical, INSTALLATION, GENERAL.

2. The panels shall be completely factory wired and tested before shipment.

3. All spare PLC input / output points shall be wired to terminal blocks.

4. A minimum of 20% spare unwired terminals shall be provided in each panel.

5. Lace tie with cord, minimum length 2', each wire bundle entering any enclosure, vault, pullbox, cable tray or any other enclosure. Place label with conduit number associated with wire on each of these bundles when there is no place to attach label to conduit. Labels for each cord shall be similar to the engraved circular tag type specified in Section 26 05 33 or approved equal.

6. Pulling lubricant shall be used when installing all wire in conduits.

B. Wiring Methods

1. Wiring Separation: Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wire ways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles.

2. Harness: All wiring shall be neatly bundled and laced with plastic tie-wraps, anchored in place by screw attached retainer. Where space is available, all wiring shall be run in slotted plastic wire ways or channels with dust covers. Wire ways or channels shall be sized such that the wire fill does not exceed 60%. Tie-wraps shall be T&B TY-RAP, or approved equal. Wiring inside of conduit, plastic wire duct, duct bank Sections or corrugated loom tubing is not to be wire tied or taped together.

3. Hinge Loops: Where wiring crosses hinged surfaces, provide a “U" shaped hinge loop protected by black head stabilized corrugated loom tubing as manufactured by Panduit # CLT100N-C630, or approved equal. The hinge loop shall be of sufficient length to permit opening and closing of the door without stressing any of the terminations or connections. Corrugated flexible wire duct shall be Graybar T25N, or approved equal.

4. Retainers: Wire ways, retainers, and other devices shall be screw-mounted with round-head 316 stainless steel screws or mechanically mounted by push-in or snap-in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series, or approved equal.

5. Routing

   a. Wires shall be routed in slotted plastic wire-ways with snap covers. Wires carrying 120 VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in ducts for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible.

   b. Ducts for 24 VDC wiring shall be used for all other wires and cables. Routing of 120 VAC in combined ducts shall be minimized.

   c. Wires and cable shall be routed along the shortest route between termination points, excepting routes which would result in routing 120

VAC and other wires and cables in the same duct. Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable.

d. Wires and cables shall be placed in the ducts in a straight, neat and organized fashion and shall not be kinked, tangled or twisted together. Additional wire ducting shall be provided for use by the electrical subcontractor for routing field wires to their landing points in the each electrical and instrumentation panel.

e. Wiring not routed in duct work shall be neatly bundled, treed, and laced with plastic ties. Wiring across door hinges shall be carefully made up and supported to avoid straining and chafing of the conductors or from putting any strain on their terminals.

6. Exposed Tie-Wraps: Plastic tie-wraps used in all outdoor or exposed applications shall be sun resistant UV rated for outdoor usage.

7. Spare Terminals: Provide a minimum of 20% spare terminals in all MCC cubicles, electrical and instrumentation enclosures, and instrumentation/control panels.

3.3 WARRANTY

A. Provide warranty as specified in Section 26 00 00- Electrical, WARRANTY.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall install, ready for use, the conduit, devices, boxes, & grounding system as specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, test equipment, incidentals, and services to provide a complete and operational conduit, devices, boxes, & grounding system as shown on the Drawings, included in these Specifications, or required for fully operating facilities.

C. Work includes that specified in Section 26 00 00 - Electrical.

D. The conduit, devices, boxes, & grounding system scope of work includes:

1. Provide and install miscellaneous trenching, conduits, junction boxes, field interconnection wiring, grounding system wiring, and associated hardware.
2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections.
3. Provide disconnect switches at all control panels and motors to disconnect all sources of power.

1.2 SUBMITTALS AND DRAWINGS

A. Provide submittals and drawings as specified in Section 26 00 00 - Electrical, SUBMITTAL AND DRAWING REQUIREMENTS.

B. Submittals for the Conduit materials and equipment shall include, but shall not be limited to, the following:

1. Catalog cuts showing manufacturer, catalog numbers, dimensions, weights and material for all raceway and accessories.
2. Dimensioned "as-built" Drawings of Contract Electrical plans.
3. Marked up “as-built” Conduit & Wire Routing Schedule.

1.3 QUALITY ASSURANCE

A. Materials shall be of a manufacturer that has been fabricating and assembling specified raceway systems in his current facility for a minimum of two (2) years.

B. All materials selected for the manufacture of the hardware shall be the best available for the purpose for which they are used, considering strength, ductility, durability, and the best engineering practice.

C. All like parts shall be interchangeable.

PART 2 - PRODUCTS

2.1 CONDUIT, RACEWAYS AND WIREWAYS

A. GENERAL - Conduit, raceways and wireways, wiring methods, materials, installation shall meet all requirements of the NEC, be UL labeled for the application, and meet the minimum following specifications.

1. All wiring shall be installed in conduits, raceways, or wireways when interconnecting equipment and devices.
2. The Contractor shall use special conduit, raceways, wireways, construction methods, and materials as shown on the Contract drawings; which shall take precedence over any general methods and materials specified in this Section.
3. The minimum size conduit shall be 3/4-inch unless indicated otherwise on the Drawings or for special connections to equipment.
4. Conduit stubs for future use shall be capped with coupling, nipple, and plug.
5. Conduits to be abandoned that protrude above graded shall be cut flush and filled with grout.
6. Conduits shall not be filled to more than 50% of their total cross – sectional area.
7. Conduit drains shall be installed with GRS-PVC condulets-T with Stainless Steel Universal Conduit Drain, Appleton ECDB38 or approved equal. Install in conduit locations where condensation may form.
8. Conduit Marking
    a. All conduits (except receptacle and lighting wiring) shall have conduit tags at both terminations of each conduit.
    b. Tag material shall be 19 gauge brass or stainless steel tag with engraved lettering. The size of the tag shall be 2″ diameter. No letters are allowed smaller than 7/16″. Securely fasten tags in place using 316 stainless steel 0.048 inch diameter wire of the type normally used for this purpose (catalog cut sheet shall be submitted). Stainless steel wire shall be crimp connected. Twisting ends together is not acceptable. Engrave the tags, on both sides, with the conduit number as listed in

the Conduit and Wire Routing Schedule on the Contract “E”-series Drawings. Labeling shall be neatly installed for visibility and shall be clearly legible. Conduit tags shall be Brady Valve Tags, or approved equal.

c. Prior to encasement, concealment, backfilling of conduits, temporary conduit labels shall be provided at each end of conduit. Temporary conduit labels shall have ½-inch (minimum) lettering at all transition points. After encasement and concealment temporary conduit labels shall be placed at each exposed end.

B. Galvanized Rigid Steel Conduit - (GRS)

1. Standard weight, zinc coated on outside by hot-dipping or sherardizing process, with either zinc coated or other approved corrosion resistant coating on inside. Fabrication shall be hot-dip galvanized after fabrication, conforming to NEMA RN 1.

2. Galvanized rigid steel factory elbows for 90 degree transitions in NEMA 1 or 12 locations. NEMA 4X area transitions shall be GRS-PVC factory ells.

3. Fittings shall be hot dipped galvanized steel or galvanized cast ferrous metal. Provide threaded-type fittings, couplings, and connectors; set-screw type and compression-type are not acceptable.

4. All joints shall be treated with T & B "Kopr-Shield".

5. Conduits entering enclosures shall be fitted with locknut and insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.

6. EMT or IMC is not considered an equivalent to GRS.

7. GRS conduit is allowed only when specifically called out in the “Conduit and Wire Routing Schedule”.

8. Pipe straps for conduits larger than ¾” shall be two-hole pipe straps. ¾” conduits may have single-hole GRS-PVC pipe straps with clamp back spacer.

C. Galvanized Rigid Steel Conduit - PVC Coated (GRS-PVC)

1. Standard weight, galvanized conduit with a 40-mil thick polyvinylchloride coating bonded to both the outside and urethane interior coating. Conduit shall be hot-dip galvanized conforming to NEMA RN 1. GRS-PVC conduit to be Robroy Plasti-bond Red or approved equal.

2. Provide PVC coated galvanized rigid steel factory ells for 90 degree transitions.

3. Fittings shall be hot dipped galvanized steel or galvanized cast ferrous metal with a PVC 40 mils thick coating. Provide threaded-type fittings, couplings, and connectors; set-screw type and compression-type are not acceptable.

4. All joints shall be treated with T & B type CP "Kopr-Shield", LPS No. 3 rust inhibitor or approved equal.

5. All junction and metal pull boxes shall be galvanized with exterior surfaces PVC coated to 40 mils thickness.

6. Conduits entering enclosures shall be fitted with locknut and insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.

7. PVC coating patching material shall be as provided by the manufacturer.

8. PVC coated Aluminum conduit is not acceptable.

D. PVC Conduit (PVC)

1. Minimum trade size one inch (1").

2. Shall be high impact schedule 40 or 80 (as specified in conduit schedule), polyvinylchloride suitable for use underground, direct burial and for use with 90 C wires, and shall conform to UL 651. Shall be UL listed and labeled for "direct" burial.

3. A copper bonding conductor shall be pulled in each raceway and bonded to equipment at each end with approved lugs.

4. Each underground run shall be placed in a trench with a minimum of four (4) inch sand bed evenly compacted on all sides, top and bottom.

5. Bends, elbows, and risers shall be made with galvanized rigid steel (GRS) conduit using threaded adapters. Bond each metallic portion to each other and to equipment connected at each end of conduit run.

6. PVC fittings shall have solvent-weld-type conduit connections.

7. PVC conduit shall be stored on a flat surface and shielded from the sun.

8. PVC conduit shall not be used above grade.

E. Liquid-Tight Flexible Metal Conduit (FLEX)

1. Minimum trade size one-half inch (1/2").

2. Connectors: Appleton "STB" or approved equal through two inches (2") trade size. Appleton "ST", O-Z "4Q", or equal with insulated bushings for over two inches (2") trade size.

3. Suitable for connection of indoor or outdoor motors, controls, and mechanical equipment.

4. Shall be used for conduit coupling to all vibrating and shifting equipment.

5. Flexible conduit lengths shall not be greater than 36 inches.

6. Flexible metallic conduit shall not be considered as a ground conductor, install a separate wire for equipment bonding.

7. Flexible conduit shall only be installed in exposed or accessible locations.

8. Final connections to vibrating equipment such as motors and fans shall be made with flexible conduits.

F. Fittings

1. GRS Fittings:

a. Fittings for GRS conduits shall be threaded type. Set-screw type and compression-type are not acceptable. Fittings shall conform to the requirements of ANSI C80.4.

2. Flex Fittings:

a. Non-NEMA 4X locations shall have cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Fittings, for not-NEMA 4X locations only, shall be Appleton "STB" OZ “4Q” or approved equal.

b. NEMA 4X rated areas shall have PVC coated flex fittings and connectors.

3. GRS-PVC Fittings:

a. GRS-PVC fittings shall be hot dipped galvanized steel or galvanized cast ferrous metal with a PVC 40 mils thick coating. Provide threaded-type fittings, couplings, and connectors; set-screw type and compression-type are not acceptable. Fittings shall be Robroy Liquitite, Perma-Cote, or approved equal coated fittings.

2.2 DEVICES

A. Boxes

1. Device boxes shall be of zinc-galvanized steel type or cast aluminum with shape and size best suited for the particular application, rated for the location installed, and shall be supported directly to structure by means of screws, anchors, or bolts. Device boxes shall be deep FD series.

2. Box dimensions shall be in accordance with size, quantity of conductors, and conduit clearances per NEC articles 314 requirements.

3. Boxes shall be located and placed according to Owner requirements.

4. All terminal and junction boxes shall be labeled identifying them by number shown on Contract Drawings engraved with ½” letters on nameplates meeting the requirements of Electrical 26 00 00.

5. Non-Weatherproof Boxes:

a. Recessed boxes shall be flush with wall. Boxes for fixtures shall not be less than four (4) inches square or diameter. Boxes for switches and receptacles shall be two and one-eight inch (2-1/8) deep. Provide plaster rings or box cover adapters for the wall surface finish.

b. Surface boxes shall be cast ferrous, deep FD type.

6. Weatherproof Boxes:

   a. Boxes located in NEMA 4X areas shall be stainless steel type rated NEMA 4X.

   b. PVC-coated cast ferrous boxes may be used in place of 316 stainless steel boxes, except where boxes contain devices on cover. Boxes shall be deep, FD type. Single gang boxes shall have cast hubs.

7. Explosion-proof Boxes:

   a. Boxes shall be rated for Class 1, DIV 1 or 2 and weatherproof locations.

B. Switches

1. General purpose switches shall be manufactured in accordance with UL 20. Switches shall be one pole rated, 20 amps, at 277 VAC. Bodies shall be of ivory phenolic compound supported by mounting strap having plaster ears. Switches shall have copper alloy contact arm with silver cadmium oxide contacts. Switches shall have slotted terminal screws and a separate green grounding screw. Furnish Hubbell 1221, Leviton 1201-2, or approved equal.

2. Special purpose switches shall be provided with the amperage, voltage, and configuration as shown on the Drawings. Switches used as motor disconnects for single phase motors shall be horsepower rated.

C. Receptacles

1. General purpose receptacles shall be duplex and rated 20 amps, 120 VAC, 2 pole, 3 wire grounding, NEMA 5-20R configuration, specification grade, and side wired to screw terminals. Face color shall be brown in industrial areas and white or ivory in finished areas. General purpose receptacles shall be Bryant, Hubbell, or approved equal.

2. UPS receptacle shall be single receptacle with orange faceplate.

3. GFI (ground fault circuit interrupting) receptacles shall be used for providing power to miscellaneous cord powered equipment. GFI receptacles shall be duplex, 20A, 120V, with "test" and "reset" buttons with shallow design for mounting and standard screw terminals for direct wiring. Receptacles shall be designed, manufactured, and tested to prevent nuisance tripping from voltage spikes, RFI, EMI, or electronic component failures. Chaining multiple receptacles from one GFI unit is not acceptable. GFI receptacles shall be Arrow-Hart "specification grade" or approved equal.

D. Device Plates and Covers

1. General purpose device plates and covers shall be anodized aluminum. Plates or covers shall be attached with stainless steel screws.

2. PVC coated device boxes shall have PVC-coated, gasketed covers.

3. Weatherproof switch, outlet, and receptacle boxes shall be fitted with Die-cast, gasketed covers rated for wet locations in accordance with NEC 406.9. Each

access cover shall have a cover to maintain the weatherproof integrity even when a plug is connected to the receptacle. Screws and hinge springs shall be stainless steel. Weatherproof access covers shall be Hubbell, Crouse-Hinds, or approved equal.

4. Receptacle and light switch plates shall be stamped or engraved with 3/16" minimum letters stating the panelboard name and circuit breaker feeder number.

2.3 PULL BOXES

A. Boxes

1. Each box shall have type construction and shall be manufactured of stainless steel. Cover shall be attached with stainless steel screws. No devices, screws, rivets, or bolts shall protrude through the exterior surface unless specifically shown on the drawings. Provide larger box as required to accommodate the conduits and wire at no additional cost to the Owner. Boxes shall be Circle AW, or approved equal.

B. Underground Boxes

1. Underground pull boxes, where shown or required by length of conduit runs, shall be prefabricated concrete type with the size shown on the Drawings or larger to allow for adequate pull area. Extension sections shall be provided as necessary to reach the depth of underground conduits.

2. All boxes shall have galvanized steel hold down bolts and hardware. Boxes located in paved areas or other areas which vehicles may travel shall be full H/20 loading rated and have traffic covers. Steel covers or lids shall be galvanized. Pull box covers shall be labeled power, signal, utility, telephone, whichever applies.

3. Pull boxes shall be Christy Concrete Products, Brooks or approved equal.

C. Provide larger pullboxes and junction boxes to accommodate the conduits and wires shown in the Conduit & Wire Routing schedule at no additional cost to Owner.

D. Provide nameplates for all boxes per Electrical 26 00 00.

2.4 DETECTABLE WARNING TAPE

A. Plastic tape shall be colored for particular underground service, 3-inch minimum width, utilize tape made of material resistant to corrosive soil. Tape shall have aluminum backing to facilitate locating it underground using a non-ferrous locator. Use red tape for "Electric" service and orange tape for "Communication" service. Use tape with printed wording listing type of service. Manufacturers and types: Seton, Blackburn, Griffolyn Co., Terra-Tape, Brady, or equivalent.

2.5 CONDUIT SEAL

A. Seal around all conduits, wires, and cables penetrating between walls, electrical panels, ceilings, and floors in all buildings with a fire stop material. Seal shall be made at both ends of the conduit with a fire-stop putty. Seal shall have a minimum two hour rating. Fire stop sealing shall be International Protective Coatings Flamesafe, or approved equal.

B. Seal around conduits entering outside to inside structures and around bottom of free standing enclosures to maintain watertight integrity of structure.

C. Conduit entrances: Seal each conduit entrance entering into the panel and other electrical enclosures with plugging compound sealant to prevent the entrance of insects and rodents. Conduits between the enclosures shall be sealed with plugging compound sealant on each end. Plugging compound sealant shall be PRC-DeSoto (formerly Courtaulds) Aerospace Semco PR-868 or approved equal.

D. Conduit seal shall provide high adhesion and moisture protection. Seal shall absorb cable-filling material and be re-enterable. Conduit seal shall be 3M #442 High Gel re-enterable encapsulant, or approved equal.

2.6 GROUNDING SYSTEM

A. The utility service entrance switchboard ground bus shall be tied to a building ground grid consisting of a "UFFER" type grounding ring system as per Contract E-Series Drawings. “UFFER” ground shall be connected to building metal frame support and metal water pipe as applicable.

B. The UFFER shall consist of AWG bare wire laid in a grid as detailed on the Contract E-Series Drawings.

C. The main ground bonding wire from the ground shall extend up into the utility service entrance main switchboard for the visible connection with a UL approved "ground clamp" attached to the ground bus.

D. Network ground bond wires shall be connected from the UFFER ground to locations shown on Contract Drawings. The network ground bonding wires shall be bare copper sized as shown on Contract Drawings.

E. Ground rods shall not stub up more than 4” in the concrete pad.

F. The ground rod shall consist of not less than 10 continuous feet of 3/4 inch copper coated electroplated high grade carbon steel. The ground rod shall be a NEHRING type NCC, Weater 348 or approved equal. The ground rod shall extend up for visible connection of a UL approved “ground clamp” to the ground bus.

G. Provide a 13 inch diameter, 9-inch nominal throat, and concrete ground rod box, minimum 12 inches deep, with cast iron traffic cover embossed or engraved "GROUND."

H. Resistance from grounded surface of the electrical system to the ground rod and to earth shall not exceed 5 ohms.

I. Ground clamps shall be bolt-on type as manufactured by ILSCO type AGC, O-Z Gedney Type GRC, Burndy Type GAR or GP, or approved equal.

J. Ground buses shall be provided in all electrical enclosures. Each ground bus shall be sized as shown on the Contract drawings or specified herein. The ground bus shall be adequately sized for the connection of all grounding conductors required per NEC. Screw type lugs shall be provided on all ground busses for connection of grounding conductors.

K. Each ground bus shall be copper. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series, or approved equal.

L. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors.

M. All raceway systems, supports, enclosures, panels, and equipment housings shall be permanently and effectively grounded.

N. One side of the secondary on all transformers shall be grounded.

O. The system neutral (grounded conductor) shall be connected to the system's grounding conductor at only a single point in the system. This connection shall be made by a removable bonding jumper sized in accordance with the applicable provisions of the National Electrical Code if the size is not shown on the Drawings. The grounding of the system neutral shall be in the enclosure that houses the service entrance main over-current protection.

P. The system neutral conductor and all equipment and devices required to be grounded by the National Electrical Code shall be grounded in a manner that satisfies the requirements of the National Code.

Q. Grounding conductors shall be sized as shown on the Plans or in accordance with NEC Table 250.122, whichever is larger.

R. Grounding and bonding wires shall be installed in all PVC conduits and nonmetallic raceways and connected to the ground bus and all equipment.

S. Conduit grounding bushings shall be installed on all metallic conduits. Conduit grounding bushings shall be set screw locking type electra-galvanized malleable iron

with insulation collar and shall be provided with a feed through compression lug for securing the ground bonding wire. Ground bonding wire shall be bare wire and shall be sized per NEC. Bonding wires at endpoints shall be connected to enclosure ground bus or equipment grounding lug.

T. All receptacles shall have their grounding contact connected to a grounding conductor.

U. Negative side of all VDC power supplies shall be grounded.

V. Branch circuit grounding conductors for receptacles, or other electrical loads shall be arranged such that the removal of a lighting fixture, receptacle, or other load does not interrupt the ground continuity to any other part of the circuit.

PART 3 - EXECUTION

3.1 CONDUIT AND RACEWAY INSTALLATION

A. Conduit and Raceway Requirements:

1. Care shall be exercised to avoid interference with the work of other trades. This work shall be planned and coordinated with the other trades to prevent such interference. Pipes shall have precedence over conduits for space requirements. Exposed conduits shall be neatly arranged with runs perpendicular or level and parallel to walls. Bends shall be concentric.
2. Exposed conduits runs shall not be run directly on the ground. Secure conduits to 316 stainless steel unistrut.
3. Install conduit free from dents and bruises.
4. All conduits shall be labeled with conduit tags on all ends; at junction boxes, pull boxes, enclosures, stub-outs, or other terminations.
5. Install an accessible raceway and conduit system for connection of all boxes, panelboards, cabinets, and equipment.
6. All conduit and raceway shall be the size and type as shown on Conduit and Wire Routing Schedule. In no case shall the conduit size be smaller than that shown, except as follows:
    a. All exposed conduits in NEMA 4X areas (except for indoor corrosive areas) and outdoor locations shall be GRS-PVC.
    b. All exposed conduits in NEMA 12 areas shall be GRS.
    c. All exposed conduits in <u>indoor</u> NEMA 4X corrosive areas shall be PVC-80.
7. Conduits connected to boxes, cabinets, etc., outdoors, exposed to weather or in areas subject to excessive moisture shall be fitted with watertight sealing hubs of steel or malleable iron with sealing ring and insulated throat, Myers hub, Thomas and Betts 370 Series, or approved equal.

8. Malleable iron threaded grounding bushing, with insulated throat and set screw solderless lugs, Appleton GIB-XXXSL series shall be placed on the end of all rigid conduits. A ground bare copper wire shall bound each bushing to the enclosure ground bus.

9. Matching Existing Facilities:

   a. When new conduit are added to areas which are already painted, the conduit and its supports shall be painted to match the existing facilities.

   b. Where new conduit is used to replace existing conduit, the existing conduit and supports shall be removed, resulting blemishes shall be patched and repainted to match original conditions.

   c. If existing conduits are to be reused and rerouted, resulting blemishes shall be corrected in the same manner.

   d. All existing conduits that are reused:

      1) Shall have a mandrel or conduit piston pulled through the entire conduit run to prove the length contains no blockages or obstructions. Mandrelling shall be witness by the Owner.

      2) Install new conduit tags for reused conduits at all transition boxes and endpoints. Conduit & Wire Routing Schedule shall be updated as these modifications take place.

B. Exposed Conduit

1. All exposed conduits shall be run in straight lines parallel to column lines, walls or beams. Where conduits are grouped, the bends and fittings shall be installed so as to present an orderly appearance. Unnecessary bending or offsets shall be avoided. Conduits shall be kept at least 12 inches away from heating devices or similar equipment.

2. Supports for exposed conduit shall be in accordance with Title 24, CAC.

3. Support rigid conduits at 8 feet intervals and PVC conduits at 4 feet intervals. Support all conduits within 1 foot of boxes or changes in direction. Use riser supports with clamps for vertical conduit risers.

4. For single conduit runs, use pipe straps or suspend from ceiling with single conduit hangers. Single hole malleable iron clamps with backplates may be used for horizontal runs on vertical surfaces. Perforated strap (plumber's tape), not acceptable.

5. For multiple conduit runs, group conduits together and support from ceiling by means of trapeze hangers. Wall brackets or unistrut supports shall be used for conduit runs on vertical surfaces. Clamp each conduit to trapeze or support, using conduit clamp.

6. Fasten hanger rods to structural steel members with beam clamps or to concrete inserts set flush with surface. Install reinforcing rod through opening in concrete insert.

7. Exposed conduit shall be supported rigidly in place. All exposed conduit shall include, where required, the drilling of holes in the bottom or sides of enclosures. The Contractor shall thoroughly examine work prior to drilling to avoid drilling into components within enclosures.

8. Conduits installed outdoor or in NEMA 4X rated areas above grade shall be braced in place with stainless steel Unistrut stanchions or PVC coated clamps with backplates.

9. Vertical offsets and sloping of conduits are not detailed on plans; the Electrical Contractor shall include in his bid the price for the complete conduit run utilizing the civil & mechanical plans to measure vertical & slope distances.

10. Exposed conduits runs shall not be run directly on the ground or roof. Secure conduits to stainless steel unistrut.

11. Duct-taping conduits together is not acceptable. Conduits, installed into concrete pads, shall be installed with a minimum of 2” distance between conduits to allow installation of bushings.

C. Conduits in Concrete Slabs

1. Conduits may be installed in structural slabs, or in slabs on grade, having the following minimum thickness: 2½" thick for ½" conduit, 4½" thick for ¾" conduit, and 5" thick for 1" conduit.

2. Maintain a minimum of two-inches of clearance between conduits and any reinforcement bars. In structural slabs, place conduits carefully between upper and lower layers of steel. In pre-stressed concrete slab construction, place conduits in center of slab and do not support from pre-stressed steel.

3. Space conduits to maintain structural integrity of slabs.

4. Place conduits running parallel to slab supports (beams, columns, walls, etc.) not less than 12" from such supports.

5. Where floor slab is in direct contact with earth or fill, rigid steel conduit may be embedded in concrete blister below bottom of slab with 2-inch minimum of concrete cover.

6. Runs of conduit to be embedded in concrete shall be rigidly supported in their proper positions while concrete is being placed. Place conduit separators every 4 feet on centers and securely anchor to prevent movement. Ends of conduits shall be plugged or capped during construction to prevent the entrance of concrete or other foreign matter. Connections shall be checked for tightness before being embedded.

D. Underground Conduits

1. Buried conduit shall be placed at least 24 inches below grade and be located to avoid interference with other underground piping, foundations, etc. Conduit for Telephone and Power Utilities shall be set to depth as required by Utility engineered drawings and not less than 36” below grade. All conduits

entering or leaving the ground shall be sealed to prevent condensation of moisture inside the conduit. Conduit entrances in the bottom of MCCs, power distribution panels, switchboards, and enclosures shall project into the enclosure a minimum of two inches to prevent water from entering conduits.

2. All conduits entering or leaving the ground shall be sealed to prevent condensation of moisture inside the conduit. Conduit entrances in the bottom of MCCs, power distribution panels, switchboards, and enclosures shall project into the enclosure a minimum of two inches to prevent water from entering conduits.

3. Conduit placed in concrete which is in contact with earth or water shall be adequately separated from the earth or water by at least 3" of concrete. Concrete encasement shall extend 4" above finished grade or into housekeeping pad at completion of each run.

4. Install expansion couplings in conduit runs crossing expansion or contraction joints in concrete. Expansion couplings shall be zinc coated and watertight.

5. Where other piping systems are encountered or being installed along a raceway route, maintain a 12-inch-minimum vertical separation between raceways and other systems at crossings. Maintain a 12-inch-minimum separation between raceways and other systems in parallel runs. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Owner's Representative for instructions before further work is done.

6. Underground conduits not encased shall have a minimum 4” sand bedding completely encircling the conduits.

E. Raceway Identification

1. All conduits and raceways listed in Conduit and Wire Routing Schedule shall have conduit tags at both terminations of each conduit. All conduits and raceways listed in Conduit and Raceway Schedule shall be provided with conduit tags with tag numbers listed in schedule. All spare conduits shall be labeled. Spare conduits that have prefix “X” with a conduit quantity greater than one shall have a unique conduit postfix number assigned to each conduit; i.e., if conduit quantity is 3 for conduit route X0001, then label conduits as X0001A, X0001B, X0001C.

2. All exposed conduit inside buildings entering/leaving panels and enclosures shall be labeled as specified herein.

3. Conduit terminating in walls shall be identified by stenciling the conduit number on the wall directly under the conduit.

4. Prior to encasement, concealment, backfilling of conduits, temporary conduit labels shall be provided at each end of conduit. Temporary conduit labels shall have ½-inch (minimum) lettering at all transition points. After encasement and concealment temporary conduit labels shall be placed at each exposed end.

5. Each conduit listed in Conduit and Wire Routing Schedule shall have permanent tags where it enters an open transition point, junction boxes, terminal boxes, pullboxes, vaults, and manholes.

F. Workmanship and Installation Requirements

1. Where field changes are required, every precaution shall be taken to insure that the change is coordinated with other conduit, structural, plumbing, and piping work. Information shall be obtained regarding the completed raceway runs to insure that there will be no interference when the raceway run is extended or revised. A complete record of such changes shall be made on the Record Contract Drawings.

2. Conduits shall be cut square, threaded and reamed to remove sharp or rough edges and burrs. No running threads will be allowed. Conduit joints and connections shall be made waterproof and rustproof by application of a non-insulating thread compound, such as white lead or graphite, and zinc sealing material. Each threaded joint shall be thoroughly cleaned to remove cutting oil before the compound is applied.

3. All bends and offsets, where required, shall either be made with factory made bends or shall be field bends made with a conduit bender designed specifically for use with the type of conduit to be bent. Elbows and bends for conduits shall be formed in the field and shall be reasonably free from flattened surfaces, indentations, or kinks. Avoid field bends and offsets where possible. Heating of conduit to facilitate bending shall not be acceptable. Metallic conduits shall be bent cold to prevent damage to the protective coating. All bending shall be gradual and be done smoothly to permit the pulling on insulated electrical wires and cables without incurring damage to the insulation or sheath. Radius of curvature shall be not less than that permitted by NEC.

4. Conduit shall be rigidly secured to panels and other electrical equipment terminal boxes with locknuts and bushings in such a manner that each system shall be electrically continuous throughout.

5. Flexible liquid-tight metal conduit shall be used to provide flexible connections between the rigid system and motor conduit boxes or other equipment subject to vibration.

6. To reduce damage to the zinc coating, only strap type wrenches shall be used. All wrench marks, field cut threads, and all other places where the zinc coating is damaged, shall be repaired with zinc-rich galvanizing repair compound.

7. Raceway shall be installed with necessary fittings and supports.

8. After installation of all conductors, all underground conduit ends into enclosures shall have a conduit seal placed around wires inside conduit.

9. Grout around conduit tie-ins entering walls of building structure for watertight seal.

10. Contractor shall limit the number of directional changes of the conduit to total no more than the equivalent of 270 degrees in any run between pull points. Where required for ease of pulling and as necessary to meet code, the Contractor shall supply and install junction or pullboxes even though not shown on Drawings at no additional cost to the Owner.

11. Conduit runs between two vaults, pull or junction boxes shall be limited to a maximum of 300 feet, or less 50 feet for every 90 degrees of conduit change in direction. Install pull boxes where required to limit bends in conduit runs to not more than 270 degrees or where pulling tension would exceed the maximum allowable for the cable. Provide additional vaults, pull or junction boxes as necessary even though not shown on Drawings at no additional cost to the Owner.

12. Install and equip conduits and fittings installed outdoors or in other wet locations, entering equipment from bottom unless necessary to enter from side, so as to prevent water from entering the equipment. Top entry of conduits into enclosures located outdoors or in other wet locations is not allowed.

13. Spare or Future Conduits:

    a. All spares shall have a mandrel or conduit piston pull through and have pull ropes installed.

    b. Provide a braided yellow polypropylene pull ropes with 1’ distance markers, ¼” minimum size.

    c. Provide a waterproof label on each end of the pull cords to indicate the destination of the other end.

    d. Provide caps on conduit ends to prevent entrance of dirt or insects.

14. Contractor shall neatly bundle all new and reused wires with tie-wraps. Ty-wraps shall not be located in conduits. All tape used for bundling wires shall be removed after installation in conduit.

15. Conduit stubs for future use shall be capped with coupling, nipple and plug.

16. Seal all conduits to prevent water traveling through conduits into buildings, junction boxes, underground facilities, electrical enclosures, panels, instruments or any other boxes that house electrical and instrumentation components per Specification Section 26 00 00. Install conduit drain boxes and plug conduit interior to form an effective barrier to keep out water traveling into equipment located below grade.

17. Conduit between vibrating equipment and outlet boxes or conduits shall be liquid-tight flexible electrical conduits.

18. Whenever possible, make bends for exposed conduit stub-ups completely below the surface. Make stubs vertical and arrange neatly.

19. Where conduits turn up in accessible floor areas or under removable partitions, install coupling flush with finish floor surface (exclusive of floor

covering). Provide flush threaded plug in this coupling where conduit is not to be extended.

20. For flush mounted panels, run empty conduits from panel to accessible spaces above. Install a minimum of one ¾" conduit for every 3 single pole spare circuit breakers or spaces, or fraction thereof.

21. Running Threads: Do not use running threads. Where such device is needed, use rain-tight unions or concrete tight couplings.

22. The entire electrical raceway system shall be bonded and form a continuous metallic electrical conductor from service point to every box and shall be terminated with ground bushings connected to the ground bus. Conduits entering enclosures shall be fitted with insulated grounding bushing. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC Code.

23. Connection to steel conduit from PVC shall be made with approved threaded adapters.

24. All conduits which are installed shall be capped during construction to prevent the entrance of foreign material.

25. Secure hangers, brackets, conduit straps, supports and electrical equipment by means of toggle bolts on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry; machine screws or bolts on metal surfaces; wood screws on wood construction. Wood or fiber plugs or concrete nails, not acceptable.

26. Special “Soft–Jaw” type pipe clamps shall be used to prevent damage to PVC-coated conduits while field threading, cutting to length, and coupling sections.

G. Detectable Warning Tapes

1. Bury detectable warning tapes approximately 12 inches above all underground conduit runs. Align parallel to and within 3 inches of the centerline of the conduit or duct bank.

H. Cutting and Patching

1. The Contractor shall do all core drilling, cutting, and patching required to install his work at no additional cost to the Owner. Core drilling, cutting, and patching is considered standard work to be done at existing facilities, therefore, this work is not specifically called out on Drawings. Any core drilling or cutting which may impair the structure shall require prior approval by the Owner. Core drilling, cutting, and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after core drilling, cutting, and patching and made watertight.

I. Excavation and Back Filling

1. At all times during the excavation and backfilling, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard authorized personnel, and the general public from excavated trenches.

2. Repave any area that was paved prior to excavation. Backfill and surface all areas as shown on the Drawings or where not shown to the original condition that was present prior to the excavation.

3. Excavations: Provide the excavation for Utility power and telephone services, electrical, and instrumentation equipment foundations and trenches for conduits and ductbanks as necessary. Backfill and surface all areas in accordance with other Contract Sections. Excavations shall be also be in accordance with other Contract Sections.

   a. Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 24 inches. Utility power and telephone conduits shall have a minimum cover of 36 inches.

   b. Trenches for all conduits below floor slabs and underground shall be excavated to the required depths. Conduits under floor slabs shall have trenches no deeper than is required to properly contain bends within walls.

   c. All trenching and underground work shall be closely coordinated with the Owner. Contractor shall be responsible for locating, and avoiding disruption of, all existing underground facilities such as gas lines, water lines, sewer, fire protection lines, and existing underground electrical facilities. Any damage caused by the Contractor must be repaired at the Contractor's cost, to the satisfaction of the Owner.

   d. All trenching shall be done as to minimize disruption to normal plant or construction operations. All open trenches shall be suitably marked and/or protected to avoid any accidents or injuries to workers or plant personnel.

   e. Where new electrical ducts intersect existing facilities, at essentially the same depth, Contractor shall gradually divert the electrical facilities down, under, and back up around the existing facilities.

   f. All excavations shall be backfilled and resurfaced to match surfaces prior to and adjacent to excavation.

4. Back filling shall be done only after conduits have been inspected by Owner. Excavation and back fill of lines and conduits shall conform to the requirements of the Earthwork Section of these Specifications, unless modified on plans.

   a. Backfill, Non-Paved Areas: Use native backfill, compacted in 6 inch layers to 90 percent relative compaction. Final backfill elevation shall match existing.

   b. Backfill, Paved Areas:

      1) Use clean imported sand rated for use under paved areas.

2) Imported sand shall be free from organic material, trash, debris and rubbish.

3) Compact trench backfill by manual methods. Water flooding or jetting is not permitted.

5. At all times during the installation of the electrical distribution system, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard all personnel, including small children, from excavated trenches.

3.2 GROUNDING INSTALLATION

A. System

1. Install all products per Electrical 26 00 00 – Installation.
2. Provide a separate grounding conductor in each raceway, securely grounded to equipment at each end of raceway.
3. Bond piping and building structure to grounding electrode per NEC.
4. Contractor shall not conceal or cover any ground connections until the Owner has established that every grounding connection conforms to the Contract Drawings and Specifications and has given the Contractor written confirmation.
5. Test grounding per Section 26 00 00 - Electrical.
6. Grounding details shown on plans are minimum. If additional equipment, such as ground rods, clamps, conductors, etc., is required per NEC, Title 24, CAC, furnish and install same without additional cost to Owner.

B. Connections

1. Use U.L. approved cast bronze ground clamps specifically designed for grounding purposes. Strap metal is not acceptable for grounding or bonding.
2. Exposed connections to ground buses, raceways, and small pipes shall be made by means of U.L. approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A, or approved equal.
3. All buried, ground rod, large pipe, and steel plate or frame ground bond connections shall be made by welding process equal to Cadweld.

C. Electrical Equipment Grounding

1. Metal conduits shall be bonded together to the enclosure ground bus.
2. Lightning arresters or suppressors shall be directly connected to the ground system using copper conductors, sized as per manufacturer's literature.
3. All motors shall be grounded by bonding the grounding conductor within the raceway to the motor frame. Motors as shown on Electrical Plans shall also

have a supplemental grounding conductor bonded to the ground grid in the immediate area of the motor.

4. Each panelboard shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall be equal to panelboard neutral bus amp rating and shall have adequate lug quantity of lugs. No more than two grounding conductors shall be installed per lug.

5. All metal panel doors shall be installed with ground straps, including all MCC bucket doors.

D. Excavation and Back Filling

1. Trenches for all bare copper ground bond wires shall be excavated to a minimum depth of 24".

2. Back filling shall be done only after grounding system has been inspected. Excavation and back fill of grounding system shall conform to the requirements of the Earthwork Section of these Specifications.

3. At all times during the installation of the grounding system, the Contractor shall provide barricades, fences, guard rails, etc., to safeguard all personnel, including small children, from excavated trenches.

E. Cutting and Patching

1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure shall require prior approval by the Owner. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

3.3 DEVICE AND BOX INSTALLATION

A. System

1. Install all products per Electrical Section 26 00 00 - Installation, General.

2. Keep boxes, and other openings closed during construction to prevent entry of foreign matter. Cover equipment, devices, apparatus, and protect them against dirt, paint, water, chemical, or mechanical damage before and during construction period. Restore to original condition apparatus or equipment damaged prior to final acceptance. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.

3. All receptacles shall be tested for correct connections utilizing a plug-in ground, line and neutral test light plug.

4. Boxes shall be relocated at no additional cost to Owner as directed by Owner when a conflict occurs in the box placement shown on drawings and other building appurtenances.

5. Conductors shall be copper type THHN, #12 AWG (minimum).

6. Mount conduits using single bolt galvanized pipe straps and clamp back spacers.

7. Use stainless steel expansion wedge anchors or epoxy anchors as necessary for device mounting.

8. Provide and install all device boxes, junction boxes, receptacles, switches, and covers.

9. Receptacles to be ground fault interrupter (GFI) type and weatherproof (WP) where shown.

10. See electrical symbols and abbreviations drawing for symbol definition.

11. All work shall conform to local codes and National Electric Code (NEC).

B. Device Mounting Heights

1. Mounting heights of fixtures and devices shall be as follows unless otherwise indicated or when height has to be adjusted to be over or under counter tops.

a.	Wall switches	=>	48 inches
b.	Convenience outlets	=>	18 inches finished areas
		=>	24 inches non-finished areas
c.	Telephone outlets	=>	54 inches
d.	Bracket fixtures	=>	7 feet 6 inches

C. Cutting and Patching

1. The Contractor shall do all cutting and patching required to install his work. Any cutting which may impair the structure shall require prior approval by the Owner. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

D. Boxes

1. Leave no unused opening in any box. Install close-up plugs as required to seal openings.

2. All spare and/or empty conduits shall terminate in a device box.

3. Use stainless steel boxes when box must support door mounted devices.

4. In NEMA 4X areas boxes are to be spaced ¼-inch from walls using stainless steel, nylon or plastic spacers. Regular steel washers are not considered an approved spacer.

3.4 WARRANTY

A. Provide warranty as specified in Section 26 00 00- Electrical, WARRANTY.

END OF SECTION

SECTION 26 05 73

POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Electrical System Studies shall be prepared for all sites:

1. Wallan Pump Station
2. Alderpoint Pump Station
3. Tobin Well

1.2 SUBMITTALS

A. Provide the following submittals, per Section 26 00 00, for the entire electrical power system including the 208/120V distribution system:

1. Short Circuit Study.
2. Protective Device Coordination Study.
3. Arc Flash Study.

B. Electrical System Studies shall be prepared, stamped and signed by a professional Electrical Engineer registered in the State of California and in accordance with IEEE 242, IEEE 399 ANSI/IEEE C37.13 and IEEE 519.

C. Exceptions / Clarifications

1. Itemize all exceptions and clarifications to the Contract Documents in a letter (located in the front of the submittal) on company letterhead.
2. Exceptions that are noted in the study, but not listed on the Exceptions/Clarifications letter, will be considered as non-responsive and not accepted as changes to the Contract Documents.
3. All exceptions taken from the Drawings and specifications shall be documented with justifications. When noting the exception, list which Drawings or which Specification Subsection number the exception is taken.
4. Clarification requests shall list which Drawing or Specification Subsection number the clarification is required for.

D. Provide two (2) DVDs at the completion of the project. One DVD will contain the as-built set of studies, reports, settings, etc. The other DVD will contain the original source format of input data used for the PC based computer software, including all SKM files

used to create the studies. Provide all setup information used for the computer based study and report.

E. For each resubmittal, provide a copy of submittal comments and a separate letter, on Company letterhead, identifying how each submittal comment has been addressed in the resubmittal.

F. When submittals are provided in PDF format, utilize the "Bookmark" feature of the Adobe Acrobat and clearly bookmark locations in the report to locations identified in the Report's Table of Contents. Bookmarks shall not be out of order; the English description shall match that listed in the Report's Table of Contents.

1.3 SEQUENCING AND SCHEDULING

A. It is the responsibility of those performing the electrical system analysis to collect and field verify all data. This includes verifying existing electrical distribution and obtaining all data from the Utility Company, Generator supplier and vendors necessary for completing the requested studies. Utilize proposed load data for the Studies obtained from submittals, Utility Company, Generator manufacturers, field verifications, etc.

B. Contractor shall provide letter certifying the inspection and verification of existing equipment and distances used in study.

C. A complete Protective Device Coordination Study shall be submitted within 60 days after approval of Short Circuit Study.

D. At the completion of the project, all studies shall be resubmitted with all calculations rerun, data and graphs updated to reflect as-left conditions. Provide new Arc Flash labels to reflect as-constructed equipment and as-left circuit breaker settings.

E. When previous electrical system analysis studies are available and provided to the Contractor, it is the Contractor's responsibility to verify the accuracy of the data used and to update it to match existing conditions.

PART 2 - MATERIALS

2.1 GENERAL

A. Equipment and component titles and numbers used in the Studies shall be identical to the equipment and component titles and numbers shown on the Drawings.

B. Perform Studies using PC based computer software. State program name and version (e.g. version 2.1) in report.

C. Perform complete fault calculations for Utility and generator sources. Equipment shall not be grouped as a single large load; they shall be treated as individual loads. When generators are incorporated into the system, develop two separate networks: one

with utility only (no generator attached) and one with generator only (no utility attached)

D. Complete protective device coordination study listing all device settings shall be utilized during start-up of electrical equipment.

E. Provide unique page numbers for every sheet in all Studies. Unique page numbers to be manually placed by Study Company after printout if study report doesn't assign page numbers.

F. One line diagrams

1. Shall be readable on 11" x 17" paper. One line diagrams shall be redrawn in AutoCAD on multiple sheets if necessary or as requested by Owner.
2. Buses and branches shall have descriptive names matching one line diagram or existing system (i.e. not Bus-0084).
3. Automatic transfer switches (ATSs), Main Switchboards (MSBs), shall not have multiple node buses.
4. Primary and secondary for transformers, Variable Frequency Drives (VFDs), etc. shall be changed to node buses.

G. Short circuit and arc flash reports shall be provided.

1. Maximum available fault current from utility transformer: with all motor contribution
2. Do not combine networks when multiple sites are modeled.
3. All studies shall be repeated with the arc flash reduction switch enabled (where applicable).

2.2 SHORT CIRCUIT STUDY

A. Include the following in the short circuit study:

1. Cable impedances based on copper conductors.
2. Bus impedances based on copper bus bars.
3. Transformer impedances based on tolerances specified in ANSI C57.12.00.
4. Source date (i.e. cable lengths, sizes, and quantity, for all runs in study, listing of bus loads, etc.).
5. Utility data:
    a. Size of Utility transformer.
    b. Impedance of Utility transformer.
    c. Primary voltage of Utility transformer.
    d. Fault information on primary side of Utility transformer:
        1) Three phase bolted fault.

2) X/R ratio (positive sequence).

3) Line to ground fault.

4) X/R ratio (zero sequence).

e. Protective relays (type & settings).

6. Voltage drop and current flow at each node and load in system.

B. Calculate Short Circuit interrupting duties for an assumed three-phase bolted fault and line-to-ground fault at each of the following locations:

1. Power transformer's primary
2. Main Switchboard.
3. All Motor Control Centers (MCCs).
4. All panelboards.
5. All 480V, 3-phase motor and equipment loads.
6. All 3-phase transformer secondaries.
7. All 240/208V equipment.

C. Verify:

1. Equipment and protective devices are applied within their ratings.
2. Adequacy of switchboard, panelboard and MCC bus bars to withstand Short Circuit stresses.
3. Adequacy of transformer windings to withstand Short Circuit stresses and over-current.
4. Cable sizes for ability to withstand normal and fault load currents.

D. Provide the following in the Short Circuit study report:

1. Calculation methods and assumptions.
2. Input data.
3. Short circuit data.
   a. Impedances.
   b. X to R ratios.
   c. Asymmetry factors.
   d. Motor contributions.
   e. Short Circuit kVA.
   f. Symmetrical and asymmetrical line-to-line and line-to-ground fault currents.
   g. Device evaluation including rating of equipment.
   h. Bus evaluation including rating of equipment.

i. Source data, from Electric Utility Company. Include copy of correspondence with Utility Company indicating values used.

j. Source data from Generator Supplier (where applicable). Include copy of Generator provided values used.

4. Tabulations of calculated quantities.

5. Results, conclusions, and recommendations.

6. One line diagrams of distribution system.

7. Impedance diagram showing the resistances and reactances for all cables of the distribution system.

2.3 PROTECTIVE DEVICE COORDINATION STUDY

A. Provide Protective Device Coordination drawings for each section of distribution system that includes the following:

1. Graphically diagram displaying coordination time-current curves on conventional log-log curve sheets. Each time-current curve shall have a unique identifier label. This identifier shall be used in the tabulated settings spreadsheet and on the associated one-line diagram.

2. Time-current curves shall include the following curves (minimum):

a. Utility relays (phase & ground) and high voltage switchgear relays (phase and ground).

b. All upstream protective devices and breakers.

c. All mechanical overloads.

d. All MCP breaker and associated motor or equipment load. Duplicates of the same sized protective device and motor size may be omitted (i.e., when there are 3 pumps for same application).

e. All transformers and associated primary and secondary protection.

f. Unique identifier for each protective device.

g. Provide separate TCC for phase and ground curves.

h. TCC for Ground curves shall include the transformer magnetizing inrush currents for all transformers downstream of the circuit breaker. Ground shall clear the inrush currents.

3. One-line diagram that applies to specific portion of distribution system associated with time-current curves. One-line diagram shall include the following:

a. Location of each device.

b. Power and voltage ratings, primary and secondary transformers amperages.

c. All significant circuit elements such as transformers, cables, breakers, fuses, relays, etc. with their corresponding amperage ratings.

d. Tag of each branch and node (shall be the same tags used in short circuit study).

e. Mechanical overload and contactor.

f. English description, equipment name, HP, and full load amp rating of motors and other 3 phase loads.

g. Terminate device characteristic curves at a point reflecting maximum fault current to which device is exposed as calculated in short circuit study.

4. Time current curves shall be provided for all protective devices with adjustable settings.

B. Characteristics plotted on time current curves shall include:

1. Protective current relays.

2. Fuses including manufacturer's minimum melts, total clearing, tolerance, and damage bands.

3. Circuit breaker trip devices, including manufacturer's tolerance bands.

4. Transformer full-load currents at 100% and 600%.

5. Motor and equipment full load currents. Motors fed from VFDs and Soft Starters shall have their starting curves adjusted according to inrush currents on the TCC. Motors on TCC shall show the DC offset for VFD and Soft Starter fed pumps.

6. Transformer magnetizing inrush currents.

7. Transformer damage curves.

8. ANSI transformer withstand parameters.

9. Fault currents.

10. Ground fault protective device settings.

11. Other electronic protective devices.

C. Provide the following recommended settings in spreadsheet format in the Protective Device Coordination study report:

1. Relay settings including CT values.

2. Circuit Breakers adjustments:

a. Long Delay Pickup and Time.

b. Short Time Pickup and Time.

c. Instantaneous Pickup and Time.

d. Ground Pickup and Time.

3. Programmable settings for all electronic devices. Settings for non-current relay settings shall also be provided.

4. Settings shall be given both in amps and seconds as well as the corresponding physical setting (i.e. 30A and setting B on MCP) for device.

5. Identify protective device associated with each curve by manufacturer type, function and part number.

2.4 ARC FLASH HAZARD STUDY

A. General:

1. Arc flash boundary and incident energy shall be calculated using a PC computer program at all significant locations in the electrical network, including switchgears, switchboards, MCCs, transformers, and other major equipment where work could be performed on energized equipment.

2. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

3. Document method of calculation.

4. Do not include the motor contribution of motors fed by VFDs in the arc flash hazard study.

B. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

C. Study shall include the following:

1. All significant locations in 480 volt, 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.

2. Incident energy and flash protection boundary calculations in spreadsheet format in the Arc Flash Hazard study report.

3. Provide the following incident energy and flash protection boundary calculations in spreadsheet format in the Arc Flash Hazard study report (values shall be calculated for all electrical equipment in the power distribution system):

a. Arcing fault magnitude

b. Device clearing time

c. Duration of arc

d. Boundary for:

1) Arc flash limited shock approach

2) Limited shock approach

3) Restricted shock approach

e. Working distance

f. Incident energy at 18 inches (in cal/sq.-cm)

g. Recommendations for arc flash energy reduction for each location having more than 8 cal/sq.-cm. Provide preliminary cost estimate for implementing recommendations.

h. Provide separate spreadsheets for all scenarios listed in subsection 2.01.G. Do not combine the spreadsheet values nor only provide the worst case scenario. Clearly list on each spreadsheet the English description of the Scenario presented.

4. Provide recommendations for the Personal Protective Equipment (PPE) that the Owner should maintain on site for the level of hazard.

5. Provide recommendations for safety label design that should be posted on electrical equipment.

6. Spreadsheet summarizing incident energy and flash protection boundary list Arc Flash Boundary in inches on label. No fractional distance in feet.

2.5 STUDY REPORTS

A. Written reports submitted for approval shall contain:

1. Scope of Studies performed.

2. Explanation of bus and branch numbering system.

3. Report calculations, tabulations and spreadsheets.

4. Selected equipment deficiencies.

5. Results of Studies.

6. Comments, recommendations or suggestions regarding:

a. Changes and additions to equipment rating and/or characteristics.

b. Circuit protective devices improperly rated for overload or fault conditions.

c. Arc Flash protective equipment and safety labels.

7. Tabulation spreadsheet for all protective device settings with the following column entries (minimum):

Device Code	Description	MFR	Type	Plug Trip	Frame	KAIC	Long Time		Short Time		Inst	Ground	
							Amps	Time	Amps	Time	Amps	Amps	Time

8. Stamped, signed and dated by Electrical Engineer registered in the State of California who performed the analysis.

B. Reports are to be updated to reflect as-built conditions and placed in O&M manual, per Section 26 00 00 requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Make minor modifications to equipment settings as required to accomplish conformance with the Short Circuit and Arc Flash Studies.

B. Notify Owner in writing of any required major equipment modifications.

3.2 FIELD TESTS

A. Provide field testing of protective equipment.

B. Adjust relay and protective device settings according to values established by Coordination Study.

3.3 ARC FLASH WARNING LABELS

A. All Arc Flash warning labels shall meet NEC requirements, OSHA standards and NFPA recommendations.

B. Provide and install 4 in. x 6 in. thermal transfer type labels of high adhesion polyester for each work location analyzed and as required by the NEC for flash protection on power distribution equipment.

C. Each label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD," and shall include the following machine printed information:

1. Location Designation
2. Nominal system voltage
3. Arc Flash boundary
4. Available incident energy and working distance (in inches)
5. Minimum arc rating of clothing
6. Site specific level of PPE
7. Engineering report number, revision number and issue date
8. Company preparing report and contact phone number.

D. Labels shall not be hand labeled.

E. For all areas, Contractor shall post the following:

1. Working distances
2. Shock hazard voltage
3. Shock Approach Boundaries:
    a. Limited

b. Restricted

F. Provide Arc Flash labels for the each of the following new pieces of equipment. Existing Equipment shall be provided with new Arc Flash Labels:

1. 480V and applicable 208V panelboards
2. MCCs
3. Control Panels
4. Disconnect Switches
5. All electrical equipment with an incident energy level greater than 1.2 Cal/cm2.
6. Where Switchgear, Switchboard, MCC, Panelboard, Distribution Panel, etc. feed multiple circuit breakers from the enclosure, provide separate line and load side Arc Flash Labels for the Main Circuit Breaker.
7. Provide separate labels at each circuit breaker that has arc flash reduction switches indicating the appropriate values when the switch is enabled.

G. Labels shall be submitted for approval. No labels shall be installed without prior approval by Owner or Owner representative.

3.4 ARC FLASH TRAINING

A. The Supplier shall train Owner personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures shall be in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces and shall be provided in the equipment manuals.

END OF SECTION

SECTION 26 21 00

LOW VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall supply along with complete startup and testing services for the low voltage electrical service entrance as specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

B. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to provide a complete and operational power distribution system as described in these Specifications, or required for fully operating facility.

C. This Section Scope of Work includes that specified in Division 26 and 40.

D. The meter/main panel scope of work which includes both the furnishing and installation:

1. Meter/main panel.
2. Utility system consisting of utility poles, risers, pull boxes, secondary conduits, etc. and main metering service etc.
3. Submittal data and drawings.
4. Startup assistance.
5. Testing and training.
6. Operation and maintenance manuals.
7. Warranty of all components.
8. Coordination with Power Company.
9. Provide trenching, backfilling, and compaction for all underground conduit routes, concrete pads, and pull boxes.

1.2 SUBMITTALS AND DRAWINGS

A. Provide submittals and drawings as specified in Section 26 00 00.

B. Submittals for the Electric Service shall include, but shall not be limited to, the following:

1. All primary and secondary utility service materials (pullboxes, transformer pads, conduits, bus duct and bollards). These materials shall also be submitted to and approved in writing by Utility service.

2. Nameplate designations, sizes and mounting methods.

3. Ratings and characteristics including voltage ratings, bussing arrangements, continuous current ratings, fault current withstand ratings, neutral bus rating, ground bar termination points, ratings and arrangement of overcurrent protective devices.

4. Provide catalog cuts of all devices used.

5. Provide seismic anchoring calculations and methods.

6. Circuit breaker time-current curves and settings.

7. Provide written statement from utility Engineer for project, stating approval of all proposed utility metering service materials, protective devices, metering provisions, and bus duct.

1.3 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals as specified in Section 26 00 00.

PART 2 - MATERIALS

2.1 UTILITY METERING

A. Provide a dead-front type, utility metering main panel, size as shown on Contract Drawings one line and elevation diagrams. Meter/Main Panel will include meter socket, factory installed main breaker and test by-pass facility. Breaker shall be lockable in the off position. Voltage, phase and amperage rating shall be continuous at amperage shown on one-line diagrams. Meter/Main panel enclosure shall be rated as shown on Contract Drawings.

B. Design entrance features per NEC, local codes and power utility requirements.

C. Submit to the power Utility proposed meter enclosure, meter socket, and service entrance drawing details. Provide a written statement from the Utility that shows approval of the proposed metering Meter/Main Panel and service entrance drawings.

D. Where generators are installed, provide engraved red phenolic nameplate with 1″ lettering per NEC 702.7(A).

E. Utility metering Meter/Main Panel shall be B-Line (Circle AW), or approved equal.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 26 00 00 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the startup and testing of a Meter/Main Panel service equipment and accessories. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Electrical Section 26 00 00 - General Construction Methods and General Equipment Fabrication apply to the construction and assembly of the Meter/Main Panel.

E. Perform any required work to correct improper installations at no additional expense to the Owner.

F. All equipment installed by the Contractor shall be in accordance with the Drawings and the manufacturer's recommendations and instructions, and shall operate to the Owner's satisfaction. Follow all manufacturer’s instructions for handling, receiving, installation, and pre-check requirements prior to energization. After energization, follow manufacturer’s instructions for programming, set-up, and calibration of breakers. The Contractor shall be responsible for, and shall correct by repair or replacement, at his own expense, equipment which, in the opinion of the Owner, has been caused by faulty mechanical or electrical assembly by the Contractor. Necessary tests to demonstrate that the electrical and mechanical operation of the equipment is satisfactory and meets the requirements of these Specifications shall be made by the Contractor at no additional cost to the Owner.

3.2 CONSTRUCTION

A. The construction methods specified herein shall be followed by the Supplier of the Meter/Main Panel. If the Supplier fails to comply with these installation methods, then the Contractor shall pay all costs required to make the changes to the equipment to conform with these installation methods.

1. All connections shall be accessible from the front without removal of internal components.

2. Terminal strips shall be provided for terminating all interconnect wiring except for prefab cable connectors. Terminals shall be labeled per Section 26 05 19.

3. All wiring shall have permanent identification at each point of connection. Wires shall be labeled per Section 26 05 19.

4. Wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be protected with plastic spiral wrap where it is subject to mechanical damage or crosses over to a hinged door.

5. Utility pull rope shall have distance markers every one (1) foot along entire length of pull rope. Size of pull rope shall be per Utility requirements.

B. The exact dimensions of the bus duct run and the connected equipment are not specified. The Contractor shall determine the actual dimensions of the bus duct run and provide coordination between the bus duct manufacturer and the manufacturer of the connecting equipment.

3.3 INSTALLATION

A. The Contractor shall coordinate all work with the serving power Utilities, and notify the Utility Company when service is required. The Contractor shall arrange a pre-construction meeting with the Utility representative prior to start of any Utility related work. The Contractor shall obtain the required PG&E inspections.

B. Utility will be responsible for furnishing and installing all transformer high voltage primary cabling.

C. Meter/Main Panel Supplier shall provide all required transformer secondary cabling and lugs at Meter/Main Panel to match secondary cabling.

D. Install pull ropes in each Utility primary and secondary conduits. Pull ropes shall have distance markers every one (1) foot along entire length of pull rope. Size and material for pull rope shall be per Utility requirements.

3.4 FIELD TESTS

A. Provide field testing as specified in Section 26 00 00.

B. Breakers shall be set to values determined by Meter/Main Panel Supplier. Meter/Main Panel shall not be energized until breakers have been set and field tested and Owner has given written approval.

3.5 WARRANTY

A. Provide warranty as specified in Electrical Section 26 00 00 - Warranty.

END OF SECTION

SECTION 26 24 16

PANELBOARD

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall supply the panelboard and panelboard transformer shown on the Contract Drawings and as specified herein.

B. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to provide complete and operational panelboard and panelboard transformer as described in these Specifications and required for fully operational facility.

C. Work includes that specified in Section 26 00 00 - Electrical.

D. The panelboard and panelboard transformer scope of work includes:

1. Providing panelboard and panelboard transformer.
2. Installation of panelboard and panelboard transformer at location shown on Drawings.
3. The quantity of breakers with size and number of poles as shown on panelboard schedules.
4. Submittal data and Drawings.
5. Startup assistance.
6. Testing.
7. Operation and maintenance manuals.
8. Warranty of components of the panelboard and panelboard transformer.

1.2 SUBMITTALS AND DRAWINGS

A. Provide data and Drawings for all materials furnished under this Section with the content and format as specified Section 26 00 00 - Electrical.

B. Provide ratings and characteristics including voltage ratings, busing arrangements, continuous current ratings, fault current withstand ratings, neutral bus rating, ground bar termination points, ratings, and arrangement of overcurrent protective devices.

C. Provide catalog cuts for panelboard, circuit breakers and transformer.

D. Submit panelboard schedules for approval.

1.3 OPERATIONS AND MAINTENANCE MANUALS

A. Provide data and Drawings for all materials furnished under this Section with the content and format as specified Section 26 00 00 - Electrical.

PART 2 - MATERIALS

2.1 PANELBOARD

A. General

1. The Contractor shall furnish each panelboard of a type indicated on the Contract panelboard schedules and specified herein.
2. Panelboard shall comply with the applicable Sections of UL, NEC, and NEMA and be manufactured by the same manufacturer for all panelboard.
3. A removable machine-typed circuit directory with clear plastic cover shall be shipped with panelboard and mounted on the inside of door in a frame and updated or replaced to show as-built breaker identification. Circuit directory shall be as approved in the Submittal and updated or replaced to show as-built breaker identification.
    a. “Sticker” type panelboard schedules are not acceptable.
    b. The directory cards shall be placed in panelboard when the panelboard are mounted in field and prior to termination of wires to breakers.
4. Provide panelboard engraved nameplates with ½-inch lettering. Nameplate inscription shall be the panel name listed on the Panelboard Schedule.
5. Panelboard door latches shall be tool-less quarter turn indicating type fasteners when installed in MCCs.
6. Panelboards mounted external of MCCs shall be provided with engraved nameplates listing Panelboard name, voltages, and location feeding it (i.e. “MCC-100 via Transformer XFMR-100”, “Power Panel 100”, etc.). Engraved nameplate shall be as specified herein.

B. Interior

1. Factory assembled with bolt-on devices.
2. Full size insulated neutral bus shall be included. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
3. Bus bar shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50° C above an ambient 40° C maximum.
4. A copper ground and neutral bus bar shall be included in panelboard with terminal screws.

C. Trim

1. Provide hinged door over all circuit breaker handles. Door of panelboard trim shall not uncover any live parts. Door shall have a catch, lock, and trim.

2. Surface of the trim assembly shall be properly cleaned, primed, and a finish coat of gray paint to match MCC color when installed in MCC, otherwise painted to match room décor.

3. Provide panelboard engraved nameplates with ½-inch lettering as specified in Section 26 00 00 - Nameplates. Nameplate inscription shall be the panel name listed on the Panelboard Schedule.

4. Provide circuit number tags next to each circuit breaker, including existing panelboards.

D. Panelboard Ratings

1. Panelboard shall be rated as shown on the Contract Drawings.

2. Breakers shall be a minimum of 100 ampere frames. Breakers 15 through 100 amperes trip size shall take up the same pole spacing. All panelboard breakers shall be provided with individual padlock hasps (lockable in off position). Provide molded-case breakers with quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by handle position between the manual OFF and ON position. Provide trip ratings as indicated in panelboard schedule. Series breakers devices are not allowed to meet interrupt ratings listed.

3. Panelboard shall be labeled with a UL short circuit rating.

E. Space Only

1. Where "space" is noted on the drawings, provide connectors, mounting brackets, blank covers, etc., for the future insertion of an overcurrent device.

2.2 PANELBOARD TRANSFORMER

A. The panelboard transformer shall be ventilated dry type. Voltage, phase, and KVA ratings shall be as shown on the Contract One-line Drawing. The transformer shall be as manufactured by G.E. Type QL, Cutler-Hammer, Acme, or approved equal.

B. The transformer shall have 115 °C rise, insulation 220 °C rise Class H insulation system.

C. Transformer shall be installed in locations as shown on Contract Drawings. All transformer installed shall be supplied by the same manufacturer.

D. Vibration isolators shall be installed between the transformer and its mounting surface to reduce case vibration and compensate for slight unevenness of the mount. They shall be sized for the appropriate loading at twice the fundamental frequency.

The transformer housing shall be securely fastened to the mounting surface to eliminate possible sound generation.

E. Each transformer shall be finished with two coats of heavy enamel to resist rust and corrosion.

F. Provide an engraved nameplate for each transformer per Section 26 00 00 – Nameplates. Nameplates shall have ½" high letters and be engraved with transformer designation as shown on one-line Drawings.

G. Transformer rated 30KVA and above shall have two 2-1/2 percent taps above and below rated voltage.

H. Transformer located inside MCCs shall be provided with adequate ventilation for heat removal as required.

I. Transformer located outdoors shall be provided with NEMA 3R enclosures or UL approved drip shields to obtain a weatherproof rating.

J. Wall mounted transformer shall be provided with appropriate wall mounting brackets. Wall mounted transformer shall be located so as not to block off conduit access to panels and so as not to impede proper working headroom and clearances.

K. Floor mounted transformer shall have a 3-1/2” concrete housekeeping pad.

L. Transformer shall be mounted with ventilation space from wall or structures as specified by the Transformer Manufacturer.

M. Transformer neutral shall be grounded in accordance with Article 250.26 and 450.10 of NEC and any applicable local ordinances. Installation and protection of the transformer grounding conductors and attachments shall be per NEC 250.24.

PART 3 - EXECUTION

3.1 GENERAL

A. Set taps under load conditions for correct voltage.

B. Install transformer located outside MCC on Korfund Series F or H double-deflection mounts selected for the weight of the transformer, to produce the maximum isolation. Secure with four one-half inch (minimum) diameter stainless steel anchors, minimum 2-1/2" embedment.

C. For floor and wall mounted transformer install with a 6" minimum clearance (or distance required by transformer manufacturer) between transformer and walls.

3.2 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 26 00 00 - Electrical.

B. Ensure that all equipment and materials fit properly in their installations.

C. Perform any required work to correct improper installations at no additional expense to the Owner.

3.3 FIELD TESTS

A. Provide transformer field testing as specified in Section 26 00 00 – Electrical, TESTING.

3.4 WARRANTY

A. Provide warranty as specified in Section 26 00 00 – Electrical, WARRANTY.

END OF SECTION

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SECTION 26 24 19

MOTOR CONTROL CENTER

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The System Supplier shall customize and supply the motor control centers (MCC) as specified herein. Standard MCCs supplied direct from MCC manufacturer's factory will not be accepted. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

B. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to provide a complete and operational MCCs as described in these Specifications, or required for fully operating facility.

C. Work includes that specified in Division 26 and 40.

D. The MCC scope of work includes:

1. Providing MCCs.
2. Installation of the MCCs.
3. Installation of concrete pad for MCCs.
4. Submittal data and Drawings.
5. Startup assistance.
6. Testing.
7. Operation and maintenance manuals.
8. Warranty of all MCC components.

E. All wiring and terminal blocks within each MCC shall be labeled as specified in Section 26 05 19 – Low Voltage Electrical Power Conductors & Cables. All neutral wires shall have white insulation.

F. All MCCs shall be wired at System Supplier's facilities. Factory wiring is not acceptable.

G. Footprints of MCCs shown on Contract Drawings were developed based on best available information. It is the Contractor's responsibility to obtain site plans of the location for each MCC, VFD, control panel, etc. to ensure the supplied equipment is appropriate for the location. Contractor is responsible for any additional conduits,

wires, construction costs, engineering design requirements, etc. to accommodate MCC, VFD, control panel, etc. that are larger than that shown on Contract Documents.

1.2 SUBMITTALS

A. Provide Data and Drawings as specified in Section 26 00 00.

B. Complete Short Circuit Study per Section 26 05 73 Power System Studies shall be submitted and approved by Owner before Owner will approve submittal for MCC and switchboard equipment.

C. All submittal drawings shall be prepared by System Supplier. Factory supplied MCC drawings are not acceptable.

1.3 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals as specified in Section 26 00 00.

B. In addition, include the following records in the O&M manuals for the MCC:

1. Each motor starter including manufacturer, full part number, size, etc.
2. Each overload heater element size and setting including manufacturer, full part number, size, etc.
3. Each breaker part number and as-finalized breaker setting.

1.4 SUPPLIERS' AND/OR MANUFACTURERS' SERVICES

A. Prices for the items specified shall include the following services of MCC supplier technical representatives at the job site. The number of hours and scope of services indicated are minimum requirements not including travel time. Time for travel and all associated expenses shall also be included in bid price for the work.

1. 32 Labor hours per MCC - Installation assistance, field inspection and functional testing.
2. 32 Labor hours per MCC - Equipment setup and startup.
3. Training hours to meet requirements of Section 26 00 00.

PART 2 - MATERIALS

2.1 MOTOR CONTROL CENTERS

A. General:

1. Each motor control centers (MCC) shall be built and tested in accordance with:
   a. NEMA Standards.
   b. ANSI.
   c. Underwriter's Laboratories, Inc.

2. Each MCC shall comply with all provisions of UL 845, and bear a separate UL label on each individual MCC Section. In addition, all wiring, devices, and components contained therein, shall be UL labeled for the application. UL approval and labels shall be provided for the individual MCC Sections prior to delivery from the factory. Field UL labeling will not be allowed.

3. MCCs shall be 600 volt class rated to operate from an incoming power as shown on Contract one-line diagrams.

4. MCC construction shall consist of NEMA rated as shown on Contract Drawings deadfront enclosure. MCCs shown as NEMA 12 shall be NEMA 1 type with gasketed doors to reduce dust entry. The height of the MCC shall be 90 inches. MCC fabrication shall be NEMA Class II with NEMA Type B wiring.

5. Each MCC shall be provided with the type, capacity, and ratings of components shown on the Drawings or otherwise specified. The 460 VAC breakers shall be rated to withstand an available fault current shown on contract Drawings.

6. MCP breakers shall be selected to have trip and breaker size based on the motor full load amps to meet NEC. When the MCP breaker size changes due to a different motor size and full load amps than that shown on the Contract Drawings, the Contractor shall provide the properly sized MCP breaker at no additional cost to Owner.

7. Provide extension handles for breakers with center of the grip of the operating handle, when in its highest position, is above 78" from floor in order to conform with NEC 404.8.

8. Where possible, pilot devices, operator devices etc. shall be maximum of 66” above finished floor.

9. MCC components such as relays, starters, breaker, lights, switches, etc. shall meet the requirements of Section 26 00 00.

B. Qualifications:

1. MCC structures shall provide for all equipment detailed on the single line Drawings including all spares and spaces. Where possible, the MCC shall be built in strict accordance with overall sizing and component layouts as detailed on the Drawings and no deviations will be allowed without prior approval of the Owner.

2. When physical size requirements for individual components are different than those detailed on the MCC Elevation Drawings, the single line Drawing shall supersede the elevation Drawing and the Contractor shall furnish additional vertical Sections based on the Owner's approval as required to provide for all equipment including spares and spaces at no additional cost to Owner. The concrete housekeeping pad shall be expanded by Contractor at no additional cost to Owner when larger MCCs are supplied.

3. MCCs shall have major components and subsystems therein (i.e., breakers, contactors) that are standard for the MCC manufacturer.

4. All devices and components located in different MCC cubicles (i.e., VFDs, contactors, control relays, timers, etc.), shall be the product of same manufacturer throughout for each device or component type.

5. All starters and contactors shall be rated and designated in accordance with NEMA standards. Starters and contactors rated in amperes without manufactures published data indicating the corresponding NEMA sizes will not be acceptable. Submittals shall provide cross reference data which includes details of the manufacturer compliance with NEMA standards and tests.

6. MCCs shall be Eaton, Allen-Bradley or approved equal.

C. Construction:

1. Each MCC shall consist of standard metal-enclosed, freestanding, dead-front and dead-back vertical Sections, not more than 90 inches in height and not less than 20 inches deep. The framework shall be made of 12-gauge steel channels. The composite MCC shall consist of vertical sections that are of equal height. Provide Switchboard with NEMA 3R weather wrap where shown on Contract Drawings.

2. Working height excluding the upper and lower wireways of MCC shall be 72 inches (min) to accommodate compartment spacing in increments of six inches. Minimum compartment height shall be twelve inches.

3. Each Section shall be provided with a horizontal top and bottom wireways. Wireways shall be readily accessible and isolated from all busing by grounded steel barriers. The bottom wireways shall have an adequate conduit entrance area and shall not be obstructed by transformers, capacitors, or other devices. The wireways in each Section shall line up with wireways in the adjacent Sections, with openings between, so that wires may be pulled the entire length of the MCC.

4. Where shown on the Drawings, isolated vertical wireways shall be provided, each with a separate full height door. Vertical wireways shall intersect the top and bottom horizontal wireways for easy cable routing. Vertical wireways shall have wire hangers for wire tie-down spaced throughout the complete vertical trough. Vertical wireway doors shall be latched by quarter turn indicating type fasteners.

5. Each MCC shall be designed for front access maintenance. All wiring, bus joints, and other mechanical parts requiring tightening or other maintenance shall be accessible from the front. Rear or side access shall not be necessary for inspection or maintenance.

6. All steel work shall be immersion cleaned and phosphated to inhibit rust prior to painting. Paint finish shall be electrostatically applied dry powder, baked to thermoset. MCC compartment interior color shall be white. All other interior and exterior MCC structure surfaces shall be finished in an ANSI 61 or ANSI 49 gray color. No field painting will be allowed except for "touching up" of damaged areas.

7. A Manufacturer's nameplate shall be attached to each MCC giving the model number, serial number, bus amps, voltage, and other manufacturer's information pertaining to the MCC construction.

8. MCCs shall be furnished completely factory assembled and shipped to the jobsite in shipping sections. Assembly of components into MCC at the jobsite is not allowed (except for connection of shipping section). Removable lifting angles or eyes shall be provided on the top of each MCC shipping section.

9. All fans, vents and louvers shall be provided with removable metal filters.

D. Bus System:

1. All bus material shall be copper. Aluminum buswork is not allowed. All buses, except ground buses, shall be completely isolated by steel plates or insulating material.

2. A continuous horizontal bus shall be furnished and rated as shown on the Contract One-Line Drawings.

3. A full length vertical bus shall be furnished in each Section and rated as shown on the Contract Elevation Drawings. Current rating shall apply to the full length of the vertical bus, tapered bus shall not be allowed. Vertical buses shall be insulated and isolated with glass polyester or equivalent continuous barriers. Cutouts shall be provided in the barriers for plug-in stab connections. Unused stab openings shall be plugged. Lower ends of vertical buses shall be insulated.

4. Buses shall be sized and braced to withstand a fault of symmetrical amperes listed on Contract one-line drawings. MCC protective breaker(s) shall have an interrupting capacity to isolate a fault current of this magnitude.

5. A copper ground bus shall be provided in the bottom horizontal wireway of each Section. The ground bus shall be rated 300A minimum. It shall be electrically continuous the entire width of each MCC. Provide cable lugs on ground bus for incoming power grounding conductors.

E. Compartments:

1. Compartments shall be isolated from each other by separate horizontal steel plates without openings that are a part of the unit itself. Draw-out units shall totally isolate enclosed equipment. All unused openings to the adjacent vertical wiring space shall be plugged. All openings used for wiring shall have insulating grommets.

2. Doors for each compartment shall be fabricated from formed sheet steel of not less than 14 gauge thickness. The door opening shall be of sufficient size to permit ready removal of any of the devices in the compartment. Doors shall be mounted on adjustable and removable pin type concealed hinges so arranged that compartment doors may be removed without disturbing compartment doors above or below. Door latches shall be quarter turn indicating type fasteners. Overload relays shall be reset from outside the enclosure by means of an insulated button mounted on the door.

3. An operator mechanism mounted on the draw-out unit shall provide the means for operating the compartment breaker or disconnect switch. The operator shall extend through an opening in the compartment door and shall clearly indicate whether the disconnect is "on", "off", or "tripped". This indication shall function whether the door is open or closed. The operating mechanism shall not be attached to the compartment door.

4. Each compartment for combination starters, breakers, and disconnect switches shall be draw-out construction, containing individual units. Draw-out provisions shall include a positive guide rail system and stab shrouds to absolutely ensure alignment of stabs with the vertical bus. The stabs shall be tin plated copper alloy and shall provide a self-aligning pressure connection. The stab design shall ensure a consistent low-resistance contact with the vertical bus even after repeated insertions and removals. Power wiring to stabs shall be contained within the draw-out unit. No wire shall extend behind the unit.

5. All similar compartments shall have the same structural features and the units shall be interchangeable.

6. With the disconnect in the "on" position, a mechanical interlock shall prevent opening of the door. This interlock shall be provided with a defeater so that authorized personnel may gain access to the compartment without interrupting service. This interlock shall also prevent unintentional closing of the disconnect when the compartment door is open. A second mechanical interlock shall prevent any possibility of removing or reinserting the draw-out unit while the disconnect is in the "on" position.

7. The operator mechanism shall allow padlocking of the disconnect in the "off" position with up to three padlocks.

8. Compartment interconnect wiring shall be connected to pull apart terminal blocks.

9. Pushbuttons, selector switches, and indicating lights shall mount where shown on the Drawings on a removable device panel which is part of the draw-out unit. The device panel shall not be part of the door.

10. Compartments containing panelboards shall have panelboards installed per Section 26 24 16. Panelboard Door latches shall be toolless quarter turn indicating type fasteners

11. Compartments containing motor starters shall each have an overload selection table posted inside the door.

12. MCC compartments labeled as space shall have a blank hinged door and drawout relay panel installed, occupying the full space area.

13. Circuit breakers with a frame size of 450 amperes to 1200 amperes shall be molded case with electronic microprocessor based RMS trip elements. Molded case circuit breakers with electronic trip shall be Eaton Series C N-Frame Type NG-H with Digitrip 310+ Electronic ALSIG trip unit, or equal. The interrupting

capacity of all main, and feeder branch circuit breakers shall be a minimum of 65,000 RMS symmetrical amperes at operating voltage.

14. Circuit breaker trip unit shall be equipped with 24 VDC coil for "Maintenance Mode" for arc flash reduction when shown. Maintenance mode selection switch (Maintenance Mode or Normal Mode selection) shall be installed on Panel face near main breaker. 24 VDC supply shall come from PLC Panel.

15. Provide all pilot devices with descriptive engraved nameplates.

16. All metal panel doors shall be installed with ground straps, including all MCC bucket doors.

2.2 FLOOR MATS

A. Provide flat, smooth, rubber mats in front of each MCC. Mat shall extend the full length of the MCC section. Mat shall have a minimum width of 36 inches extending out from the front of MCC. The mat supplied shall be specifically made for this insulation/isolation application.

PART 3 - EXECUTION

3.1 WORKMANSHIP SECTION INCLUDES

A. All work in this Section shall conform to the safety lockouts, codes and standards specified in Section 26 00 00 - Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the startup and testing of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations and all doors open a minimum of 90°.

D. Electrical Section 26 00 00 – General Construction Methods and General Equipment Fabrication apply to the construction and assembly of MCCs.

E. Perform any required work to correct improper installations at no additional expense to the Owner.

3.2 INSTALLATION

A. MCCs shall be factory inspected and witness tested by the Owner prior to it being shipped to the jobsite. If a MCC shows up at the jobsite and has not been previously inspected and tested by the Owner, then the Contractor shall remove the MCC from the jobsite and return it to the factory for factory inspection and witness testing, all at the expense of the Contractor.

B. The as-built Electrical Drawings shall be placed in a water tight plastic wrap and shipped with the MCCs to the jobsite. As-Built drawings shall be updated and replaced prior to final acceptance.

C. Vertical Sections shall be mounted, leveled, and anchored to the concrete pad.

D. In general, all conduits entering or leaving a MCC shall be stubbed up into the bottom horizontal wireway directly below the vertical Section in which the conductors are to be terminated.

E. All motor starters that utilize changeable overload heater elements shall be furnished to the job site without the elements installed. After the mechanical equipment arrives, the Contractor shall check the nameplates for the full load amperage (FLA) rating and select the appropriate overload element to be installed. Electronic overloads shall be adjusted based on equipment nameplate FLA rating.

F. Field interconnect wiring to the MCCs shall be neatly grouped by compartment and bound by plastic ty-wraps. All wiring shall be supported so that circuit terminations are not stressed.

G. All lugs shall be copper sized for wires listed in the Conduit and Wire Routing Schedule.

H. Construction of MCC Sections shall be modular to allow installation of MCCs in buildings through standard access doors.

I. MCC supplier to provide all necessary lugs for connection of power cables to MCC bus and breakers.

J. Bottom of MCCs shall be sealed to prevent the entry of insects and rodents.

K. Clean and touch up paint the MCC exterior surfaces prior to final punch list.

L. Clean and vacuum the interior of MCC prior to applying power and at the end of project, prior to final acceptance.

3.3 FIELD TESTS

A. Provide field testing of MCCs as specified in Section 26 00 00.

B. All breakers shall be set to values determined by Section 26 05 73 Power System Studies. Breakers shall not be turned on to power equipment until breakers have been set and field tested.

3.4 SPARE PARTS

A. Provide 1 cup of each color used for exterior paint finish of MCC to Owner for its use.

B. Spare parts shall be provided as specified in Section 26 00 00.

3.5 WARRANTY

A. Provide warranty as specified in Electrical Section 26 00 00 – Warranty.

END OF SECTION

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SECTION 26 32 13.13

DIESEL ENGINE DRIVE GENERATOR SET

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. These specifications describe the minimum requirements for pad & trailer mounted, standby duty, three-phase diesel generators. Larger generators shall be supplied when necessary to meet the requirements of this section. Appendix “A” contains the “Generator Data Form” which lists the minimum sizing for the generator and accessories. The Contractor shall submit the “Generator Data Form” form with proposed values and include this form with the generator submittal.

B. The diesel generator shall include a diesel engine, control & instrument panel, batteries, battery charger, brushless alternator, excitor, voltage regulator, generator main breaker, fuel pump, sub-base fuel tank, radiator, blower fan, vibration isolators, load bank, weatherproof housing when shown, trailer (when shown), intrusion switches (on three outer doors, wired to control panel terminal blocks), and accessories.

C. A 120VAC powered battery charger shall be mounted to the generator skid.

D. The diesel generator shall be provided as described in the following specification and as shown on the Contract drawings, herein designated as the design documents.

E. All auxiliary apparatus and accessories shall be provided, at no additional cost to the Owner, as required for a fully functional diesel generator.

F. The stationary diesel generator shall be delivered as a skid mounted unit, piped and wired for operation.

G. The trailer mounted generator shall delivered as a self contained trailer mounted portable unit, piped and wired for operation.

H. Install a steel reinforced concrete pad, adequately sized to support the diesel generator and load bank being supplied.

I. Provide the field installation, startup, testing and training for the diesel generator and associated equipment as part of this scope of work.

J. All equipment shall be new, of current production by a U.S. firm which manufactures and/or assembles the components of the diesel generator as a matched unit so that there is one-source responsibility for warranty, parts, and service through a manufacturer's local representative.

K. The Contractor shall:

1. Thoroughly examine conditions before submitting his bid proposal to perform any work. He shall compare site conditions with data given on the in these Specifications. No allowance shall be made for any additional costs incurred

by the Contractor due to his failure to have examined the site or to have failed to report any discrepancies to the Owner.

2. Verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work described in these specifications and measurements at the site.

3. Coordinate with the other trades the exact location for the engine generator, load bank and routing of piping, cable and conduits.

L. The manufacturer's local representative shall be an authorized distributor who maintains a stock of spare parts for the supplied diesel generator and has a service facility with factory-trained service personnel. The manufacturer's local representative shall be located within a radius of 100 miles of the Site.

M. The diesel generator shall be as manufactured by Kohler or Cummins Power (Onan), to match Owner Standard.

N. Unit shall meet all current, Local, State and Federal emissions requirements for the location the engine generator will be installed at time of installation.

O. The manufacturer shall provide an Environmental Protection Agency (EPA) certified engine-generator unit. Submit proof that engine-generator unit is EPA certified.

P. The engine generator shall meet all local Sonoma County and Environmental Protection Agency (EPA) emission and noise requirements at final inspection. Obtain permits, provide all information, fill out forms (permit to construct and permit to operate) and obtain approval from the Northern Sonoma County Air Quality Management District (phone number (707) 433-5911). Permit to construct shall be provided with generator submittal. Permit to operate shall be provided prior to construction.

Q. Sub-Base fuel tank shall meet UL142.

1.2 PLANS AND SPECIFICATIONS

A. The Contractor shall examine carefully the plans, specifications, and contract forms. It is assumed that the Contractor has investigated and is satisfied as to the conditions to be encountered, as to the character, quality and quantities of work to be performed and materials to be furnished, and as to the requirements of these specifications and the Contract. After the signing of the Agreement, no consideration will be given to any claims of misunderstanding of the work to be done, or of any provisions of the proposal, plans, specifications and contract documents.

B. All equipment/options are to be factory installed. If the equipment/options are not available factory installed, dealer installed equipment/accessories may be acceptable. The bidder is to specify those items which will be dealer installed in the submitted bid document.

C. Only new models in current production, that meet the requirements of these specifications and which are cataloged by the manufacturer and for which manufacturer's published literature and printer specifications are currently available,

will be considered. Special options may be included only when recommended by the manufacturer of the unit approved by the Owner.

D. The Contractors price shall include tax, licenses, freight, delivery expenses, fuel, installation of all components and other miscellaneous charges.

1.3 QUALIFICATION

A. Acceptable equipment suppliers will be considered only for those represented by a reliable California firm carrying an adequate supply of repair parts in the State.

B. The supplier shall have represented both the engine and generator manufacturers for at least three years prior to the bid award.

C. By entering into this Contract, the suppliers shall guarantee the availability of service for this engine-generator set by the supplier during the warranty period.

1.4 SUBMITTALS AND DRAWINGS

A. Submit shop documents and drawings for approval in accordance with this subsection and as specified in Section 26 00 00 - Electrical. All non-relevant items not provided for on this project shall be crossed-off on all documents and drawings.

B. Submit data sheets and catalog cuts for:

1. Engine:
    a. Make and model
    b. Number of cylinders and cylinder arrangement
    c. Bore, Inches
    d. Stroke, Inches
    e. Compression ratio
    f. Piston displacement, Cubic Inches
    g. Piston speed, Feet per Minute, at rated RPM
    h. HP at rated KW output
    i. Rated RPM
    j. Number and type of bearings
    k. Fuel type and consumption at full load
    l. Cylinder head and block material
    m. Crankshaft material
    n. Valves material
    o. Governor type
    p. Block heater
2. Generator:
    a. Make and type
    b. Generator full load electrical rating, KVA, KW, Voltage, Amperage, Hz, # of Phases, # of Wires, Power Factor
    c. Peak motor starting, KVA

d. Number of leads
e. Number and type of bearings
f. Voltage regulator type
g. Exciter type
h. Generator winding insulation class and temperature rise
i. Generator transient (X'd) and subtransient (X'd) reactance in per unit
j. Frequency regulation, %, from no-load to full load
k. Frequency regulation, %, at steady state full load
l. Ambient temperature range
m. Voltage regulation from no load to full load

3. Electrical:
   a. Control and instrument panel
   b. Generator breaker
   c. Batteries and battery charger
   d. Standby system three-line diagrams which include the generator equipment and load bank
   e. Standby system interconnection diagrams for all generator and load bank wiring. Standard internal connection diagrams for each piece of equipment shall only be accepted when modified to indicate corresponding wire and cable numbers on drawings for external pieces of equipment.

4. Accessories:
   a. Exhaust silencer, stack, and piping system
   b. Fuel tank and piping system
   c. Vibration isolation system
   d. Heater systems
   e. Load Bank
   f. Load Bank breaker
   g. Weatherproof Housing. Submit sizing of sound attenuating enclosure. Coordinate sizes with available lengths.
   h. Run Cycle Timer
   i. Paint Finish

C. Submit electrical schematics and wiring diagrams for:
   1. Generator control panel
   2. Battery charging system
   3. Generator main breaker
   4. Voltage regulator
   5. Governing system

6. Load Bank Feed breaker
7. Load Bank system
8. Weatherproof housing for auxiliary electrical devices

D. Submit dimension drawings for:

1. Diesel generator and load bank side, front, and top
2. Pad construction and size, anchor details
3. Fuel tank and containment basin
4. Exhaust muffler and air intake baffle
5. Conduit stub-up areas under generator frame, fuel tank and load bank
6. Weatherproof housing

E. Submit reports, calculations, and curves for:

1. Engine horsepower curves. These curves shall show the manufacturer's approval of the engine rating for standby application per the specifications stated herein.
2. Engine generator fuel consumption curves.
3. Concrete pad seismic calculations. The Contractor shall submit seismic calculations signed by a California Registered Professional Structural Engineer for the proposed construction of the bolt tie-down to concrete pad to anchor the engine generator, load bank and fuel tank.
4. Trailer Mounted Unit:
    a. Trailer structural design. The Contractor shall submit design calculations signed by a California Registered Professional Structural Engineer for the portable engine generator trailer frame, hitch, and wheels demonstrating compliance with these specifications.
    b. State of California vehicle registration made out to the City of Garberville Public Works Department.
    c. Weight certification for registration purposes.
5. Calculations showing that the unit meets the specified emission requirements.
6. Generator load report showing that the unit shall start the loads as shown on Contract Drawings without exceeding the maximum allowable voltage dip.
7. Submit typed statement that the generator has been sized to operate the specified loads. Submit calculations and back-up to shown the generator is properly sized.
8. Sound level data showing that the complete generator package meets the sound attenuating requirements stated herein.
9. Provide fuel tank pressure testing as required by the local jurisdiction.

F. Descriptive literature shall be provided that describes the diesel generator and all accessories. This literature shall provide sufficient detail to determine that the diesel generator has all the accessories, options, features, and characteristics specified herein. Items that are not provided shall be neatly lined out.

G. The Contractor shall include in writing as part of the submittal details any proposed departures from the design documents and the reasons therefore. Incorporate no such departures into the work without prior written approval of the Owner. The approval of departures which substantially deviate from the design documents shall be evidenced by a "change order" directive by the Owner. Any cost differential associated with this change order must be negotiated with the Owner to amend the scope of work to reflect the costs or savings.

H. A copy of this specification section, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore, requested by the Contractor, each deviation shall be underlined and denoted by a unique number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications. The submittal shall be accompanied by a detailed, written justification for each numbered item explaining variance or non-compliance with specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no review.

I. The Contractor shall note that the named generator equipment, if given, is considered acceptable, but in some cases additional design, options, or modifications may be required, at no additional cost to the Owner, to meet Specifications.

J. The decision of the Owner governs what is acceptable as an approved equal. If the Owner considers it necessary, tests to determine equality of the proposed substitution shall be made, at the Contractor's expense, by an unbiased laboratory satisfactory to the Owner. Equality will be judged on the basis of the following:

1. Conformance with description or performance required.
2. Equal in quality.
3. Comparable in operation and maintenance.
4. Equal in longevity and service under conditions of climate and usage for given application.
5. Conformance with space allocations.
6. Comparable in appearance and artistic effect.
7. Compatible with mechanical and electrical construction of related work without necessitating changes in detail.

K. No material or equipment shall be allowed to be delivered to the Owner until the submittal for such items has been reviewed by the Owner and approved.

L. Each submittal shall be bound in a three ring binder, which is sized such that when all material is inserted the binder is not over ¾ full. Binder construction shall allow easy removal of any page without complete manual disassembly; spiral ring type binders are not acceptable. Each binder shall be appropriately labeled on the outside with the project name, job number, equipment Contractor's name, specification section(s), and major material contained therein. An index shall be provided at the front of all sections which itemizes the contents of each tab and subtab section and lists the project name, job number and equipment's Contractor's name, address, phone number, and contact person. Drawings that are "C" or "D" size shall be folded with the title block visible and placed in clear plastic pockets. Faxed documents shall not be used in any manuals.

M. Submit complete and specific information with regard to equipment representatives and service facilities.

N. The generator manufacturer (representative is not acceptable) shall submit and provide the following letters in the manufacturer's letterhead prior to shipment of generator from the factory:

1. Letter certifying that the manufacturer has reviewed the connected loads power and certifies that the generator to be provided shall start the loads, in any combination or sequence, without generator voltage dropping below any of the connected equipment ratings. The connected equipment is shown on the Contract one-line diagram.

2. Letter certifying that the manufacturer has contacted the pump, motor and motor control suppliers for this project to ensure compatibility and proper coordination between the generator and the pump, motor, and starting methods. Interaction between the generator and the pump and motor starting method shall not cause adverse effects to electronic devices such as soft starters and variable frequency drives. This letter shall list each individual load by type, size, manufacturer, starting method and compatibility with generator.

3. Letter shall state that the generator to be supplied was verified to be compatible, without any adverse effects with other major equipment to be supplied for this project in load configuration as shown on Contract One-Line diagrams. This letter shall state the name and manufacturer of each major piece of equipment and proof of verification of compatibility.

1.5 OPERATION AND MAINTENANCE MANUALS

A. Prior to the delivery of the equipment, the Contractor shall submit five (5) sets of "operation and maintenance" (O&M) manuals for approval. O&M manuals shall be per this subsection.

B. At least one of these sets of O&M manuals shall be made up of "original" (no copies or reproductions) documents. In addition, a full set of O&M manuals that are also professionally copied to a CD or DVD format shall be provided.

C. Manufacturers' or Contractor's standard brochures or manuals shall be edited to reflect only that model or series of equipment installed on this project, including any modifications. All extraneous material shall be crossed out or otherwise removed in a manner acceptable to the Owner. All text, tables, graphs, and drawings shall be clear

and legible. Black and white copies of color originals are not acceptable. Color originals or true color copies of these originals shall be provided in each set.

D. All information required herein shall be provided even though it may be considered proprietary. If any of the information herein is considered proprietary, the Owner will enter into a proprietary agreement with the Contractor. This agreement will stipulate that all such information will be kept confidential by the Owner and the Owner will use the information only for its internal use and will not reproduce any proprietary information for distribution.

E. O&M manuals shall contain the following:

1. All submittal documentation required under this section with all corrections and changes made to reflect final as-built conditions.

2. Operation, maintenance, troubleshooting, instruction, calibration, user, and other manuals available for "equipment" from the manufacturer. Subtab and index the different manuals for easy location.

3. These manuals shall include or be amended to include the following:

a. An itemized list of all data provided.

b. Name and location of the manufacturer, the manufacturer's nearest distributor and spare parts warehouse.

c. Recommended installation, adjustment, modes of operation, startup, calibration, and troubleshooting procedures.

d. Warnings and cautions to prevent equipment damage and to ensure personnel safety.

e. Complete internal wiring, component layout, connection, and schematic diagrams. All "proprietary" diagrams shall be included.

f. Complete parts lists, by generic title and identification number, cross-referenced to component layout diagram.

g. Disassembly and assembly instructions.

h. Recommended preventive maintenance procedures and schedule.

i. Recommended lubrication and an estimated quantity for a year duration.

j. Recommended spare parts list, including the unit price of each. The Contractor shall provide an availability policy listing the location of where spare parts are stocked and the delivery time for each of the recommended spare parts.

k. All test data and test forms completed for this project.

PART 2 - MATERIALS

2.1 QUALITY

A. It is the intent of these design documents to secure a diesel generator of the latest commercial design that has been prototype tested, factory built, production tested, site tested, as a total unit together with all accessories.

B. All materials, components, and parts supplied shall be highest grade, unused, new, and in current production.

C. Provide all of the features, options, and accessories specified herein and shown on the design drawings.

D. All rotating parts shall be guarded against accidental contact, in accordance with Federal OSHA and Cal-OSHA requirements.

E. Generator shall be rated for use with reduced voltage starters.

F. Generator Data Form in Appendix "A" lists the minimum requirements to meet specification. Contractor shall submit this form complete with generator data of submitted generator. Contractor shall submit cover letter documenting reasons explaining why any values are less than that specified.

2.2 RATING

A. The engine generator shall have a minimum continuous standby rating as listed in Appendix "A". Standby rated shall mean that generator starts within 60 seconds upon being called to operate at continuous uninterrupted operation for the total duration of a power outage. Rating of the diesel generator shall be based on operation when equipped with all necessary operating accessories such as radiator, fan, air cleaners, lubricating oil pump, governor, exhaust silencer, etc.

B. No derating from the ratings specified shall occur for ambient temperatures below 122°F or installation elevation below 1,000 feet.

C. The diesel generator will be installed at the elevation shown on the Contract Drawings. The diesel generator shall operate successfully at ambient temperatures between 40 degrees Fahrenheit and 122 degrees Fahrenheit.

D. The engine/generator shall accept 100% of the nameplate KW rating in one step, in compliance with NFPA 110, Paragraph 5-13.2.6.

E. The diesel generator shall be capable of successfully providing three phase, 60 hertz power as shown on Contract One Line Drawings to start and continuously run the squirrel cage motors in addition to the lighting and control loads. The maximum step voltage dip shall be as listed in Appendix "A" below line voltage, as measured line to line at the generator terminals, during start of any of the station loads.

F. Generator set mean time between failures shall be a minimum of 5,000 hours.

2.3 ENGINE

A. The engine shall be a turbocharged compression ignition engine type, four cycle, with vertical inline or V-type cylinders and an overhead valve configuration.

1. The engine shall utilize only No. 2 diesel fuel.

2. Piston displacement shall be a minimum cubic inches listed in Appendix "A" of this Section.

3. The engine shall be of direct injection design, i.e. pre-combustion chambers shall not be incorporated in the cylinder heads. Glow plugs shall not be used for engine starting.

4. The engine shall deliver a minimum HP listed in Appendix “A” of this Section.

5. The engine shall have sufficient power to produce the specified ratings when operating with all accessories including exhaust, fuel, cooling, and battery charging systems, etc.

B. The engine shall be equipped with:

1. Engine driven or electric fuel transfer pump, water/oil separator and particulate type fuel filters, and electric fuel shutoff valve. The fuel transfer pump shall be capable of lifting the fuel from the subbase or adjacent fuel tank. Primary and secondary fuel filters shall be provided. The fuel filters shall be replaceable and conveniently located for servicing.

2. Electrical governor; consisting of a magnetic pickup speed sensor, adjustable electronic control, and an electrical actuator mounted integrally with the fuel pump. The governor shall provide automatic engine generator set frequency regulation adjustable from isochronous to 5% droop. Governors using external throttle linkages are not acceptable.

3. Positive engagement solenoid shift-starting VDC starter rated for amps cranking current as listed in Appendix “A.”

4. Battery charging alternator with a minimum ampere output as listed in Appendix “A.”

5. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain. The oil pump shall be capable of supplying adequate lubricating oil under pressure to the main bearings, crankshaft bearings, pistons, piston pins, timing gears, camshaft bearings, and valve rocker mechanism. The cartridge oil filters shall be full flow type, conveniently located for servicing. Filters shall be equipped with a spring loaded bypass valve to ensure oil circulation if filters are clogged.

6. Dry type replaceable air cleaner elements. The dry-type air cleaner shall be equipped with a self-cleaning dust and water evacuator and a vacuum restriction gauge to indicate maximum allowable restriction of the air cleaner system according to the engine manufacturer's recommendations. The air cleaner elements shall be conveniently located for servicing.

7. Unit mounted radiator, blower fan, water pump, and thermostat. The radiator with blower type fan shall be sized to maintain safe operation at 122° F ambient temperature. The engine cooling system shall be filled with a solution of 50/50 ethylene glycol/water antifreeze or equivalent as recommended by the manufacturer.

8. Removable type cylinder liners.

9. Replaceable insert main bearings.

10. Heater system.

a. The engine shall be equipped with an engine jacket water preheaters. Each preheater shall be a "Kim Hotstart", with a thermostat range 120° - 160° F, or comparable to allow the engine to be readily started at 10°

F. Block heater sizing and voltage, listed in Appendix “A” for “hot” start of engine.

11. A circulation pump shall be provided if recommended by the manufacturer for this application. Contractor is responsible for coordinating the proper breaker and wire size for generator heater at no additional cost to Owner. When the generator block heater power, voltage, amps, wire, conduit, etc. differs from that specified on Contract documents, Contractor shall modify power feed arrangements (any necessary hardware, conduit, wiring, fittings, devices, engineering, etc.) as directed in field at no additional cost to the Owner.

2.4 GENERATOR

A. The generator alternator shall be brushless permanent magnet-excited generator (PMG), with skewed stator windings and amortisseur rotor windings skewed for smooth voltage waveform. The generator shall have the following features:

1. Self-ventilated cooling.
2. Drip-proof housing construction.
3. 105° C alternator temperature rating.
4. Voltage regulation under load from no load to full load within +/- 1%.
5. Random voltage variation for constant loads, from no load to 100% load shall not exceed +/-1 % of its mean value.
6. Frequency variation shall isochronous under varying loads from no load to 100% load.
7. Random frequency variation shall not exceed +/- 0.25% of its mean value from no load to full load.
8. The insulation material shall meet the NEMA standard (MG1-22.40 and 16.40) for class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL I-24092.
9. The excitation system shall be of brushless construction controlled by a solid state voltage regulator with adjustable volts-per-hertz operation capable of maintaining voltage within +/- 1% at any constant load from 0 to 100% of rating. The regulator shall be sealed from the environment and isolated from the load to prevent tracking when connected to loads producing high harmonic voltage and current distortion.
10. Semi-flexible disc direct coupling to engine flywheel.
11. Maintenance free bearings.
12. Radio interference suppression to meet the BS.800 and VDE Class G and N standards.
13. Telephone interference factor of less than 50 per NEMA MG1-22.43.
14. AC voltage waveform total harmonic distortion of less than 5% total from no load to full load. Any individual harmonic shall have less than 3% THD.

B. On starting each listed load, the unit shall recover to +/- 1% of rated voltage within one second.

C. The generator shall be capable of sustaining at least 250% of rated current for at least 10 seconds.

D. The generator shall be capable of providing a minimum of KVA for motor starting with maximum dip listed in Appendix "A" and KW for continuous operation as listed in Appendix "A."

2.5 CONTROLLER & INSTRUMENT PANEL

A. Provide a generator-set mounted controller & instrument panel installed facing the direction shown on the design drawings. The panel mounting shall be vibration isolated from the rest of the engine / generator set.

B. The controller unit shall be of all solid state construction, except for relays used as alarm followers to provided dry contacts or in switching high current circuits. The controller shall utilize a microprocessor for logic control. All printed circuit boards shall be conformably coated and moisture proof. Circuitry shall be of plug-in design for quick replacement. The controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall be capable of operation from –40°C to 85°C.

C. The controller shall include:

1. Fuse DC control circuits.

2. Complete two-wire start/stop control wired to terminal blocks which shall operate on closure of a contact from a remotely located automatic transfer switch.

3. Engine starter control for:

a. Speed sensing and a second independent starter motor disengagement systems to protect against the starter engaging with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose.

b. Starting system designed for restarting in event of a false engine start, by permitting the engine to completely stop rotating before reengaging the starter.

c. Cranking cycler with 15 second ON and OFF cranking periods or as recommended by the manufacturer. Cranking shall cease upon engine starting and running. Two means of cranking termination shall be provided, one as a backup to the other. Failure to start after three cranking cycles shall shut down and lockout the engine, and visually indicate an overcrank shutdown on the indicator panel.

d. Circuitry and sensing devices for emergency shutdown of the engine on any occurrence of the following conditions:

1) High coolant temperature.

2) Low oil pressure.

3) Over speed.

4) Over-crank.

5) Low coolant level.

6) Remote manual stop station.

7) Shutdown shall be initially inhibited for a time delay period as necessary to allow the engine start for shutdown conditions 1, 2, and 5 or as recommended by the manufacturer.

4. A dry contact, normally open, which closes when the generator is running shall be provided and brought out to terminals for remote from the unit status monitoring.

5. Engine cool down timer factory set at five (5) minutes to permit unloaded running of the generator set after transfer of the load to normal.

6. Three position (RUN-OFF-AUTO) selector switch with two complete sets of spare normally open contacts for the "RUN" and "AUTO" positions. In the RUN position the engine shall start and run regardless of the position of the remote starting contact. In the AUTO position, the engine shall start when contacts in the remote control circuit close and stop five minutes after those contacts open. In the OFF position the engine shall not start even though the remote start contact closes. This position shall also provide for immediate engine shutdown in case of emergency.

7. Emergency Stop maintained pushbutton located at maximum 5 feet above grade after installation on vibration isolators and sub-base fuel tank. Provide additional Emergency Stop pushbutton as necessary to meet this requirement.

D. The instrument panel shall meet NFPA-110 Controller Accessories Requirements and shall include the following (digital display may be provided in place of analog instruments). Units shall read in US units (°F, PSI, etc.):

1. Indicating lights to signal:

a. System Ready

b. Low oil pressure.

c. High engine temperature.

d. Low water temperature.

e. Overcrank.

f. Overspeed.

g. Low engine temperature.

h. Fuel tank leak.

i. Low fuel level.

j. Low battery voltage.

k. Battery charger fail.

l. Alarms lights shall latch-in on occurrence of an alarm unit manually reset by an operator. A test button shall be provided for testing the operation of all the lights listed above. A follower dry contact (normally

open which closes on an abnormal condition) shall be provided and brought out to terminals for remote from the unit status indication of a common alarm which is activated on the occurrence of any of the alarm and shutdown conditions.

2. AC voltmeter.

3. AC ammeter.

4. Voltmeter/ammeter phase selection.

5. Direct reading pointer-type frequency meter.

6. Water temperature gauge.

7. Oil pressure gauge.

8. Battery charging current gauge.

9. Engine running time meter, non-resetting, with a minimum display capability of 9999 hours.

10. Voltage adjust rheostat.

11. Panel light shall be provided to illuminate all gauges, meters, and controls on the instrument panel. Graphical display (with 9 lines of data) in place of gauges and meters is acceptable.

2.6 ACCESSORIES

A. The following diesel generator accessories shall be provided and installed:

1. Exhaust System:

a. Exhaust Silencer: A critical type silencer including flexible stainless steel exhaust piping & fittings properly sized and installed according to the manufacturer's recommendation. The silencer shall be coated to be temperature and rust resistant. Gasproof, seamless, stainless steel, flexible exhaust connector(s) ending in pipe thread or SAE flange shall be used. Support for exhaust silencer is not to be carried by the exhaust manifold.

b. Exhaust Stack Pipe: An exhaust stack pipe to connect to the engine exhaust silencer. The silencer, stack, and exhaust piping shall be sized to ensure that measured exhaust back pressure does not exceed the manufacturer's minimum or maximum limitation. Install a spring loaded galvanized rain cap at end of exhaust pipe.

2. Screenings – Provide screenings on intake and exhaust system to prevent rodent intrusion into generator. Generator supplier is responsible for examining all Contract drawings for falling debris prior to submitting on vertical intake or exhaust systems.

3. Fuel tank piping shall vent outdoors 12 feet (minimum) above grade, 5 feet (minimum) away from property line and 2 feet away from building opening to meet Code.

4. Vibration Isolation: Vibration isolation dampeners between the engine-generator and steel mounting skid. The engine-generator isolation shall be galvanized steel compression spring type; seismic rated with earthquake restraints in both lateral and vertical directions. The specified exhaust silencer shall be mounted on the top of the unit with vibration isolators. The enclosure shall be mounted with vibration isolators which effectively isolate the enclosure from all vibration frequencies of the engine-generator. In addition, snubbers shall limit and cushion extreme excursions due to shocks encountered when the engine-generator is in transit. Isolation dampeners may be built into the generator skid.

5. Sub-Base Fuel Tank

   a. Fuel Tank: The fuel tank, sized for 24 hours – fully loaded, shall be skid sub-base mounted. The fuel tank shall have the following features:

      1) Steel construction.
      2) Steel channel side supports.
      3) 3/8" minimum drain.
      4) 1-1/4" mechanical fuel level gauge.
      5) Internal baffles.
      6) 2" fill-locking vented fill cap.
      7) Flexible fuel line(s) rated 300°F and 100 PSI ending in pipe thread.
      8) 3/8" minimum suction connection.
      9) 3/8" minimum return connection.
      10) Primer and enamel exterior.
      11) 1/4" minimum fitting for fuel sensor.
      12) High, and Low fuel sensors with independent set of contacts for high and low fuel alarm indication wired to generator control panel.
      13) Fuel tank leak sensor with independent set of contacts wired to generator control panel.
      14) Sub-base rupture containment basin. This containment basin shall be sized to contain a minimum of 110% of the capacity of the fuel tank. A 3/8" minimum drain plug shall be provided in each rupture containment basin. Extend exterior enclosure to cover basin.
      15) Meet UL 142.

   b. The fuel tank shall not be filled in excess of 90 percent of its capacity. An overfill prevention system shall be provided for the tank. During tank filling operation, the system shall:

      1) Provide an independent means of notifying the person filling the tank that the fluid level has reached 85 percent of tank

capacity by providing a tank level gage marked at 85 percent of tank capacity.

2) Visual and audible operator notification when the quantity of liquid in the tank reaches 90 percent of tank capacity.

3) A permanent sign shall be provided at the fill point for the tank documenting the filling procedure and the tank calibration chart. The filling procedure shall require the person filling the tank to determine the gallonage required to fill it to 90 percent of capacity before commencing the fill operation.

6. Batteries: Battery rack with tie down clamps, battery cables, and batteries all located mounted to the engine/generator skid. The batteries shall be capable of delivering the cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537. The batteries shall be sized a minimum as listed in Appendix A.

7. Battery Charger: A current limiting minimum ampere, at VDC as listed in Appendix "A", completely solid state battery charger to automatically recharge the starting batteries. The charger shall be a float and equalize type. The complete charger unit shall be U.L. listed. The charger shall be mounted to the engine/ generator skid. The charger shall be operational through an ambient temperature range of –40°F to 140°F. It shall include the following features:

   a. Fused AC input and DC output overload & short circuit protection.

   b. DC ammeter and voltmeter, 5% full scale accuracy, to indicate battery charging rate.

   c. "Power on" lamp to indicate when the charger is powered.

   d. Reverse polarity protection to prevent the charger from operating if improperly connected.

   e. Charger circuitry protection from line or load voltage transients. Provide a "Battery Charger Fail" dry contact to be connected to generator control panel.

   f. Charger temperature compensation. The charger shall provide temperature compensation of -2 mv/°C per cell over the ambient temperature of –40°C up to 60°C. This shall automatically adjust the "float" and "equalize" voltage settings to prevent the batteries from overcharging at high temperature and under charging at low ambient temperatures.

   g. DC voltage regulation +/- 1% from no load to full load and over AC input line variations of +/- 10%.

   h. Current limiting. Current limiting circuitry shall be provided to prevent damage to the charger from being overloaded at low battery voltage such as occurs during short circuit conditions or during engine starter cranking.

   i. Automatic "high rate" constant current charge circuit with automatic switchover to a lower "equalize" constant voltage charging rate and finally to a "float" charging rate. When the batteries has lost charge and

AC power is applied to the charger input, the charger shall operate in the "high rate" constant current mode until the batteries voltage rises to the preset "equalize" level. At the preset "equalize" level, the charger shall switch to the “equalize" constant voltage mode until the current required to maintain this voltage drops to 50% of the charger's high rate current. The charger shall now switch to the lower constant voltage "float" mode (fully charged batteries). The charger shall continue to operate in this mode until AC input power is lost or the current required to maintain the batteries at float voltage setting exceeds a preset amperage.

j. The battery charger shall be powered from 120 VAC.

8. Noise Reducing Weatherproof Housing: This enclosure shall house the engine, generator, control & instrument panel, battery charger, generator breaker, and all accessories.

a. The enclosure shall have galvanized steel or aluminum construction, painted inside and out with two (2) coats each of rust inhibiting primer and two (2) coats of exterior rated enamel. Color to be standard color as normally supplied by generator manufacturer. The side and rear panels shall be removable for easy servicing.

b. Provide urethane foam coating on interior of housing, double wall construction, or equal sound attenuating treatment.

c. All panels shall have lockable latches to prevent tampering and unauthorized entry.

d. Sound attenuating louvers and/or intake and exhaust silencers shall be provided at generator and radiator ends to control noise levels. Louvers shall prevent any water entrainment into intake air during generator operation. Water shall be prevented from entering the enclosure at all times. Devices shall be sized to provide ample air flow to insure proper cooling, without having to remove side panels. The specified exhaust silencer shall be mounted in or on the roof of the enclosure with vibration isolators.

e. Pressure drops through the enclosure shall not exceed limits set by the manufacturer of the diesel-driven standby electric generator.

f. The enclosure shall be free standing, attached to unit or resting on the concrete pad supporting the engine generator.

g. The engine exhaust silencer shall be attached to the enclosure and exhaust out of the top of enclosure.

h. Provide load center to distribute power to battery charger and two (minimum) each LED lights. Locate light switches near main access panels.

i. The enclosure including exhaust system shall be designed so that sound levels measured at 25 feet from any face of the enclosure, 3 feet above ground level, shall not exceed dB(A) listed in Appendix “A” when the engine generator is running with no load and full load at full speed.

j. Enclosure to have the following electrical devices mounted inside housing prewired to terminal blocks located in generator control panel via conduits: (Contractor shall verify that power is available for voltage required for panelboard)

1) Intrusion alarm door switch on each enclosure door.

2) GFI 20A receptacle.

3) Two (minimum) each LED lights and light switch.

9. A resettable line current sensing safeguard thermal-magnetic circuit breakers with inverse time versus current response shall be provided mounted to the engine/generator unit. This breaker shall have adjustable long time, short time instantaneous and ground fault (LSIG) settings when shown to allow selective tripping of downstream fuses or circuit breakers under a fault condition. "TM" indicates a non-adjustable thermal magnetic circuit breaker. This breaker shall protect the generator from damage that could occur due to the generator's own high current capability. This breaker shall not automatically reset preventing restoration of voltage if maintenance is being performed. The breaker size shall be three-pole with interrupt KAIC and amps rating (maximum size listed in Appendix "A") to match the rating of the wiring and automatic transfer switch. Circuit breaker shall have copper lugs.

10. Intrusion Switch

a. Intrusion switches shall be provided on all exterior doors and panels. Intrusion switches shall be wired normally closed in series and brought to terminal blocks near the generator control panel and be properly labeled.

b. Doors - Each intrusion door switch shall have a wide gap magnetic sensor with S.P.D.T. contacts mounted in a rugged steel housing with a 3 foot stainless steel armored cable for wiring to a terminal strip. Door switches shall be General Electric (Sentrol) 2507-A or approved equal.

2.7 TRAILER

A. The entire engine-generator, controller & instrument panel, fuel tank, and all accessories shall be trailer mounted and equipped as indicated below.

1. The fully loaded trailer, including the engine-generator set, weather protective housing, fuel, oil, water, instruments, etc., shall be suitable for towing on highways at 55 mph.

2. The generator and engine shall be transported on a trailer equipped with dual tandem axles. The axles shall be located such that the hitch weight shall be a minimum of 400 pounds and a maximum of 800 pounds with the fuel tanks full of fuel and the engine and generator equipped as specified.

3. The axles shall be equipped with leaf type spring suspension with a combined capacity of a minimum of 12,000 pounds.

4. The wheels shall be a single steel disc wheels with a minimum combined capacity of 12,000 pounds. All wheels shall be the same size.

5. The tires shall be truck type tires with highway type threads and have a minimum combined capacity of 12,000 pounds. All tires shall be the same size.

6. The trailer shall be equipped with electric brakes on both axles.

7. The hitch shall be constructed of steel channel, adequately reinforced, and braced to support the hitch weight of the trailer fully equipped and capable of being towed at a speed of 55 miles per hour. A lunette towing eye shall be installed and shall be adjustable in height from 21 inches to 29 inches above the ground level.

8. The towing eye shall by constructed of 1-5/8 inch solid round stock and have an I.D. of 3 inches. Install two (2) safety chains of not less than 3/8 inch high-test chain and extending 24 inches beyond each side of drawbar. Chains shall be provided with safety hooks on both ends. (Ref. Herc-Alloy #HA250S or comparable.)

9. The hitch jack shall be a screw jack type. Screw jack shall have a rated capacity of not less than 4,000 pounds. The hitch jack shall be mounted such that a clearance of 12 inches between the ground and the bottom of the hitch jack can be obtained with the trailer sitting on a level surface and the hitch attached to a towing vehicle.

10. A break-away switch to activate the trailer braking system in event of the trailer parting from the towing vehicle shall be provided, or other comparable means of emergency breaking.

11. A tire lifting jack shall be located under each side of the tandem wheels. Each tire lift jacking stand shall be hydraulically hand operated and rated to lift and support twice the full load weight of the entire portable emergency generator. The tire lifting jack shall be mounted such that a clearance of 12 inches between the ground and the bottom of the tire lifting jack can be obtained when the jack is in its recessed position.

12. Lights: The unit shall be equipped with clearance lights, running lights, license plate light, combination taillight stop lights, and directional lights. All lights shall be 12-volt lights. A 6-wire SAE standard trailer light connector (Ref. Pollak 11-620 or comparable) extending 24 inches beyond the trailer towing eye. The connector supplied must mate with Pollak 11-620 socket in use on Owner trucks. All wiring installed above the cable storage compartment shall be installed in automotive type loom and securely attached to the frame by metal clips. All wiring installed below the cable storage compartments shall be protected by 1/2 inch minimum EMT conduit. The conduit shall be securely attached to the frame of the trailer. All rear lamps shall be guarded or recessed into the trailer frame. All reflectors shall be mechanically attached to the trailer; adhesive-attached reflectors are not acceptable. A storage pocket shall be supplied to hold connector when not in use.

13. The overall trailer shall not exceed eight (8) feet in width and eight (10) feet in height including the exhaust system.

14. A cable storage compartment system shall extend along both sides and around the front of the trailer as needed. The cable storage compartment space shall be large enough to store four (4) lengths of the portable power cable. The cable storage compartments shall be capable of being locked with standard padlocks.

15. The frame and bed shall be of ample structural strength and rigidity to hold the alignment of the engine-generator to tolerable limits as recommended by the engine-generator manufacturer.

16. All steel work shall be immersion cleaned and phosphated to inhibit rust prior to painting. Paint finishes shall be electrostatically applied dry powder, baked to thermoset. All the external surfaces of the trailer and weatherproof sound attenuating housing shall be painted with a minimum of two coats of champagne white color paint, Fuller No. 312-91 or approved equal. No field painting will be allowed except for "touching up" of damaged areas.

PART 3 - EXECUTION

3.1 GENERAL

A. The diesel generator shall not be delivered to the job site until the certified factory test report as specified under testing has been reviewed and accepted by the Owner. Missing or non-reviewed certified factory test report shall be sufficient cause for the unit to be rejected.

B. The Owner reserves the right at any time to reject any equipment that is not in conformance with design specifications and drawings.

C. Rejected equipment shall be immediately removed from the delivery jobsite by the Contractor.

3.2 CONSTRUCTION METHODS

A. The construction methods specified herein shall be followed by the manufacturer of the diesel generator. If the manufacturer fails to comply then the Contractor shall pay all costs required to make the changes to the equipment to conform with these construction methods.

B. Screw-type, solderless terminals or lugs shall be provided for connecting all external line & load power cables, control and instrument wiring. All connections shall be accessible from the front without removal of internal components.

C. A terminal strip shall be provided for terminating all control and instrument wiring. Number all terminals with machine printed lettering matching the wire number of the terminated wire. Numbered terminal blocks shall be installed for landing all field wiring.

D. All control and instrument wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered wiring sleeves. Electrically common wires shall have the same wire number. Electrically different wiring shall have unique wire numbers.

E. Control and instrument wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be protected with plastic spiral wrap where it is subject to mechanical damage or crosses over to a hinged door.

F. Workmanship: The equipment and any accessories shall be a product of good workmanship and shall be free from any defects that will affect their appearance or serviceability.

G. Ground generator neutral per generator manufacturer's installation instruction since this is a 3 wire distribution system.

3.3 FACTORY INSPECTION AND TESTS

A. Factory Inspection: Prior to delivery to the Owner, the Contractor shall notify and give the Owner the opportunity to inspect and witness each factory test of the completed diesel generator assembly at the factory location. A written notice shall be given to the Owner seven (7) days prior to the date for the factory test. Owner costs to attend factory inspection and test will be paid by the Owner, if the Owner elects to attend. The diesel generators shall not be shipped from the supplier to the Owner without acceptance of factory test report and written authorization from the Owner.

B. Factory Tests: Each diesel generator to be supplied shall be tested by the manufacturer prior to shipment. All tests shall be made with all accessories installed. The factory tests shall be made under varying loads for a minimum of four hours total. The factory testing shall include the following tests:

1. Single step load pickup.
2. Transient and steady state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated power.
6. Maximum power.
7. Test all generator control panel alarms and status lights & indicators.
8. Test all status and alarm points' contacts for remote monitoring utilizing ohmmeter.
9. Simulate remote ATS start/stop of generator utilizing jumper.

C. A typewritten factory test report shall be provided which lists the factory tests performed, results of the each test, name & phone number of person who performed the tests, date(s) of when tests were performed, serial & part number of equipment tested, all adjustment or setting values, and failures encountered & repairs made during testing. This factory test report shall be certified by a Public Notary as to its authenticity and accuracy. A Factory Test Report, as shown on sheet TFG1 in Appendix "B," shall be completed and submitted to the Owner for review and approval prior to shipment of generator to the job site.

3.4 INSTALLATION

A. Battery Mounting: Mount batteries on steel battery rack attached to generator skid in a clean, dry location protected from falling hazards, but accessible to permit ease of inspection of electrolyte level. Provide and install a 2-pole padlockable-knife switch adjacent to batteries that will disconnect both the positive and negative leads of the batteries that feed all the generator circuits.

B. Install condensation drain in exhaust piping and weather hood at end of exhaust for each engine generator.

C. Equip all fuel lines with manual and automatic shutoff valves.

D. Mount engine, generator and radiator on a common structural steel sub-base capable of maintaining unit alignment suitable for mounting unit on a concrete foundation. Equip with vibration isolators between generator set and sub-base.

E. Mount generator breaker, battery charger, batteries, heater and control panel to generator set unit.

F. Install all drain lines and valves for access without removal of any equipment.

3.5 FIELD TESTS

A. The Contractor shall take all precautions necessary to ensure the safety of all personnel during the tests. Absolutely no tests shall be ran that could potentially cause injury or jeopardize personnel safety.

B. Submit test procedures per Section 26 00 00 “Electrical” for approval two (2) weeks (minimum) prior to start of field tests.

C. Fuel System Testing prior to being placed in service – Fuel tank and associated piping shall be field tested prior to being placed in service if required by local jurisdiction or code. Provide Initial Testing and Tightness Testing per NFPA 30.

D. The initial setup of each diesel generator shall be performed by a factory-trained service person of the manufacturer's local representative. The factory-trained service person shall furnish and fill the engine fuel, lubricants, and cooling system. The factory-trained service person shall make all preliminary tests and checks required before engine start-up the day prior to witness field testing. Portable load bank shall be set-up the day before the start of each generator load bank testing.

E. The Contractor shall be responsible and pay the costs for the necessary fuel to fill each diesel generator tank prior to the start of the field tests. This fuel shall be No. 2. Diesel fuel with a fuel conditioner or as recommended by the manufacturer. Contractor shall fill each generator fuel tank after all tests have been accepted at no additional cost to the Owner. Contractor shall fill all fuel tanks prior to final acceptance.

F. The Contractor shall pay for a factory-trained service representative to perform one (1) 8-hour day (minimum) of field tests for each generator, beginning at 8:00 a.m. any weekday, except Monday and Friday.

G. Each failure mode, alarm, and control function shall be demonstrated to Owner by the Contractor's factory-trained service representative prior to performing any other field tests.

H. The following Generator Field Checklist shall be filled out by the generator factory-trained service representative and given to the Owner at the end of the field tests. Each item on the "Generator Field Test Checklist" sheet in Appendix "C" shall be marked with a check (√) or "N/A" (not-applicable).

I. A resistive load shall be applied for a four (4) hour, full-load test for each generator. The load bank is to provide a load equal to 100 percent of the generator nameplate kW.

1. Portable load bank shall be connected to generator main breaker and not to load bank breaker that is intended only to exercise the generator

2. The full-load test shall be initiated immediately upon reaching rated rpm, pick up percent of nameplate kW rating on one step, less applicable derating factors for site conditions.

3. Generator supplier shall provide load bank during test. Unity power factor is acceptable for on-site testing, provided that rated load tests at rated power factor have been performed by the manufacturer of the generator at factory test prior to shipment.

4. The factory-trained service person shall be responsible for running the diesel generator during these load tests. Any defects or failures discovered during these tests shall be corrected or adjusted by the factory-trained service person. The engine generator load test shall be restarted after each repair or adjustment that required shutdown of the diesel generator as many times as necessary until the complete diesel generator runs without shutdown or failure for four (4) continuous hours. After the four hour full load test is completed, the Owner will start and stop the loads during the tests to simulate normal operating conditions.

J. All field tests shall be witnessed by Owner.

K. Record the data listed on Field Generator Report Test Form TFG2 in Appendix "B" at first load acceptance and every 15 minutes thereafter until the completion of the four hour test period.

3.6 TRAINING

A. The local representative's factory-trained service person shall instruct up to six of the Owner's personnel in the proper operating and maintenance procedures for all components of the diesel generator. This instruction shall be given for a minimum length of six (6) hours for each generator and on a date acceptable to the Owner's schedule. Two (2) hours of the training shall cover "operation" and four (4) hours of the training shall cover "maintenance". Training shall not be given until the Owner has received and approved the operation and maintenance manuals and field tests have been completed.

3.7 SPARE PARTS

A. The Contractor shall supply sufficient spare parts to support the diesel generator throughout the warranty period.

B. The following spare parts shall be provided to the Owner for each generator:

1. 10 each of each type and size of fuse.
2. 2 sets of all fuel, lube oil and coolant filters.
3. 2 each indicating lights for each type of light.
4. 1 cup of touch up paint for each color of housing.

C. Spare parts shall be packaged for safe shipping and storage and clearly labeled with part name & number.

3.8 WARRANTY

A. The Contractor shall have a staff of experienced personnel available to provide service on two (2) working days' notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the equipment delivered; and of implementing corrective measures.

B. If the Contractor fails to respond in two (2) working days, the Owner at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. The use of other resources, as stated above, shall not change or relieve the Contractor from fulfilling the remainder of the warranty requirements.

C. Prior to final acceptance, the Contractor shall furnish to the Owner a listing of warranty information for all manufacturers of materials and equipment supplied under the scope of work covered in these design documents. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.
2. Material and equipment description, equipment number, part number, serial number, and model number.
3. Warranty expiration date.

D. Hardware support:

1. The Contractor shall warrant all equipment for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer.
2. The Contractor shall provide all labor and material to replace or repair any hardware that fails during the warranty period, at no additional cost to the Owner.
3. Free technical phone support on equipment for a period of one year. Support shall be provided directly from the manufacturer. Phone support shall be available between 8 a.m. and 5 p.m. Monday through Friday.
4. Each time the Contractor's repair person responds to a system malfunction during the warranty period, he or she must contact the designated Owner maintenance supervisor for scheduling of the work, access to the jobsite, and permission to make repairs. Operation of facilities necessary to test

equipment shall only be performed by or under the direction Owner staff. The Owner reserves the right at its sole discretion to deny operations requested by the Contractor.

3.9 FINAL ACCEPTANCE

A. Final acceptance will be given by the Owner after the equipment has been field tested satisfactorily, each deficiency has been corrected, documentation has been provided, and all the requirements of design documents have been fulfilled.

B. Generator is successfully permitted by all local air resource authorities.

C. All Fuel tanks have been refilled.

D. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Contractor shall provide the following to the Owner:

1. Each "operation, maintenance and parts" manual shall be modified or supplemented by the Contractor to reflect all field changes and as-built conditions.
2. Manufacturer’s field representative shall furnish a letter of compliance for the engine generator:
3. Has been properly installed and lubricated.
4. Is in accurate alignment and all leaks fixed.
5. Has been operated satisfactorily under full-load conditions and all tests have been completed.
6. Personnel trained in all operations.
7. Electrical system is completely corrected and properly functioning.
8. Ready for Owners usage as a standby generator.
9. Generator unit cleaned and touchup painted.
10. Two sets of keys for all locks turned over to Owner.
11. Punch list items have been corrected.
12. Warranty information provided.
13. O&M manuals completed.
14. Electronic documentation given to Owner.

SECTION 26 32 13.13 - APPENDIX "A"

GENERATOR DATA FORM

Index:

GENERATOR DATA FORM - ALDERPOINT PS

Description	Specification Minimum	Submitted Value	Units
GENERATOR			
Generator Continuous Output Power	80		KW
	100		KVA
Amperage	120		AMPS
Three Phase Voltage	480		VAC
Power Frequency	60		Hz
Motor Starting (max. 35% voltage dip)	270		KVA
Maximum Step Voltage Dip	10		%
BREAKERS			
Generator Main Breaker Rating	200		Amps
Generator Main Breaker Type	TM		-
Generator Main Breaker Interrupt Rating	42		KAIC
ENGINE			
Horsepower at Rated RPM	145		HP
Rated RPM	1800		RPM
HP Rating	1.81		HP/KW
Displacement	276		Cubic In.
Fuel Type	No. 2 Diesel		-
Engine Type	Turbo		-
ENGINE ELECTRICAL SYSTEM			
Starter/Battery/Voltage	12		VDC
Cold Cranking Current	640		A
Alternator Output	65		A
Battery Charger Output	10		A
ENGINE BLOCK HEATER			
Size	750		W
Phase	1		ø
Voltage	120		VAC
FUEL TANK			
Capacity (Minimum)	180		Gallons
Fuel Tank Type	Sub-Base		-
Fuel Consumption at 100% Load	7.6		Gal/Hr
Runtime at 100% Load	23.7		Hr
ENCLOSURE			
Type	Sound Attenuating		-
Maximum Sound Level	72		dB

GENERATOR DATA FORM - TOBIN WELL

Description	Specification Minimum	Submitted Value	Units
GENERATOR			
Generator Continuous Output Power	15		KW
	19		KVA
Amperage	45		AMPS
Three Phase Voltage	240		VAC
Power Frequency	60		Hz
Motor Starting (max. 35% voltage dip)	270		KVA
Maximum Step Voltage Dip	10		%
BREAKERS			
Generator Main Breaker Rating	100		Amps
Generator Main Breaker Type	TM		-
Generator Main Breaker Interrupt Rating	42		KAIC
ENGINE			
Horsepower at Rated RPM	22		HP
Rated RPM	1800		RPM
HP Rating	1.47		HP/KW
Displacement	122		Cubic In.
Fuel Type	No. 2 Diesel		-
Engine Type	Turbo		-
ENGINE ELECTRICAL SYSTEM			
Starter/Battery/Voltage	12		VDC
Cold Cranking Current	640		A
Alternator Output	65		A
Battery Charger Output	10		A
ENGINE BLOCK HEATER			
Size	750		W
Phase	1		ø
Voltage	120		VAC
FUEL TANK			
Capacity (Minimum)	180		Gallons
Fuel Tank Type	Sub-Base		-
Fuel Consumption at 100% Load	7.6		Gal/Hr
Runtime at 100% Load	23.7		Hr
ENCLOSURE			
Type	Sound Attenuating		-
Maximum Sound Level	72		dB

GENERATOR DATA FORM - TRAILER MOUNT

Description	Specification Minimum	Submitted Value	Units
GENERATOR			
Generator Continuous Output Power	30		KW
	38		KVA
Amperage	90		AMPS
Three Phase Voltage	240		VAC
Power Frequency	60		Hz
Motor Starting (max. 35% voltage dip)	140		KVA
Maximum Step Voltage Dip	10		%
BREAKERS			
Generator Main Breaker Rating	100		Amps
Generator Main Breaker Type	TM		-
Generator Main Breaker Interrupt Rating	42		KAIC
ENGINE			
Horsepower at Rated RPM	64		HP
Rated RPM	1800		RPM
HP Rating	2.13		HP/KW
Displacement	177		Cubic In.
Fuel Type	No. 2 Diesel		-
Engine Type	Turbo		-
ENGINE ELECTRICAL SYSTEM			
Starter/Battery/Voltage	12		VDC
Cold Cranking Current	640		A
Alternator Output	55		A
Battery Charger Output	10		A
ENGINE BLOCK HEATER			
Size	750		W
Phase	1		ø
Voltage	120		VAC
FUEL TANK			
Capacity (Minimum)	500		Gallons
Fuel Tank Type	Sub-Base		-
Fuel Consumption at 100% Load	2.9		Gal/Hr
Runtime at 100% Load	172.4		Hr
ENCLOSURE			
Type	Sound Attenuating		-
Maximum Sound Level	72		dB

SECTION 26 32 13.13 - APPENDIX "B"

GENERATOR TEST FORMS

Index:

TFG1 Factory Generator Test Report

TFG2 Field Generator Test Report

FACTORY GENERATOR TEST REPORT

TEST FORM 1 (TFG1)

JOB # _____	ENG MODEL: _____ S/N: _____
SERIAL# _____	GEN MODEL: _____ S/N: _____
MODEL # _____	VOLT REG MODEL: _____ S/N: _____
KW: _____ KVA: _____ Hz: _____	ELECT GOV CONT P/N: _____ S/N: _____
VOLTS: _____ PH: _____	ELECT GOV ACT P/N: _____ S/N: _____
AC CONNECT: _____	CONTROL MODULE/SPEED SWITCH #: _____

PRELOAD CHECKS

		CKD	N/A	
____ CRANK CUT-OUT				
____ OVERSPEED SET 67HZ	___ LIGHT	___	___	GENERATOR RUN LIGHT
____ HI WATER TEMP SHUTDOWN	___ LIGHT	___	___	PANEL LIGHT
____ LO OIL PRESSURE SHUTDOWN	___ LIGHT	___	___	LAMP TEST SWITCH
OIL PRESSURE SHUTDOWN DELAY @ ____ SEC		___	___	ALARM HORN & SILENCE SW.
CRANK @ ___ CYCLES ON ___ SEC, OFF ___ SEC		___	___	SWITCH NOT IN AUTO LIGHT
MAG P/U VOLTS: _____ DC VOLTS: _____		___	___	EMERGENCY STOP PB
VOLTAGE CHECKS		___	___	PRE LOW OIL PRESSURE LIGHT
L1 TO L2: _____	L1 TO N: _____	___	___	PRE HIGH WATER TEMP LIGHT
L2 TO L3: _____	L2 TO N: _____	___	___	LOW COOLANT LEVEL CONTACT
L3 TO L1: _____	L3 TO N: _____	___	___	LOW FUEL LEVEL CONTACT
VOLT ADJUST MIN @ _____	MAX @ _____	___	___	TACH CALIBRATE
		___	___	BLOCK HEATER
1 STEP LOAD PICK-UP _____ AMPS @ ____ PF		___	___	REMOTE START CONTACTS
		___	___	LOW COOLANT TEMP

LOAD TEST @ 1.0 POWER FACTOR

TIME HRS	% LOAD	VOLTS ø B	AMPS ø B	HZ	KW	AMB °F	WATER °F	OIL PSI	ENGR HRS
WARM UP	0								
0.1	25								
0.1	50								
0.2	75								
0.2	100								
0.2	100								
0.2	MAX								

COMMENTS:

TESTED BY : _____ PHONE: _____ DATE : ____/____/____

CERTIFIED BY : _____ PHONE: _____ DATE : ____/____/____

FIELD GENERATOR TEST REPORT

TEST FORM 2 (TFG2)

JOB NAME:			CUSTOMER:
SITE ADDRESS:			ADDRESS:
CITY, STATE ZIP:			CITY, STATE ZIP:
GENERATOR MODEL:	SPEC:		GENERATOR SERIAL NO.:
ENGINE MAKE:	MODEL:		ENGINE SERIAL NO:
KW/KVA RATING:	VOLTS: Hz:		PHASE: WIRE:

COLD START TEST

START TIME	TIME			OPERATING SPEED VOLT.			OVERSHOOT VOLT.			OVERSHOOT FREQ.
	DELAY START	CRANKING	FULL SPEED	L1	L2	L3	L1	L2	L3	HZ

STEADY STATE TEST

	VOLTAGE			AMPS				KILOWATTS, CYCLES PRESSURE					TEMPERATURE			BATT.
TIME	L1	L2	L3	L1	L2	L3	% LOAD	KW	HZ	RPM	P.F.	OIL	WATER	OIL	AMBIENT	CHRG.

TESTED BY: _____ DATE : ____/____/____

WITNESSED BY: _____

NOTES:

SECTION 26 32 13.13 - APPENDIX "C"

GENERATOR FIELD TESTS

CHECKLIST

The Following (minimum) Installation Checks Must Be Made by Service Representative Before Start-Up in addition to those recommended by Generator manufacturer:

NOTE: This form is to be used as a general guide, follow the manual supplied with generator along with reference to any applicable codes or standards. Ultimate compliance must be with applicable generator manual and codes and standards.

___ 1. Equipment installed in dedicated room?

___ 2. Battery-powered emergency lighting installed in equipment room?

___ 3. Adequate clearance on all sides to allow ease of maintenance?

___ 4. Proper construction and leveling of mounting bases?

___ 5. Adequate heating for equipment room?

___ 6. Adequate incoming and outgoing air (louver motors adjusted and of proper voltage)?

___ 7. Radiator duct flange properly sized and connected?

___ 8. Cooling system properly filled?

___ 9. Proper level of specified oil in crankcase?

___ 10. Adequate/dedicated fuel supply?

___ 11. Flexible sections installed in cooling water lines?

___ 12. Manually-operable fuel and cooling water valves installed, allowing manual operation of, or bypass of solenoid valves, when used?

___ 13. Flexible fuel lines installed between engine and fuel piping?

___ 14. Fuel tanks and piping installed in accordance with applicable codes and standards?

___ 15. Adequate fuel transfer tank pump lift and pump motor properly wired?

___ 16. Proper size exhaust line and flexible connector(s)? Flexible connector(s) should not be bent.

___ 17. Exhaust line condensate trap with drain installed?

___ 18. Exhaust line installed with proper downward outgoing incline?

___ 19. Proper-specified muffler installed with hangers and mounts tight?

___ 20. Exhaust line free of excessive bends and restrictions? Back pressure under specified limit?

___ 21. Exhaust line protected from entry by rain, snow, and animals?

___ 22. Approved heat-isolating thimble(s) installed at points where exhaust line passes through combustible wall(s) or partition(s)?

___ 23. Exhaust system termination located to prevent entry of exhaust gases into structures?

___ 24. Battery(ies) of proper size and voltage?

___ 25. Battery(ies) filled with electrolyte and properly connected to charger?

___ 26. Battery charger AC circuit properly connected and charger operational?

___ 27. Battery(ies) properly mounted with adequate ventilation?

___ 28. Starting cables of proper length and gauge?

___ 29. Battery isolation disconnect knife switch installed?

___ 30. Starting cables properly connected to battery(ies)?

___ 31. Generator load conductors of proper ampacity, and properly connected to circuit breakers, and/or emergency side of transfer switch?

___ 32. Load conductors, engine start leads, battery and heater power source leads installed in separate conduits?

___ 33. Nameplate voltage and frequency of both generator set and transfer switch matching normal/utility source ratings?

___ 34. Transfer switch AC conductors properly connected (Normal to NL1, NL2, NL3; Emergency to EL1, EL2, EL3; Load to LL1, LL2 and LL3)?

___ 35. Transfer switch switching mechanism free from binding? NOTE: Disconnect all AC sources, and operate manually to check.

___ 36. All other wiring, including customer added options, connected properly?

___ 37. Equipment room clean with all material not related to Generator Supply System operation removed?

___ 38. Earthquake rated anchoring adequate for equipment and support systems?

Tested by: _____ Witnessed by: _____

Date of Test: _____

END OF SECTION

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SECTION 26 36 23

AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall supply along with complete startup and testing services for each automatic transfer switch (ATS) as specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

B. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to provide a complete and operational ATS as described in these Specifications, or required for fully operating facility.

C. Work includes that specified in Division 26 and 40.

D. The ATS scope of work includes:

1. Providing and installing automatic transfer switches at locations shown.
2. Installation of the complete ATS.
3. Submittal data and drawings.
4. Startup assistance.
5. Testing.
6. Operation and maintenance manuals.
7. Warranty of all components of the automatic transfer switch.

1.2 SUBMITTALS AND DRAWINGS

A. Provide Submittals and Drawings as specified in Section 26 00 00.

1.3 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals as specified in Section 26 00 00.

1.4 SUPPLIER SERVICES

A. Prices for the ATS shall include the following services of technical representatives at the job site for each ATS. The number of hours and scope of services indicated are

minimum requirements not including travel time. Time for travel and all associated expenses shall also be included in the bid price for the work.

1. 4 Labor hours - Installation assistance, inspection, and functional testing.
2. 4 Labor hours - Equipment startup and training.

PART 2 - MATERIALS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

A. Open Transition Switch Unit

1. The automatic transfer switch shall consist of completely enclosed draw out mount breaker contact assemblies and a separate control logic panel. The transfer switch unit shall be electrically operated and mechanically held open transition type. The transfer switch shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power, without derating.
2. Transfer switch shall be capable of being operated manually under full load conditions and shall be equipped with a permanently affixed manual operator designed to prevent injury to operating personnel in the event that the electrical operator should suddenly become energized during transfer.
3. RMS current sensing, 3 phase, 480VAC circuit breakers shall be provided with long, short, and ground fault adjustable settings. Overcurrent protection shall be provided for both the emergency power source and the normal power source. Unit shall have interrupt rating as shown on Contract one-line diagrams.
4. Three levels of interlocking shall be provided; two mechanical and one electrical.
5. The switch shall be positively interlocked mechanically and electronically to ensure only one of two possible positions, normal or emergency.
6. A position indicator shall be visible from the front of the switch to show to which source the load is connected.
7. Inspection and replacement of all parts (moving and stationary) shall be possible from the front of the switch by draw out assembly. Draw out assembly shall be able to be disengaged under power.
8. The switch shall be fully rated at the minimum amps shown on Contract one-line diagram. The ATS shall be rated for switching all types of loads, including induction motors, at the specified amperage and voltage.
9. Switches that are not rated for continuous duty, repetitive switching of all types of loads or transfer between two active power sources are not acceptable.

10. The main contact design shall allow repeated making and breaking of full load current, in a combination of motor and other loads, without damage to the main contacts per UL 489 and/or UL1008.

11. Draw out mechanical linkages, and control elements shall be serviceable or removable from the front without disconnection of the power cables or control wiring.

12. A terminal strip shall be provided for terminating all control wiring. Number all terminals with machine printed lettering matching the wire number of the terminated wire.

13. All control wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered wiring sleeves. Electrically common wires shall have the same wire number. Electrically different wiring shall have unique wire numbers.

14. Control wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be protected with plastic spiral wrap where it is subject to mechanical damage or crosses over to a hinged door.

15. The switch assembly shall be in a free standing switchboard enclosure with code gauge fully finished steel with rust resistant primer and two coats of baked enamel paint, the ATS manufacturer's standard grey color.

16. The automatic transfer switch shall be ASCO-7000, Zenith automatic transfer switch with IQ Transfer microprocessor logic, or approved equal. Breaker type ATSs are not acceptable.

B. Control Panel

1. Top of operator interface (pilot devices / switches) to be maximum 66" above finished floor

2. A microprocessor based control panel shall be provided to direct the operation of the transfer switch. The control panel shall have a keyboard, LED display and LED status lights.

3. The transfer switch control panel shall be mounted separately from the transfer switch and shall be supplied with a quick disconnect plug for ease of maintenance.

4. The control panel shall meet or exceed the voltage surge withstand capability in accordance with ANSI/IEEE Standard (C37.90.1 2012) and the withstand voltage test in accordance with the proposed NEMA Standard ICS1-109.21.

5. The phase failure or under voltage of each phase of the normal power source shall be monitored.

6. The control panel shall include the following field adjustable time delays:

   a. Time delay to override momentary normal source outages. This adjustment shall be field set in order to have standby generator into operation within 10 seconds.

b. Transfer to emergency time delay for controlled timing of load transfer to emergency. This adjustment shall be field set to have standby generator into operation within 10 seconds.

c. Retransfer to normal time delay, adjustable 0.2 to 30 minutes. This adjustment shall be factory set at 5 minutes. The time delay is automatically bypassed if the emergency source fails and normal source is acceptable.

d. Unloaded running time delay for emergency engine generator cooldown, adjustable from 0.2 to 30 minutes. This adjustment shall be factory set at 5 minutes.

e. Open transition delay, to set the length time ATS is in open transition in which both Utility and Generator breakers are in the open position.

7. Contacts shall be provided for starting the engine when the normal source fails. The contacts shall be double pole double throw (DPDT), and compatible with low and high voltage engine start signals.

8. Provide Auto/Test switch to provide test operation of the ATS by simulating a loss of the Normal Power Source.

9. Provide visual switch position indication on the face of the ATS.

10. Two auxiliary dry contacts shall be provided. One that closes when the switch is in the normal position and one that closes when the switch is in the emergency position. These auxiliary contacts shall be rated 1 amps at 120 volts.

11. LED display to show voltage of each phase and frequency. This display shall also show timer setpoint values, which can be changed with keypad.

12. All adjustments shall be fully field adjustable without the use of tools, meters, power supplies, or special test equipment.

13. Each adjustment resolution shall be settable within minimum increments of 1%.

14. Repetitive accuracy of timer, voltage and frequency settings over a temperature range of -20 C to 70 C shall be within +/-2%.

15. The control panel shall be arranged such that adjustments to time delay settings can be safely made without personal exposure to live parts.

16. The control panel shall be completely covered to protect against accidental contact, foreign matter, and tampering.

17. Top of control panel, pilot devices, etc. shall be maximum of 66” above finished floor.

18. The wire harness for connection of the control panel to the transfer switch shall have sufficient length to reach between the mounting locations shown on the design drawings.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 26 00 00 – Electrical.

B. The Supplier shall employ personnel that are skilled and experienced in the startup and testing of ATS and its accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Electrical Section 26 00 00 – General Construction Methods and General Equipment Fabrication apply to the construction and assembly of the automatic transfer switch.

E. Perform any required work to correct improper installations at no additional expense to the Owner.

F. Provide nameplates as shown on Contract drawings.

3.2 INSTALLATION

A. The installation methods specified herein shall be followed by the Supplier of the automatic transfer switch. If the Supplier fails to comply with these installation methods, then the Contractor shall pay all costs required to make the changes to the equipment to conform with these installation methods.

B. All connections shall be accessible from the front without removal of internal components.

C. Terminal strips shall be provided for terminating all interconnect wiring except for prefab cable connectors. All terminals shall be labeled.

D. All wiring shall have permanent identification at each point of connection. Wire identification shall be by machine printed numbered wiring sleeves. All Wires shall have labels.

E. Wiring shall be neatly bundled and secured in place by plastic cable ties. Wiring shall be installed and protected with corrugated loom tubing where it is subject to mechanical damage or crosses over to a hinged door.

F. All lugs shall be copper sized for wires listed in the Conduit & Wire Routing Schedule.

3.3 FIELD TESTS

A. Provide field testing as specified in Section 26 00 00 – Electrical and Instrumentation Field Tests.

B. All time delays and programmable settings shall be set in the field by the Supplier to the settings as directed by the Owner at no additional cost.

3.4 WARRANTY

A. Provide warranty as specified in Electrical Section 26 00 00 - Warranty.

END OF SECTION

31 Earthwork

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SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnishing all labor, materials, and equipment necessary for all earthwork as indicated on the Drawings and specified herein, or as required for completion of the Work including:

a. Rough grading

b. Filling and backfilling

c. Excavation

d. Onsite utility verification

e. Protection of Work, people, and existing Site elements

f. Seasonal limits

g. Materials

h. Execution of Work

B. Trench excavation, backfill, compaction, and all other associated Work involved in trench excavations is not covered in this Section. Refer to "Section 31 23 33 Trenching and Backfill."

C. Related Sections:

1. “Engineering Geologic and Geotechnical Investigation Report Proposed Water System Improvements for the Garberville Sanitary District, Humboldt County, California-Revision 1” (SHN, 2023)

2. Section 31 50 00—Excavation Support and Protection

3. Section 01 33 00—Submittal Procedures

4. Section 01 70 00—Execution and Closeout Requirements.

1.2 REFERENCES

A. ASTM-International (ASTM):

1. ASTM D1557–Standard Test Methods for Laboratory Compaction Characteristics of Soil

Using Modified Effort (56,000 ft/lbf/ft^3 [2,700 kN-m/m^3]).

2. ASTM D422–Standard Test Method for Particle-Size Analysis of Soils.
3. ASTM D4318–Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
4. ASTM D6938–Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. California Building Code (CBC):

1. Current edition.

C. California Department of Transportation (Caltrans):

1. Caltrans Test 205

D. California Department of Transportation (Caltrans):

1. Standard Specifications, current edition.

E. California Occupational Safety and Health Administration (Cal-OSHA):

1. Title 8, Section 1590 (e).

F. Any Work within the street, highway, or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction and shall not begin until all of those governing authorities have been notified.

1.3 SUBMITTALS

A. Refer to “Section 01 33 00 Submittal Procedures” for Submittal requirements.

B. Import Materials: Submit information regarding all materials to be imported to the Project Site for use as engineered fill, aggregate base, or other materials required to accomplish the earthwork element of this Project including, but not limited to,

1. Laboratory testing information for all aggregate base material being used on the Project
2. Mix designs for any slurry cement used on the Project.
3. Material Source
4. Submit, in air-tight containers, 5-gallon samples of each type of aggregate base fill to testing laboratory.
5. Submit samples of drain rock to the Engineer.
6. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

C. Load Slips: The Contractor shall retain load slips for all materials delivered to the Site and make them available to the Project Engineer upon request.

D. Excavation shoring and Bracing Plan (when applicable). Refer to “Section 31 50 00 Excavation Support and Protection” for Submittal requirements.

E. Excavation Protection Plan (when applicable): Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan. Refer to “Section 31 50 00 Excavation Support and Protection” for Submittal requirements.

F. Geotextile Fabrics. Refer to Section 2.1 for further guidance.

1.4 CLOSE OUT SUBMITTALS

A. Refer to “Section 01 70 00: Execution and Closeout Requirements”

B. Project Record Drawings: Accurately record locations of utilities remaining, re-routed utilities, new utilities, and newly discovered utilities by horizontal dimensions, elevations, inverts, and slope gradients.

1.5 QUALITY ASSURANCE/QUALITY CONTROL

A. Contractor shall be responsible for providing representative samples of materials for laboratory analysis for conformance to these Specifications.

B. All materials shall conform to the applicable sections of the State of California Department of Transportation (Caltrans) Standard Specifications, most current edition, unless otherwise specified in these Specifications or on the Drawings. In addition, all materials testing performed to provide quality assurance shall be in accordance with "Section 01 40 00 Quality Requirements."

C. Furnish each aggregate material from single source throughout the Work.

D. The Owner will pay for the initial test of each materials test required in these Specifications. The Owner will pay for additional testing as necessary and back charge the Contractor for additional testing required as a result of failed tests.

E. The Owner will pay for labor and materials for the first compaction test in accordance with these Specifications and the Drawings. Additional tests resulting from failed tests will be paid for by Owner and back charged to the Contractor.

F. Use only new materials and products unless existing materials or products are specified otherwise on the Drawings to be salvaged and re-used or as approved by the Owner or Engineer.

G. Contaminated Soil Procedure: If the Contractor or any of the Contractor’s agents or employees encounters or discovers materials that appear, by visual or olfactory inspection, to contain regulated or hazardous materials (as defined by the California Environmental Protection Agency) during the performance of the Work, the Contractor shall inform the Engineer immediately and suspend Work in the affected area until the Engineer has inspected the location and materials in question. Operations in the affected area shall be resumed only upon written notice by the Engineer.

H. All materials, components, assemblies, Work quality, and installation are to be observed by the

Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.

I. Geotechnical Investigation:

1. Refer to Project Geotechnical Investigation Report. Contractor is responsible for being aware of the requirements provided in the Geotechnical Investigation Report.

2. Compaction densities specified for structural fills under footings, slabs, or pavements shall be determined in accordance the Geotechnical Engineer's written recommendations.

J. The representatives of the Owner's testing lab will neither act as supervisor of construction, nor direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the Contractors or Subcontractors for defects discovered in their Work during or following completion of the Project. Corrections made due to inadequate compaction or moisture content are the sole responsibility of the Contractor.

K. Tests: See PART 3: EXECUTION for Compaction Testing.

L. Contractor shall be solely responsible for all subgrades built. Failures resulting from inadequate compaction or moisture content are the responsibility of the Contractor. Contractor shall be solely responsible for any, and all, repairs.

M. All materials testing shall be conducted by a laboratory certified by the State of California to conduct such tests.

N. Materials testing shall conform to the requirements of these Specifications, the Contract Documents, and the Geotechnical Investigation Report.

O. Results of materials testing shall be submitted to the Engineer within two (2) working days of test completion.

1.6 PROTECTION

A. Protect all benchmarks, survey control points, existing structures, fences, roads, sidewalks, paving, curbs, and other items as necessary from earthwork activity.

B. Protect above or below grade utilities that are to remain.

C. Protect trees, plant growth, and features designated to remain.

D. Protect stockpiles from erosion and deterioration of materials.

E. Repair damage to any existing site features that are to remain.

F. Repair and restoration shall be equal to quality and appearance of prior condition and to the satisfaction of the Owner's Representative.

G. Subgrade Protection: Refer to the Geotechnical Investigation Report.

H. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The Contractor shall make a reasonable effort on a daily basis to keep all excavations and the Site free from water during entire progress of Work, regardless of cause, source, or nature of water.

I. Adjacent streets and sidewalks shall be kept free of mud, dirt, or similar nuisances resulting from earthwork operations.

J. The Site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.

K. Refer to Project Stormwater Pollution Prevention Plan (SWPPP)

1.7 GRADE STAKES AND LINES

A. All grading and subgrading shall be controlled by Contractor-installed intermediate grade stakes and lines necessary to obtain the finished grade elevations shown or implied in the Drawings. Subgrade and finish grade surfaces shall conform to the control planes established by these grade stakes and lines.

B. Protect and maintain all existing benchmarks, monuments, and other reference points. If disturbed or destroyed, they shall be replaced at the Contractor's expense.

C. Contractor shall set temporary benchmarks as necessary to properly complete construction operations.

1.8 SURVEYING

A. Contractor shall be responsible for hiring a licensed professional surveyor to perform all surveying, layout, and staking.

1.9 WARRANTY

A. Refer to General Conditions.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Transport, store, and handle all materials in strict accord with the local jurisdiction.

B. Delivery of materials to job Site shall only take place after notification by Contractor verifying that the job is ready to receive the Work of this Section and that arrangements have been made to properly store, handle, and protect such materials and Work.

C. Prevent contamination.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

1. Plan/Specification Coordination:

a. It is the intent of the developers of these Project Documents that materials listed on the Drawings shall be named to match the materials listed in this section.

b. If the Contractor encounters material named on the Drawings, and not described in this section, either during the bid or construction phases of the Project, the Contractor shall

request that the material be described fully before preparing a bid or installing materials.

c. The Contractor shall not make assumptions as to the specifications of any material not explicitly described in this Specification section.

2. Material specifications listed on the Drawings, where applicable, shall supersede those listed in this Section.

B. Engineered Fill Materials: All fill shall be of approved local materials supplemented by imported fill if necessary. "Approved" local materials are defined as local soils tested and approved by Geotechnical Engineer. Refer to the Project Geotechnical Investigation Report for detailed guidance on engineered fill materials and compaction criteria.

C. Imported Fill: Imported fill shall be free of contaminants and meet the specifications for "Select Engineered Fill" outlined in the Geotechnical Report.

1. All import fill material shall be tested and approved by Geotechnical Engineer or their Authorized Representative prior to transportation to the Site.

2. Sample testing of proposed import fill materials shall be performed and approved by the Engineer prior to use at the Site.

3. Results of the testing analysis shall be sent to the Owner and Engineer. Results shall be submitted within two (2) working days of test completion.

D. Native Backfill: Native backfill shall consist of material excavated during the course of the Project, shall be free of organic and other deleterious material, and shall meet the requirements of "Select Engineered Fill" outlined in the Geotechnical Investigation Report.

E. **Native Topsoil**: Native topsoil shall consist of material excavated from the upper soil layer (from the surface to a depth of approximately 6 inches) during the course of the Project. Native topsoil shall be stockpiled separately from native subsoil.

F. Drain Rock: Refer to Geotechnical Engineer or their Representative for specific applications.

G. **Rock Slope Protection (RSP) :** Rock slope protection used as slope protection shall meet the gradation requirements provided in Caltrans Standard Specifications, Section 72 for the corresponding class identified in the Drawings. Method of placement and fabric shall be in accordance with Section 72 of the Caltrans Standard Specifications unless otherwise specified in the Drawings.

H. **Rock Slope Protection (RSP) Energy Dissapators:** Rock slope protection used for energy dissapators shall meet the gradation requirements provided in Caltrans Standard Specifications, Section 72 for the corresponding class identified in the Drawings. Method of placement and fabric shall be in accordance with Section 72 of the Caltrans Standard Specifications unless otherwise specified in the Drawings.

I. **Aggregate Base:** "Base", "aggregate base", or "Class 2 Aggregate" shall refer to the following. Aggregate base shall be ¾-inch Class 2 aggregate base and shall conform to Caltrans Standard Specifications. For Class 2 aggregate base below paved surfaces or where used as finished surface material, the aggregate shall have at least 50% crushed course particles with at least

two fractured faces using Caltrans Test Method 205. Aggregate base material shall be free from organic matter and other deleterious substances and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base. Refer to the Project Geotechnical Investigation Report for detailed guidance on aggregate base materials and compaction criteria.

J. **Slurry cement backfill:** Refer to "Section 31 23 24 Controlled Low Strength Materials."

K. **Imported Topsoil:** Imported topsoil shall be sandy loam; shall be friable; shall have a high degree of fertility; and shall be free of weeds, clods, roots, rocks, gravel, sticks, brush, and other deleterious material. An imported topsoil analysis shall be submitted to the Engineer for approval prior to delivery of any imported topsoil to the Project site. If the Engineer rejects any portion of the delivered soil for any reason, it shall be removed immediately at no cost to the Owner. The Contractor shall be responsible for maintaining all placed topsoil until the Project has been accepted.

L. **Water:** Contractor shall furnish all required water for construction purposes, including compaction and dust control. Water shall be clean, potable, and free of oil, acids, salts, and other deleterious substances.

M. Engineering Fabrics (Geotextile Materials)

1. Engineering fabrics used for subgrade separation, filtering, and rock slope protection applications shall conform to “Section 88: Geosynthetics” of the Caltrans Standard Specifications unless otherwise specified in the Geotechnical Report recommendations. Install fabrics in accordance with “Section 72: Slope Protection” of the Caltrans Standard Specifications.

2. Refer to Geotechnical recommendations for the use of geotextile fabric for access and hauling roads.

N. Planting Materials

1. Seeding, Soil Supplements, and Mulch: Furnish and install in accordance with State of California Department of Transportation, Standard Specification Section 20 “Landscape.”

PART 3 EXECUTION

3.1 PERFORMANCE

A. General: Perform all grading, excavating, and cutting necessary to conform finish grade and contours as shown. All cuts shall be made to true surface of subgrade.

B. Excavation dewatering may be necessary. Contractor shall provide any and all tools, equipment and labor necessary for excavation dewatering no matter what the source. Dewatering shall be continuous until all Site utilities are installed and backfilled. Discharge of dewatering water shall comply with all necessary Project permit conditions and regulations.

C. Archaeological Artifacts: If any artifacts of possible historic interest are encountered during earthwork operations, halt all Work in area of discovery and immediately contact the Owner and Engineer for notification of appropriate authorities.

D. Degree of Compaction: Percentage of maximum density, hereinafter specified as degree of compaction required, means density equivalent to that percentage of maximum dry density and such expressed percentage will be minimum acceptable compaction for specified Work.

E. Moisture Content: Moisture content shall be as noted below and as called for on the Drawings. Moisture content shall be maintained until subgrade is covered by surfacing materials.

3.2 EXAMINATION

A. Existing Utilities on the Drawings may be shown incorrectly or not at all. The Contractor shall contact Underground Service Alert (USA) at 811 at least forty-eight (48) hours, but not less than two (2) working days, prior to any demolition or excavation and request field markings of all Underground Utilities.

B. Verify that survey benchmarks and intended elevations for the Work are as indicated.

C. Contractor shall acquaint themselves with all Site conditions. If unknown active utilities are encountered during Work, notify Engineer promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.

D. Existing conditions are shown on the Drawings to the extent known. If the Contractor encounters any deviation between actual conditions and those shown, they shall immediately notify the Engineer before continuing Work. Unknown buried utility lines may exist. If encountered, notify Engineer immediately for direction and re-direct Work to avoid delay. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.

1. Cooperate and coordinate with Owner’s Representative and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility district.

2. Do not interrupt existing utilities serving occupied facilities without proper notification to, and written direction from, Engineer.

3.3 ONSITE UTILITY VERIFICATION AND REPAIR PROCEDURES

A. Ground-breaking requirements:

1. All underground Work performed by a Contractor must be authorized by the Owner’s Construction Manager prior to start of construction.

2. The Contractor is to obtain and keep the original construction utility plans on Site during all excavation operations.

B. Underground Utility Locating:

1. Contractor shall inform the Owner and Engineer no later than two (2) days prior to the date scheduled for the utility locator service to be on Site.

3.4 SAFETY

A. Adequate protection measures shall be provided to protect workers and passers-by on and off

the Project Site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition if damage occurs. Replace trees and shrubs outside construction area disturbed by operations.

B. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job Site, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and shall not be limited to normal working hours.

C. Provide shoring, sheeting, sheet piles and or bracing to prevent caving, erosion or gullying of sides of excavation. Refer to “Section 31 50 00 Excavation Support and Protection” for requirements.

D. Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction Site.

3.5 SEASONAL LIMITS

A. No fill material shall be placed, spread, or rolled during unfavorable weather conditions. When work is interrupted by rains, fill operations shall not be resumed until field tests indicate that moisture content and density of fill are satisfactory. Refer to the Geotechnical Investigation Report for guidance on wet weather considerations.

B. Excessively wet fill material shall be bladed and aerated.

3.6 LAYOUT AND PREPARATION

A. Prior to installation of the Work of this Section, carefully inspect and verify by field measurements that installed Work of all other trades is complete to the point where this installation may properly commence.

B. Layout all Work, establish grades, locate existing Underground Utilities, set markers and stakes, setup and maintain barricades and protection facilities; all prior to beginning actual earthwork operations. Layout and staking shall be done by a licensed Land Surveyor or Professional Civil Engineer.

C. Verify that specified items may be installed in accordance with the approved design.

D. Verify existing plant life designated to remain is tagged or identified.

E. In event of discrepancy, immediately notify Engineer. Do not proceed in discrepant areas until discrepancies have been fully resolved.

3.7 DEMOLITION, DISPOSAL, AND DISPOSITION OF UNDESIRABLE MAN-MADE FEATURES

A. All other obstructions, such as abandoned utility lines, septic tanks, concrete foundations, and the like shall be removed from Site. Excavations resulting from these removal activities shall be cleaned of all loose materials and widened as necessary to permit access for compaction equipment. Areas exposed by any required over- excavation should be scarified to a minimum depth of 6 inches, moisture-conditioned to near optimum moisture content, and recompacted

to at least 90% of the maximum dry density.

3.8 TESTING AND OBSERVATION

A. All grading and earthwork operations shall be observed by the Geotechnical Engineer or their Representative, serving as the representative of the Owner.

B. The Geotechnical Engineer or his/her Representative shall inspect and approve subgrade prior to the placement of any fill material.

C. Compaction testing shall be performed per ASTM D 6938 based on the maximum dry density and optimum moisture content as determined by ASTM Method D 1557.

D. Field compaction tests shall be made by the Geotechnical Engineer or their Representative. If moisture content and/or compaction are not satisfactory, Contractor will be required to change equipment or procedure or both, as required to obtain specified moisture or compaction.

E. Earthwork shall not be performed without the notification or approval of the Geotechnical Engineer or their Representative. The Contractor shall notify the Geotechnical Engineer at least two (2) working days prior to commencement of any aspect of the Site earthwork.

F. If the Contractor should fail to meet the compaction or design requirements embodied in this document and on the applicable plans, they shall make the necessary readjustments until all work is deemed satisfactory, as determined by the Geotechnical Engineer.

G. Costs of Geotechnical Engineer or their representative will be borne by Owner, except those costs incurred for re-tests or re-inspection will be paid by Owner and back charged to Contractor.

   1. If Contractor elects to process or mine onsite materials for use as suitable fill, aggregate sub-base, aggregate base, rock, crushed rock, or sand, the cost of all testing of this material shall be paid for by the Contractor.

H. Compaction testing shall be performed at random locations in each lift as often as necessary to ensure that the specified compaction is being achieved by the Contractor. Frequency of the testing shall increase if there are difficulties achieving adequate compaction.

3.9 CLEARING AND GRUBBING AND SITE PREPARATION

A. Refer to “Section: 31 10 00 Site Clearing”

B. Refer to Geotechnical Investigation Report

C. Prior to earthwork operations, remove all debris off Site.

D. Site preparation shall extend at least 5 feet beyond the limits of improvements.

E. Clear areas required for access to Site and execution of Work to minimum depth of six (6) inches or through full depth of topsoil, or as directed by Engineer and specified on the Drawings and Geotechnical recommendations. Stockpile topsoil for placement after final grading. Protect topsoil from erosion.

F. Remove trees and shrubs indicated. Remove stumps, main root ball, and root system to a minimum depth of 24 inches below finish grade. Refer to Geotechnical recommendations for fill requirements after removal.

G. Clear undergrowth and deadwood, without disturbing subsoil.

H. Remove debris, rock, and extracted plant life from Site.

I. Remove paving, curbs, other concrete material, and other miscellaneous debris to facilitate construction. Neatly saw cut edges at right angle to surface.

J. Remove or grout fill abandoned utilities as shown in the Drawings. Indicate removal termination point for Underground Utilities on Record Documents.

K. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on Site.

L. Do not burn or bury materials on Site. Leave Site in clean condition.

M. Dispose of materials at an approved offsite disposal site.

N. Refer to Geotechnical Report for further additional guidance on Site preparation.

3.10 TOPSOIL REMOVAL, STOCKPILING, AND STORAGE

A. Prior to beginning any excavation or fill, the Contractor shall remove the topsoil and stockpile it for future use (if applicable). Stockpiled topsoil shall be stored clear of the construction area. The Contractor shall take reasonable care to prevent the topsoil from becoming mixed with subsoil. Topsoil that has been mixed with other soil types shall not be used as topsoil.

3.11 STORAGE OF MATERIALS

A. It shall be the sole responsibility of the Contractor to segregate and store all earthwork material in a safe location out of the construction area and travelway, in a manner that does not allow sediment to migrate into storm drains or waterways.

3.12 GENERAL EXCAVATION

A. The Contractor shall perform all excavation Work required to accomplish the construction, regardless of the type, nature, or condition of material encountered. No equipment shall be operated near existing structures or newly completed construction if such operation will endanger these structures. Excavation that cannot be accomplished using power equipment without endangering these structures, or those within 24 inches of marked Underground Utilities, shall be dug with hand tools.

B. The Contractor shall complete all excavations to the elevations, lines, and grades shown on the Drawings or as shown on survey staking cut sheets provided by the Engineer or Project Surveyor. Allowances shall be made within the excavation for shoring, forms, working space, bedding, and backfill. Over-excavation below the grade lines shown on the Drawings or established by the Engineer shall be backfilled at the Contractor's sole expense with Class 2 aggregate base, compacted to 90% relative compaction, unless otherwise directed by the Engineer (including over-excavation required to remove existing utilities shown on the Drawings as to be removed). Over-excavation required due to unsuitable subgrade soils shall

be covered under its own heading below.

C. The Contractor shall control excavations through careful backfill and shoring placement that prevents excavation wall sloughing, and shall remove all material that sloughs into the excavation. In addition, all voids or cavities that result from sloughing excavation walls shall be backfilled and compacted with the same material at the same compaction/vibration requirements as shown on the excavation detail for that excavation. If, in the opinion of the Engineer, additional asphalt, concrete, or other surface material must be removed to compact or vibrate the backfill placed in these voids or cavities adequately, the Contractor shall sawcut and remove the surface material to the limits of the voids or cavities as directed by the Engineer. All costs associated with the removal of material that has sloughed into the trench; placement and compaction of the additional backfill material; and the saw cutting, removal, and patching of additional surface material shall be the sole responsibility of the Contractor, and no additional payment will be made to the Contractor for this Work.

D. Remove excess excavated materials not intended for reuse from Site.

E. When excavating through roots, perform Work by hand and cut roots with sharp axe.

3.13 CUTTING

A. Building pads that are located within a cut/fill transition area will have to be over-excavated to provide a uniform fill beneath the building pad. The portions of building pads located in cut areas shall be over-excavated to provide no more than 1-foot difference in fill placed in the same building pad.

B. Perform all cutting necessary to bring finish grade to elevations shown on Drawings.

C. Carefully excavate around existing utilities to avoid unnecessary damage. The Contractor shall anticipate and perform hand Work near existing utilities, without additional claims or cost.

D. Excavation in areas with sloped ground shall be benched in accordance with the Geotechnical Investigation Report.

3.14 EXCAVATION DEWATERING

A. The Contractor shall provide and install sufficient means and facilities to divert, remove, and properly dispose of all water in the area of the excavation from any source, and shall maintain all Work areas and excavations in a clean, dry, and safe condition.

B. The Contractor shall dewater all excavations to keep groundwater out of the excavation. Water shall not be allowed in excavations during concrete pours, or bedding, backfill, and compaction operations. Dewatering shall be accomplished by methods that will ensure a water-free excavation, preserve the design lines and grades of the bottom of the excavations, maintain the groundwater level at least one (1) foot below the excavation design grade, and prevent the loss of fines from the bottom of the excavation. Dewatering shall be a continuous 24-hours-a-day, 7-days-a-week operation until construction and backfilling are complete.

C. If excessive groundwater is present and cannot be adequately controlled, or if “pumping” of the subgrade material occurs during compaction, the Engineer may deem the bottom of the excavation unsuitable for placement of backfill material.

3.15 SUBGRADE PREPARATION

A. Subgrade preparation shall be conducted in accordance with these Specifications and the recommendations contained in the Geotechnical Investigation Report. In the event of a discrepancy between the two, the Geotechnical Investigation Report shall take precedent. The Contractor shall notify the Engineer immediately upon discovery of any discrepancies.

B. Prior to placement and compaction of embankment, road structural sections or other engineered fill applications, the Contractor shall scarify, moisture condition, and re-compact the upper 8 inches of exposed native subgrade soils to a minimum 95% of the wet density of the same materials using Caltrans Tests 216 and 231 for locations beneath public roadways, or 90% of the dry density per ASTM D1557.

C. Grade, compact, and finish all subgrades within a tolerance of 0.10 feet of grades as indicated on Drawings and so as not to pool water. Subgrade within building pad and concrete walkway extents shall be within 0.05 feet of grades indicated.

D. If the existing soils are at a moisture content higher than specified, the Contractor shall provide multiple daily aerations by ripping, blading, and/or disking to dry the soils to a moisture content where the specified degree of compaction can be achieved. After seven (7) consecutive working days of daily aerations, and the moisture content of the soil remains higher than specified, the Contractor shall notify the Engineer. If the existing soils have a moisture content lower than specified, the Contractor shall scarify, rip, water, and blade existing soil to achieve specified moisture content. The Contractor shall make proper allowance in schedule and methods to complete this Work.

E. Compacted subgrade should be non-yielding under construction traffic, including a 10-wheel truck, such as a fully loaded water truck or dump truck, in all pavement areas and building pads. Removal and subsequent replacement of some material (such as, areas of excessively wet materials, unstable subgrade, or pumping soils) may be required.

F. Subgrade preparation for areas where structures are supported shall extend laterally at least 5 feet beyond the limits of the improvements.

G. Subgrade within the limits of bioretention basins or other vegetated low impact development (LID) features, where applicable, shall not be compacted, unless otherwise stated on the Project Drawings.

H. Where Contractor over-excavates building pads through error, resulting excavation shall be recompacted in accordance with Geotechnical Investigation Report recommendations at Contractor's expense.

I. See Project Geotechnical Investigation Report for Project specific guidance.

3.16 UNSUITABLE SUBGRADE EXCAVATION AND BACKFILL

A. Unsuitable subgrade is native excavation material at subgrade that, in the opinion of the Engineer, is unsuitable to use as a subgrade layer and must be removed to provide a solid construction surface. Examples of this type of subgrade are plant material, logs, trash, wood chips and debris, mud, soft or spongy soil, and the like. It DOES NOT refer to material that sloughs into the excavation from the sidewalls due to insufficient shoring and must be dug out. If unsuitable material is encountered at the bottom of the excavation, the Engineer shall direct

the Contractor as to the total volume of unsuitable material to be removed PRIOR to its removal from the excavation.

B. Once the unsuitable material has been excavated to the satisfaction of the Engineer, the Contractor shall backfill the over-excavation up to the elevations, lines, and grades shown on the Plans or as shown on survey staking cut sheets provided by the Engineer or Project Surveyor. Backfill material shall be Class 2 aggregate base, compacted to 90 % maximum dry density of the same materials required in ASTM method D1557 method, unless otherwise directed by the Engineer.

C. If, upon over-excavation, the resulting subgrade, in the opinion of the Engineer, is still unsuitable to use as a compaction bed, the Contractor shall backfill the over-excavation up to the elevations, lines, and grades shown on the Drawings or as shown on survey staking cut sheets provided by the Engineer or Project Surveyor with permeable material or slurry cement, as directed by the Engineer.

3.17 BACKFILLING

A. General:

1. Backfill shall be placed in lifts in accordance with the Geotechnical Investigation Report.
2. The Contractor shall obtain the Engineer's approval of concrete Work and shall remove all trash and other debris from the excavation, prior to backfilling.
3. The Contractor shall not operate wheeled or tracked equipment within five (5) feet of the walls of concrete structures for the purpose of depositing or compacting backfill material.
4. Backfill areas to required contours and elevations with acceptable materials.
5. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
6. Employ placement method that does not disturb or damage other Work.
7. Maintain optimum moisture content of backfill materials to attain required compaction density.
8. Do not backfill against unsupported foundations and retaining walls.
9. Make gradual grade changes. Blend slope into level areas.
10. Remove surplus backfill materials from Site.
11. Repair or replace items indicated to remain that have been damaged by excavation or filling.

B. Slurry Cement:

1. Refer to "Section 31 23 24 Controlled Low Strength Materials."
2. Refer to Geotechnical Investigation Report recommendations.
3. Slurry cement backfill shall be consolidated using motor-driven vibrators to remove all voids

and shall be placed in the work within one (1) hour after mixing. The vibrator used shall be large enough to vibrate the slurry cement to the satisfaction of the Engineer. In addition, the slurry cement mixture shall contain enough water that it flows into the hole left when the vibrator is removed.

4. Slurry material that does not flow into the hole left by the vibrator shall have water added to it in the truck in an amount sufficient to make it do so.

5. Slurry cement shall not be covered with other material for at least four (4) hours after placement.

3.18 PLACING, SPREADING, AND COMPACTING ENGINEERED FILL MATERIAL

A. Select Engineered Fill material shall be placed in horizontal, loose lifts not exceeding eight (8) inches in thickness. Each layer shall be spread evenly and thoroughly mixed to ensure uniformity in moisture content. Selected fill material shall be moisture-conditioned to specified moisture content (see Geotech report for location specific guidance).

B. Selected Engineered Fill material shall be unfrozen.

C. When moisture content of fill material is less than that specified, add water until proper moisture content is achieved. When moisture content is above that specified, aerate by blading, or other methods noted in this Section, until moisture content is satisfactory.

D. After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted to a relative compaction specified in the Project Geotechnical Report and as shown on the Project Drawings. Compact each layer over its entire area until desired density has been obtained.

E. Fill materials shall be mechanically compacted. Jetting is not allowed. Care shall be taken not to damage pipe, conduit, or other facilities with compacting equipment.

F. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

G. Proofroll compacted, scarified, and re-compacted, or fill surfaces before placement of structural material.

H. Backfill adjacent to concrete walls shall be compacted with hand-operated tampers or similar equipment that will not damage the structure.

3.19 EMBANKMENT CONSTRUCTION

A. Subgrade Preparation

1. After clearing and grubbing operations have been completed, native soils beneath embankments shall be scarified to a minimum depth specified in the Drawings and in accordance with Geotechnical recommendations.

B. Embankments shall be constructed in layers of uniform thickness, and each layer shall be compacted in accordance with the requirements specified in the Drawings and the Geotechnical Investigation Report.

C. Prior to placement of fill on an existing slope, the existing slope shall be benched in accordance with the recommendations provided in the Geotechnical Report.

D. When an embankment is to be made and compacted on hillsides, where new embankment is to be compacted against existing embankments, or where embankment is built one half (½) width at a time, the slopes of the original hillsides and old or new embankments shall be cut into a minimum of six (6) feet horizontally as the Work is brought up in layers. Material thus cut out shall be recompacted along with the new embankment material at the Contractor's expense, unless the width of excavation required by the Engineer exceeds six (6) feet, in which case the excavation will be measured and paid for as excavation.

E. Where an embankment is to be made and compacted on original hillsides, old or new embankments, and end dumping is permitted, the slopes of the original ground or embankment shall be plowed or cut into before starting end dumping.

F. When an embankment is to be placed on an existing roadway, the existing roadbed shall be scarified, watered, graded, and rolled in advance of placing new material thereon.

G. Whenever selection is possible, borrow or excavation material having a sand equivalent (SE) value less than 15 shall not be placed within 2.5 feet of finished grade, and shall be placed in the lower portions of embankments.

H. Clods or hard lumps of earth more than six (6) inches in greatest dimensions shall be broken up before compacting the material in the embankment, except as provided in the following paragraph.

I. Embankment material consisting of large rocky material or hard lumps (such as, hardpan or cemented gravel) that cannot be broken readily shall be well distributed throughout the embankment. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so that it fills the voids and produces a dense, compact embankment.

J. Unless otherwise directed, all embankments shall be placed and compacted before any required excavation for installation of structures is performed in embankment areas. For pipelines to be installed in embankments, embankment shall be placed and compacted to a minimum of 2 feet above the top of the pipe before the pipe trench excavation will be allowed.

3.20 COMPACTION

A. General:

1. Fill materials shall be mechanically compacted. Jetting is not allowed. Care shall be taken not to damage pipe, conduit, or other facilities with compacting equipment.

2. Proofroll compacted, scarified, and re-compacted, or fill surfaces before placement of structural material.

3. Backfill adjacent to concrete walls shall be compacted with hand-operated tampers or similar equipment that will not damage the structure.

B. Compaction Testing:

1. Refer to "Section 01 40 00 Quality Requirements" and "Section 01 70 00 Execution and

Closeout Requirements."

2. Compaction testing may be performed by the Engineer to determine if the Contractor's compaction efforts are meeting the minimum compaction requirements. Excavation backfill that fails compaction tests shall be re-compacted as necessary to meet the minimum compaction requirements at the sole expense of the Contractor.

3. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.21 FINISH GRADING

A. At completion of Project, Site shall be finished graded, as indicated on Drawings. Finish grades shall be "flat graded" to grades shown on the Drawings. Mounding of finish grades will not be allowed unless otherwise directed on the landscape drawings. Tolerances for finish grades in landscaped areas shall be +/- 0.10 feet. Tie in new and existing finish grades.

B. Leave all landscaped areas in a finished condition for lawn seeding. Landscaped planters shall be graded uniformly from edge of planter to inlets. If sod is used for turf areas, the finish grade on which it is placed shall be lowered to allow for sod thickness. All landscape areas shall be left free of rock or foreign material. All landscape areas shall be approved by Engineer prior to any planting.

3.22 GRADING TOLERANCES

A. Unless otherwise specified in the Drawings or Geotechnical recommendations, grading tolerances for each type of material is listed below:

B. Top Surface of Topsoil: ±0.10 foot from required elevations.

C. Top Surface of Subgrade: ±0.10-foot from required elevations.

D. Top Surface of General Backfilling: ±0.10 feet from required elevations.

E. Top Surface of Backfilling under Paved Areas: ±0.05 feet from required elevations.

F. Top Surface of Backfilling beneath Water Tank: ±0.05 foot from required elevations.

3.23 SURPLUS MATERIAL

A. Coordinate with Owner for stockpiling of surplus materials.

B. Excavated material not required for grading or backfill shall be removed to an off-site permitted location at Contractor's expense.

3.24 CLEANING

A. Remove from fill all vegetation, wood, form lumber, casual lumber, and shavings in contact with ground; buried wood will not be permitted in any fill.

B. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent accumulation of surface water and to restore surface drainage patterns.

C. Restore stockpile area to pre-construction conditions, or as required by the Contract

Documents.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris
2. Removing designated trees, shrubs, and other plant life
3. Removing abandoned utilities
4. Excavating topsoil

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordinate with Owner or their Authorized Representative. Contractor shall verify existing plant life designated to remain is tagged or identified.

B. Contractor shall coordinate with Engineer and Owner to ensure all sensitive habitat (plant communities, wetlands, etc.) is delineated and construction fencing is installed prior to and Site clearing activities.

3.2 PREPARATION

A. Humboldt County Encroachment Permit must be obtained by Contractor prior to conducting any work in the County right of way.

B. Notify Owner's Construction Manager a minimum of twenty (20) working days prior to the start of tree removal.

C. Call Underground Service Alert (USA) service at 811 not less than two (2) working days before performing Work.
1. Request Underground Utilities to be located and marked within, and surrounding, construction areas.

3.3 PROTECTION

A. Locate, identify, and protect utilities indicated to remain from damage.

B. Protect trees, plant growth, and features designated to remain.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

A. Clear areas required for access to Site and execution of Work to minimum depth of 6 inches or through full depth of topsoil.

B. Stockpile topsoil for placement after final grading.

C. Protect topsoil from erosion.

D. Where required and directed by the Engineer, all trees, stumps, large roots, buried logs, decayed vegetable matter, heavy growth of grass and weeds, and all other objectionable material shall be removed from the Site of Work.

E. Where the removal of large trees is required, it will be necessary to remove all major root systems. Refer to the Geotechnical Investigation Report for replacement fill requirements.

F. Clear undergrowth and deadwood, without disturbing subgrade.

G. Contractor shall coordinate with Geotechnical Engineer prior to the start of any excavation, subgrade preparation, or placement of fill.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from Site.

B. Remove all trash from within the Work area limits.

C. Remove abandoned utilities. Indicate removal termination point for underground utilities on Record Documents. Removal, handling, storage, and disposal of any existing asbestos cement pipe shall comply with all regulatory requirements.

D. Continuously clean up and remove waste materials from Site. Do not allow materials to accumulate on Site.

E. Do not burn or bury materials on Site. Leave Site in clean condition.

F. Contractor shall be responsible for waste disposal at approved disposal site.
   1. See “Section 01 74 19 Construction Waste Management and Disposal.”

END OF SECTION

SECTION 31 23 24

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Controlled low strength materials (CLSM), in accordance with the requirements of the Contract Documents.

a. Flowable Fill (Slurry Backfill): Trench Backfill

b. Sand Cement Slurry: Trench Plugs

c. Pressure Grout: For abandonment of existing pipelines

d. Lean Cement Slurry: Gaps between footing and adjacent grounds

1.2 SUBMITTALS

A. Preliminary mix designs which show the proportions and gradations of all materials proposed for CLSM trial batch tested for compressive strength by an independent testing laboratory acceptable to the Engineer.

B. Certified Delivery Tickets:

1. Where ready-mix CLSM is used, Contractor shall provide certified delivery tickets at the time of delivery of each load. Each certificate shall show the state certified equipment used for measuring the total quantities by weight of

a. Cement

b. Fly ash

c. Sand

d. Each class of aggregate

e. Admixtures

f. Amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the Site for the specific design mix

g. The mix number

h. Total yield in cubic yards

i. Time of day, to the nearest minute, corresponding to:

i. when the batch was dispatched

ii. when it left the plant

iii. when it arrived at the job

iv. time that unloading began

v. the time that unloading was finished.

C. Where a portable batch plant is used provide certified batch tickets that show the batch quantities for each mix component as required for the certified delivery tickets above.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM-International (ASTM) C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field

2. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

3. ASTM C143: Standard Test Method for Slump of Hydraulic-Cement Concrete

4. ASTM C150: Standard Specification for Portland Cement

5. ASTM C403: Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

6. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

PART 2 PRODUCTS

2.1 GENERAL

A. CLSM shall consist of cement, fly ash, fine aggregate, water, and admixtures that is placed, consolidated, and cured to produce a controlled low strength material that fills all spaces.

B. The fully cured regular strength CLSM shall meet the strength requirements herein and be capable of excavation by a small backhoe.

2.2 MATERIALS

A. Cement shall conform to ASTM C150, Type II.

B. Mixing water shall be clean and potable water.

C. Admixtures shall meet the requirements of “Section 03 33 00 Cast-in-Place Concrete”.

D. Sand:

1. Fly ash shall be Class C or Class F in conformance with ASTM C 618.

2.3 DESIGN REQUIREMENTS

A. The water-cement ratio shall not exceed 3.5.

B. The minimum cement content shall be 50 pounds per cubic yard.

C. Fly ash may be used to improve flow-ability of the fresh CLSM and to regulate the strength.

D. Flowable Fill (Slurry Backfill):

1. The compressive strength for flowable fill shall be within the range of 50-100 pounds per square inch (psi) when tested at 28 days.

2. Flowable fill shall be excavatable.

3. Flowable fill shall be a stabilized sand or lean cement mix.

E. Sand Cement Slurry:

1. The compressive strength for sand cement slurry used for utility trenches shall be a minimum of 500 psi when tested at 28 days.

F. Pressure Grout:

1. Pressure grout for pipeline abandonment shall be lean cement mix freely flowing and capable of filling entire extent and cross section of pipe to be abandoned.

2. See Flowable Fill (slurry backfill) for strength requirements.

G. Lean Cement Slurry:

1. The compressive strength for lean cement slurry used for filling gaps between foundation footings and adjacent ground shall be a minimum of 100 psi when tested at 28 days.

2.4 CONSISTENCY AND MIXING

A. The consistency of the fresh CLSM shall be that of a thick liquid so that it flows readily and fills spaces and voids around the pipe and structures.

B. Consistency of the CLSM used for trench plugs and lean cement slurry shall be as measured by a slump which shall not exceed 8 IN when tested by ASTM C143.

C. The consistency of CLSM used for flowable fill (slurry backfill) shall be of a slump that permits the stable placement of the material on slopes consistent with the site topography.

D. The freshly mixed CLSM shall have a uniform consistency and appearance just before placement.

E. The mixing method and time shall be that which is required to produce a uniform mixture of cement, fly ash, aggregate, admixtures, and water.

2.5 MEASUREMENT OF CEMENT, FLY ASH, AGGREGATE, AND WATER

A. The amount of cement, fly ash, and aggregate entering into each batch shall be determined by direct weighing equipment furnished by Contractor and acceptable to Engineer. Where batches

are proportioned to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 pounds.

B. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the Engineer and capable of measuring the water in variable amounts within a tolerance of 1 percent.

PART 3 EXECUTION

3.1 PLACEMENT

A. As CLSM is placed in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer that is being consolidated, into a dense, homogeneous mass, filling all spaces and voids and bringing only a slight excess of water to the exposed surface. The CLSM shall be placed and consolidated by means that will not cause segregation of the mix.

B. If vibrators are used, they shall be high speed power vibrators (8,000 to 10,000 rotations per minute [rpm]) of an immersion type in sufficient number and with standby units as required.

C. Contractor shall use placement methods that ensure that the CLSM completely fills all spaces and voids around the footings, spaces between pipes and trench walls, spaces between pipes, gaps between footings, keyways in trench plugs, and spaces and voids around adjacent and crossing utilities. The placement method shall achieve complete consolidation and contact between the CLSM and surrounding materials.

D. CLSM shall not be placed when the air temperature is below 40 degrees Fahrenheit (^{o}F). The temperature of the fresh CLSM shall be 50 ^{o}F or greater at the time of placement. CLSM shall not be placed during inclement weather, when the trench contains water, or when the bottom or walls are frozen or contain frozen material. Flowable fill shall be protected from freezing temperatures during installation and curing.

E. The Contractor shall not permit the floatation of the pipe where CLSM is used as utility trench backfill.

F. Pressure Grout:

1. Provide machinery, tools, and equipment necessary for proper execution of the Work, including but not limited to pumps, mixers, and relief ports.

2. Before applying pressure grout in pipes to be abandoned, coordinate with Engineer for hole location and dimensions.

3. Do not drill more holes during the day's operations than can be grouted during the same day, unless otherwise specified by the Engineer.

4. After grouting has been completed, plug holes immediately.

3.2 PROTECTION OF CLSM

A. CLSM that has been placed shall be protected from equipment, traffic, and backfilling operations until the surface has achieved an initial set and has hardened enough to develop a

minimum penetration number of 650 when tested in accordance with ASTM C 403.

3.3 TESTING

A. The cost of production quality tests on cement, fly ash, aggregates, and CLSM will be borne by Contractor.

B. Freshly mixed CLSM and constituent materials for testing shall be supplied by Contractor at no cost to Owner, and Contractor shall provide assistance to the Engineer in obtaining all samples, and disposal and cleanup of excess material.

C. CLSM must meet specified requirements including compressive strength.

D. Field Compression Tests:

1. Compression test specimens will be taken during construction from the first placement of CLSM and at intervals thereafter as selected by Engineer or their Authorized Representative. Each set of test specimens will be a minimum of three cylinders for each 200 cubic yards of CLSM placed, with a minimum of three cylinders for each location where CLSM is used.

2. Specimens shall be 6 inches in diameter by 12 inches high cylinders.

3. Compression tests will be performed in accordance with ASTM C 39. One test cylinder will be tested at 7 days and one at 28 days. The remaining cylinder will be held to verify test results, if needed.

4. Furnish slump testing equipment and test slump in accordance with ASTM C143.

END OF SECTION

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SECTION 31 23 33

TRENCHING AND BACKFILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trench excavation
2. Shoring
3. Dewatering
4. Unsuitable subgrade removal and replacement
5. Trench backfill and compaction
6. All other associated Work involved in trench excavations.

B. Related Sections:

1. "Engineering Geologic and Geotechnical Investigation Report Proposed Water System Improvements for the Garberville Sanitary District, Humboldt County, California-Revision 1" (SHN, 2023)
2. Section 31 50 00—Excavation Support and Protection
3. Section 01 33 00—Submittal Procedures
4. Section 01 70 00—Execution and Closeout Requirements
5. Section 31 23 24: Controlled Low Strength Material

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T 180–Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop

B. ASTM-International (ASTM):

1. ASTM D698–Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 [600 kN m/m^3])
2. ASTM D1557–Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 [2,700 kN m/m^3])

3. ASTM D6938–Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. California Department of Transportation (Caltrans):

1. Standard Specifications, current edition.

D. California Occupational Safety and Health Administration (Cal-OSHA):

E. Any Work within the street, highway, or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction and shall not begin until all of those governing authorities have been notified.

1.3 SUBMITTALS

A. Refer to "Section 01 33 00: Submittal Procedures." For Submittal requirements

B. Import Materials: Submit information regarding all materials to be imported to the Project Site for use as engineered fill, aggregate base, or other materials required to accomplish the trenching/backfill element of this Project including, but not limited to,

1. Lab testing information for all aggregate base material being used on the Project

2. Mix designs for any slurry cement used on the Project.

a. Refer to Section 31 23 24: Controlled Low Strength Material for Submittal requirements.

3. Material Source

4. Submit, in air-tight containers, 5-gallon of each type of aggregate base fill to testing laboratory.

5. Submit samples of drain rock to the Engineer.

C. Load slips for all material delivery trucks shall be delivered to the job Site with the truck. The Contractor shall retain all load slips and shall make them available to the Engineer upon request.

D. Excavation Shoring and Bracing Plan (when applicable). Refer to "Section 31 50 00: Excavation Support and Protection" for Submittal requirements.

1.4 CLOSE OUT SUBMITTALS

A. Refer to "Section 01 70 00: Execution and Closeout Requirements"

B. Project Record Drawings: Accurately record locations of utilities remaining, re-routed utilities, new utilities, and newly discovered utilities by horizontal dimensions, elevations, inverts, and slope gradients.

1.5 QUALITY ASSURANCE

A. Contractor shall be responsible for providing representative samples of materials for laboratory analysis for conformance to these Specifications.

B. The Owner will pay for the first test of all materials testing required in these Specifications. The Owner will pay for additional testing as necessary and back charged to the Contractor for additional testing required as a result of failed tests.

C. The Owner will pay for labor and materials for the first compaction test in accordance with these Specifications and the Drawings. Additional tests resulting from failed tests will be paid for by Owner and back charged to the Contractor.

D. Use only new materials and products unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.

E. All materials, components, assemblies, Work quality, and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.

F. Geotechnical Investigation:

1. A Geotechnical Investigation report has been prepared for this Project. Contractor is responsible for being aware of the requirements provided in the Geotechnical Investigation Report.

2. Compaction densities specified for structural fills under footings, slabs, or pavements shall be determined in accordance the Geotechnical Engineer's written recommendations.

G. The representatives of the Owner's testing lab will not act as supervisor of construction, or direct construction operations. Neither the presence of the Owner's testing lab representatives nor the testing by the Owner's testing lab shall excuse the Contractors or Subcontractors for defects discovered in their Work during or following completion of the Project. Correction of inadequate compaction or moisture content is the sole responsibility of the Contractor.

H. Tests: See "PART 3: EXECUTION" for compaction testing.

I. Contractor shall be solely responsible for all subgrades built. Failures resulting from inadequate compaction or moisture content are the responsibility of the Contractor. Contractor shall be solely responsible for any, and all, repairs.

J. All materials shall conform to the applicable sections of the State of California Department of Transportation (Caltrans) Standard Specifications, most current edition, unless otherwise specified in these Specifications or on the Drawings. In addition, all materials testing performed to provide quality assurance shall be in accordance with "Section 01 40 00–Quality Requirements".

K. Contaminated Soil Procedure: If the Contractor or any of the Contractor's agents or employees encounters or discovers materials that appear, by visual or olfactory inspection, to contain regulated or hazardous materials (as defined by the California Environmental Protection Agency) during the performance of the Work, the Contractor shall inform the Engineer immediately and suspend Work in the affected area until the Engineer has inspected the location and materials in question. Operations in the affected area shall be resumed only upon written notice by the Engineer.

L. Results of materials testing shall be submitted to the Engineer within two (2) working days of test completion.

1.6 PROTECTION

A. Protect all benchmarks, survey control points, existing structures, fences, roads, sidewalks, paving, curbs, and other items as necessary from trenching activity.

B. Protect above or below grade utilities that are to remain.

C. Protect trees, plant growth, and features designated to remain.

D. Protect stockpiles from erosion and deterioration of materials.

E. Repair damage to any existing Site features that are to remain.

F. Repair and restoration shall be equal to quality and appearance of prior condition and to the satisfaction of the Owner's Representative.

G. Subgrade Protection: Refer to the Geotechnical Investigation Report.

H. Surface Drainage: Provide for surface drainage during period of construction in manner to avoid creating nuisance to adjacent areas. The Contractor shall make a reasonable effort on a daily basis to keep all excavations and the Site free from water during entire progress of Work, regardless of cause, source, or nature of water.

I. Adjacent streets and sidewalks shall be kept free of mud, dirt, or similar nuisances resulting from earthwork operations.

J. The Site and adjacent influenced areas shall be watered as required to suppress dust nuisance. Dust control measures shall be in accordance with the local jurisdiction.

K. Refer to Project Stormwater Pollution Prevention Plan (SWPPP)

1.7 GRADE STAKES AND LINES

A. All grading and subgrading shall be controlled by Contractor-installed intermediate grade stakes and lines necessary to obtain the finished grade elevations shown or implied in the Drawings. Subgrade and finish grade surfaces shall conform to the control planes established by these grade stakes and lines.

B. Protect and maintain all existing benchmarks, monuments, and other reference points. If disturbed or destroyed, they shall be replaced at the Contractor's expense.

C. Contractor shall set temporary benchmarks as necessary to properly complete construction operations.

1.8 SURVEYING

A. Contractor shall be responsible for hiring a licensed professional surveyor to perform all surveying, layout, and staking.

1.9 WARRANTY

A. Refer to General Conditions.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Transport, store, and handle all materials in strict accord with the local jurisdiction.

B. When necessary, coordinate with Owner to store materials on Site in advance of need.

C. Prevent contamination.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

1. Plan/Specification Coordination:

a. It is the intent of the developers of these Project Documents that materials listed on the Drawings shall be named to match the materials listed in this section.

b. If the Contractor encounters material named on the Drawings, and not described in this section, either during the bid or construction phases of the Project, the Contractor shall request that the material be described fully before preparing a bid or installing materials.

c. The Contractor shall not make assumptions as to the specifications of any material not explicitly described in this Specification section.

2. Material Specifications listed on the Drawings, where applicable, shall supersede those listed in this Section.

B. **Engineered Fill Materials:** All fill shall be of approved local materials supplemented by imported fill if necessary. "Approved" local materials are defined as local soils tested and approved by Geotechnical Engineer. Refer to the Project Geotechnical Investigation Report for detailed guidance on engineered fill materials and compaction criteria.

C. **Imported Fill**: Imported fill shall be free of contaminants and meet the specifications for “Select Engineered Fill” outlined in the Geotechnical Investigation Report.

1. All import fill material shall be tested and approved by Geotechnical Engineer or the Authorized Representative prior to transportation to the Site.

2. Sample testing of proposed import fill materials shall be performed and approved by the Engineer prior to use at the Site.

3. Results of the testing analysis shall be sent to the Owner and Engineer. Results shall be submitted within two (2) working days of test completion.

D. **Native Backfill:** Native backfill shall consist of material excavated during the course of the Project, shall be free of organic and other deleterious material, and shall meet the requirements of “Select Engineered Fill” outlined in the Geotechnical Investigation Report.

E. Native Topsoil: Native topsoil shall consist of material excavated from the upper soil layer (from the surface to a depth of approximately 6 inches) during the course of the Project. Native topsoil shall be stockpiled separately from native subsoil. Provide soil material free from

deleterious substances, containing no rocks or lumps more than 2 inches in greatest dimensions.

F. **Imported Topsoil:** Imported topsoil shall be sandy loam; shall be friable; shall have a high degree of fertility; and shall be free of weeds, clods, roots, rocks, gravel, sticks, brush, and other deleterious material. An imported topsoil analysis shall be submitted to the Engineer for approval prior to delivery of any imported topsoil to the Project Site. If the Engineer rejects any portion of the delivered soil for any reason, it shall be removed immediately at no cost to the Owner. The Contractor shall be responsible for maintaining all placed topsoil until the Project has been accepted.

G. **Aggregate Base:** Aggregate base shall be Class 2 aggregate base (3/4-inch maximum) and shall conform to Section 26, "Aggregate Bases" of the Caltrans Standard Specification. Aggregate base material shall be free from organic matter and other deleterious substances and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base. For Class 2 aggregate base below paved surfaces, the aggregate shall have at least 50% crushed course particles with at least one fractured face using Caltrans Test Method 205. Refer to the Project Geotechnical Investigation Report for detailed guidance on aggregate base materials and compaction criteria.

H. **Permeable Material**: Permeable material shall consist of crushed rock conforming to the following gradation requirements, unless otherwise approved by the Engineer:

Sieve Size	Percent Passing
3/4-inch	90-100
1/2-inch	30-60
3/8-inch	0-20
No. 4	0-5

1. The portion of the material that is retained on a 3/8-inch sieve shall contain at least 50 percent of particles having 3 or more fractured faces. Not over 5 percent shall be pieces that show no fractured faces. Rounded rock material (commonly called "washed rock") that shows little evidence of the crushing process is not acceptable and will be rejected.

~~I.~~ **Slurry Cement Backfill:** Refer to "Section 31 23 24: Controlled Low Strength Material"

J. **Sand Bedding:** Sand bedding and cover shall have a minimum sand equivalent of 30 and shall be uniformly graded from No. 4 to 200 mesh screen.

K. **Stabilization Material:** In accordance with Geotechnical recommendations

L. **Water:** Contractor shall furnish all required water for construction purposes, including compaction and dust control. Water shall be clean, potable, and free of oil, acids, salts, and other deleterious substances.

M. Engineering Fabrics (Geotextile Materials):

1. Engineering fabrics used for subgrade separation, filtering, and rock slope protection applications shall conform to "Section 88: Geosynthetics" of the Caltrans Standard Specifications unless otherwise specified in the Geotechnical Investigation Report.

N. Planting Materials:

1. Seeding, Soil Supplements, and Mulch: Furnish and install in accordance with State of California Department of Transportation, Standard Specification Section 20 “Landscape.”

PART 3 EXECUTION

3.1 EXAMINATION

A. Existing Utilities on the Drawings may be shown incorrectly or not at all. The Contractor shall contact Underground Service Alert (USA) at 811 at least forty-eight (48) hours, but not less than two (2) working days, prior to any demolition or excavation and request field markings of all underground utilities.

1. Contractor shall inform the Owner and Engineer no later than two (2) days prior to the date scheduled for the utility locator service to be on Site.

B. Verify that survey benchmarks and intended elevations for the Work are as indicated.

C. Contractor shall acquaint themselves with all Site conditions. If unknown active utilities are encountered during Work, notify Engineer promptly for instructions. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.

D. Existing conditions are shown on the Drawings to the extent known. If the Contractor encounters any deviation between actual conditions and those shown, they shall immediately notify the Engineer before continuing Work. Unknown buried utility lines may exist. If encountered, notify Engineer immediately for direction and re-direct work to avoid delay. Failure to notify will make Contractor liable for damage to these utilities arising from Contractor's operations subsequent to discovery of such unknown active utilities.

E. Cooperate and coordinate with Owner’s Representative and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility district.

F. Do not interrupt existing utilities serving occupied facilities without proper notification to, and written direction from, Engineer.

3.2 SAFETY

A. Adequate protection measures shall be provided to protect workers and passers-by on and off the Project Site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition if damage occurs. Replace trees and shrubs outside construction area disturbed by operations.

B. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job Site, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and shall not be limited to normal working hours.

3.3 CLEARING AND GRUBBING AND SITE PREPARATION

A. Refer to “Section: 31 10 00 Site Clearing”

B. Take necessary steps to ensure that service is not interrupted. If water or sewer service to any residents, buildings, or facilities within the Work area will be interrupted during portions of the Work, the Contractor shall coordinate with Owner with respect to the required notice to affected residents.

C. Identify required lines, levels, contours, and datum locations.

D. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Engineer.

E. Prior to trenching operations, remove all debris off Site.

F. Remove trees and shrubs indicated. Remove stumps, main root ball, and root systems where specified.

G. Clear undergrowth and deadwood, without disturbing subsoil.

H. Remove debris, rock, and extracted plant life from Site.

I. Remove paving, curbs, other concrete material, and other miscellaneous debris to facilitate construction. Neatly saw cut edges at right angle to surface.

J. Remove or grout fill abandoned utilities as shown on the Drawings. Indicate removal termination point for Underground Utilities on Record Documents.

K. Do not burn or bury materials on Site. Leave Site in clean condition.

L. Dispose of materials at an approved offsite disposal site.

M. Refer to Geotechnical Investigation Report for further additional guidance on Site preparation.

3.4 TRENCHING

A. Trench Excavation

1. The Contractor shall perform all excavation required to accomplish the construction, regardless of the type, nature, or condition of material encountered.

2. Excavations within 24 inches of marked Underground Utilities shall be dug with hand tools.

3. The Contractor shall excavate the trench to the elevations, lines, and grades shown on the Drawings. Allowance shall be made within the excavation for shoring, forms, working space, bedding, and backfill.

4. Over-excavation below the grade lines shown on the Drawings or established by the Engineer shall be backfilled at the Contractor’s sole expense with trench backfill material approved by the Engineer and compacted to specified densities (including over-excavation required to remove existing utilities shown on the Drawings as to be removed). Over-excavation required due to unsuitable subgrade soils is addressed in this Specification.

5. The Contractor shall control excavations through careful backfill and shoring placement

that prevents trench wall sloughing and shall remove all material that sloughs into the trench. In addition, all voids or cavities that result from sloughing trench walls shall be backfilled and compacted with the same material at the same compaction/vibration requirements as shown on the trench detail for that section of trench.

6. If, in the opinion of the Engineer, additional asphalt, concrete, or other surface material must be removed to adequately compact or vibrate the backfill placed in these voids or cavities, the Contractor shall sawcut and remove the surface material to the limits of the voids or cavities as directed by the Engineer.

7. All costs associated with the removal of material that has sloughed into the trench, placement and compaction of the additional backfill material, and the sawcutting, removal, and patching of additional surface material shall be the sole responsibility of the Contractor, and no additional payment will be made to the Contractor for this Work.

B. Trench Shoring and Safety

1. Refer to "Section 31 50 00 Excavation Support and Protection" for requirements.

2. The Contractor shall furnish and install all shoring and bracing required to support the trench walls for the protection of all personnel working in the excavation. Shoring and bracing shall be removed in a manner that protects the workers and prevents sloughing of trench walls.

3. The Contractor is solely responsible for the safety of all workers, the general public, and private and public property within the Project Site for the duration of the Project. This responsibility shall be in effect at all times.

C. Trench Dewatering

1. The Contractor shall dewater all excavations for pipelines, sewer laterals, water main fittings and valves, and other underground items to keep groundwater out of the excavation.

2. Water and residual sewage will not be allowed in excavations during bedding, concrete pours, or backfill and compaction.

3. If excessive groundwater is present and cannot be adequately controlled, the Engineer may deem the bottom of the trench unsuitable for placement of bedding material.

4. The Contractor shall have pumps on hand of sufficient capacity and horsepower to pump all residual water and sewage from sewer mains, laterals, and services that may be anticipated entering the trench, from existing water mains and services as they drain, and from existing sewer laterals downstream from the bypass point.

5. The Contractor shall provide/construct sedimentation measures to contain sediment from dewatering operations from migrating into the storm drain system of waterways.

D. Unsuitable Subgrade and Backfill

1. Unsuitable subgrade is native trench material at subgrade that, in the opinion of the Engineer, is unsuitable to use as a pipe bed and must be removed to provide a solid construction surface.

a. Examples of this type of subgrade are plant material, logs, trash, wood chips and debris, mud, soft or spongy soil, and similar materials. It DOES NOT refer to material that sloughs into the trench from the sidewalls due to insufficient trench shoring and must be dug out.

b. If unsuitable material is encountered under the pipe, the Engineer shall direct the Contractor as to the total volume of unsuitable material to be removed PRIOR to its removal from the trench.

2. Once the unsuitable material has been excavated to the satisfaction of the Engineer, the Contractor shall backfill the over-excavation up to the elevations, lines, and grades shown on the Drawings or as shown on survey staking cut sheets provided by the Engineer or Project Surveyor.

3. Backfill material for unsuitable over-excavations shall be stabilization material in accordance with the Geotechnical recommendations, as approved by the Engineer, unless otherwise directed by the Engineer or indicated on the Drawings.

a. If, upon over-excavation, the resulting subgrade, in the opinion of the Geotechnical Engineer, is still unsuitable to use as a compaction bed, the Contractor shall backfill the over-excavation up to the elevations, lines, and grades shown on the Drawings.

b. If the length of the stabilization material placement exceeds 20 feet as measured along the trench, the Contractor shall construct slurry cement waterstops that extend from 12 inches above the top of the pipe to the bottom of the over-excavation every 20 feet measured along the trench.

c. Slurry cement waterstops placed under these conditions shall be considered as trench backfill, and no additional payment shall be made to the Contractor for their inclusion in the trench backfill.

i. If, in the opinion of the Engineer, an excessive amount of groundwater is flowing (not seeping) in the trench and cannot be removed from the trench by pumping, the Engineer may deem the trench subgrade unsuitable; however, this condition will not require removal of the unsuitable subgrade. Instead, the Engineer may opt to require the Contractor to place stabilization material for pipe bedding in the section of trench that the groundwater is flowing into.

E. Incompatible Areas

1. When pipelines cross through areas where compaction cannot occur (underneath large conduits or other obstacles), the Contractor shall bed and backfill the pipe (up to 12 inches above the top of the pipe or to the bottom of the obstacle, whichever is less) with slurry cement.

a. Refer to “Section 31 23 24 Controlled Low Strength Material” for slurry cement requirements.

F. Bedding and Backfill

1. In general, 6 inches of pipe bedding shall be laid on firm, undisturbed native material true to line and grade. Refer to Drawings for requirements.

2. Bedding material shall be placed into the trench prior to pipe placement, shall be compacted to 90 percent relative compaction, unless specified otherwise in the Drawings, and shall be of the thickness specified on the trench detail on the Drawings.

3. Bedding material under the coupling bells shall be hand-excavated so that there is a minimum clearance under the bell of 1 inch.

4. Backfill material in the pipe haunching zone between the bottom of the pipe and the spring line of the pipe shall be "shovel-sliced" underneath the pipe overhang, then hand-tamped with J bars or pneumatic "pogo stick" to a relative compaction of 90 percent along the entire length of the pipe.

    a. Tamping with a shovel is not sufficient and does not meet this requirement.

        i. Backfill material from the spring line of the pipe to the bottom of the trench patch shall be of the material, thickness, and compaction shown in the trench detail on the Drawings.

    b. Slurry cement backfill shall be consolidated using motor-driven vibrators to remove all voids and shall be placed in the Work within one hour after mixing.

        i. The vibrator used shall be large enough to vibrate the slurry cement to the satisfaction of the Engineer.

        ii. The slurry cement mixture shall contain enough water that it "flows" into the hole left when the vibrator is removed.

        iii. Slurry material that does not "flow" into the hole left by the vibrator shall have water added to it in the truck in an amount sufficient to attain a "flowing" behavior.

        iv. Slurry cement shall not be covered with other material for at least 4 hours after placement.

        v. Refer to "Section 31 23 24 Controlled Low Strength Material" for slurry cement requirements

        vi. Contractor shall be responsible for ensuring that piping does not float during placement or curing of slurry cement.

5. Class 2 aggregate base backfill shall be placed in lifts as directed by the Engineer. The maximum lift thickness will be determined by the Engineer based upon the compaction method being employed; however, the maximum lift thickness when hand-operated compaction devices are used shall not exceed eight (8) inches.

G. Trench Bedding and Backfill Compaction

1. Trench bedding and backfill shall be compacted to the densities shown on the trench detail on the Drawings, and as specified in this Section.

2. Compaction testing shall be performed by the Engineer to determine whether or not the Contractor's compaction efforts are meeting the minimum compaction requirements.

a. Trench bedding and backfill that fails compaction tests shall be re-compacted as necessary to meet the minimum compaction requirements at the sole expense of the Contractor.

H. Work Quality Guarantee

1. The Contractor shall guarantee their trench Work against settlement for a period of 1 year after the Notice of Completion has been filed. During this time, the Contractor shall repair, at their own expense and to the satisfaction of the Engineer, all failed trench backfill and resurfacing.

2. For the purpose of this Contract, failure shall be deemed to have occurred if any of the following conditions exists:

a. On paved streets, a depression in a pavement patch of 1/8 inch (0.01') below the sides of the uncut portion of pavement (includes trench lines and pavement widening).

b. Along shoulder areas, behind sidewalks, and in other unpaved portions of the right-of-way, a depression of ¾ inch (0.06') below the average of the sides of the uncut portion.

c. Across all fields, pastures, or areas untraveled by automotive equipment, a depression causing the ponding of water between the sides of the uncut portion.

d. Any other settlement that causes drainage problems or concentrations of water to run along the excavation line.

3.5 TOLERANCES

A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations

3.6 FIELD QUALITY CONTROL

A. See “Section 01 40 00 Quality Requirements” for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D6938.

C. Evaluate results in relation to laboratory compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor").

D. Installations within County roadways shall be installed and tested in accordance with County standards.

E. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest. The costs for re-testing due to failed tests will be paid by Owner and back charged to Contractor.

F. Testing Frequency: Every 1-foot lift of compacted backfill, minimum of one (1) test every 50 feet of trench length.

3.7 CLEANING

A. Maintain unused materials in a neat, compact stockpile.

B. Remove excess materials from Site once construction is complete

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SECTION 31 25 00

STORMWATER POLLUTION AND PREVENTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Stormwater Pollution Prevention Plan (SWPPP) Implementation, Monitoring, and Reporting Roles and Responsibilities

2. Best Management Practices (BMPs)

B. Related Sections:

1. Section 01 33 00—Submittal Procedures

2. Section 01 70 00—Execution and Closeout Requirements

C. A copy of the SWPPP (most current amendment) including a copy of the General Permit; notice of intent (NOI); Waste Discharge Identification Document (WDID); and associated records, certifications, and forms shall be maintained at the Project Site.

1.2 REFERENCES

A. California State Water Resources Control Board:

1. Construction General Permit (CGP): National Pollution Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities (General Permit); Order No. 2022-0057-DWQ; NPDES No. CAS000002; and Subsequent Amendments

B. California Stormwater Quality Association (CASQA):

1. Stormwater Best Management Practice Handbook for Construction

C. Revegetation, Mitigation, Monitoring, and Reporting Plan, Garberville Sanitary District, Robertson/Wallan/Hurlbutt Tanks Replacement, (SHN, 2024)

D. Mitigation, Monitoring, and Reporting Program

E. California Department of Transportation (Caltrans):

1. Standard Specifications, current edition.

F. Geotechnical Report:

1. “Engineering Geologic and Geotechnical Investigation Report Proposed Water System Improvements for the Garberville Sanitary District, Humboldt County, California-Revision 1”

(SHN, 2023)

G. Stormwater Pollution Prevention Plan (SWPPP):

1. Stormwater Pollution Prevention Plan, Garberville Services District Water System Improvements, Construction General Permit, Waste Discharge Identification (WDID to be provided prior to construction)

1.3 SUBMITTALS

A. Refer to "Section 01 33 00 Submittal Procedures."

B. Product data sheets for all materials indicating that they meet or exceed the requirements of the General Permit, the SWPPP, the CASQA Stormwater Best Management Practice Handbook for Construction, and/or other relevant requirements contained in this Specification, in the Drawings, and in the Contract Documents.

1.4 CLOSEOUT SUBMITTALS

A. Refer to "Section 01 70 00 Execution and Closeout Requirements."

1.5 QUALITY ASSURANCE

A. Contractor shall perform Work in accordance with requirements of:

1. Storm Water Pollution Prevention Plan
2. Geotechnical Report
3. Humboldt County Ordinances
4. Requirements of applicable permits by oversight agencies

B. Contractor's responsibilities include:

1. Conformance with the requirements of the SWPPP
2. Conformance with SWPPP recommendations for vehicle and equipment staging, fueling, and maintenance.
3. Construction, maintenance, replacement, and upgrading of the best management practices (BMPs) in accordance with the Project SWPPP and upon notice of a deficiency by the Owner, the Engineer, or their Authorized Representative or Delegate.
4. Provide a safe, dry, and accessible location onsite for storage of SWPPP training, inspection, monitoring, reporting, and maintenance records.
5. These responsibilities of the Contractor continue until all construction is completed and approved, until permanent vegetation/landscaping is established, and a notice of termination (NOI) is issued by the California State Water Resources Control Board.

C. Owner's responsibilities include:

1. Preparation of the SWPPP

2. All SWPPP related inspections, testing, reporting, documentation, and uploading will be undertaken by the Owners or their Duly Authorized Representative or Delegate.

3. The Owner and Engineer shall prepare and coordinate submittal of the NOI to comply with terms of the CGP.

4. The Work shall not begin until coverage under the CGP is confirmed by the Engineer.

5. Before commencing the Work, the Owner's Representative shall schedule and convene an in-field meeting with the Contractor and Engineer to discuss the intent of the SWPPP, and to discuss the Contractor's maintenance responsibilities throughout Project construction.

PART 2 PRODUCTS

2.1 BEST MANAGEMENT PRACTICE (BMP) MATERIALS

A. Geotextile Fabric: Furnish in accordance with Caltrans Standard Specifications Section 96 for Geosynthetics

B. BMP Materials and Products: Shall comply with SWPPP recommendations or subsequent revisions and shall be as described in the CASQA Stormwater Best Management Practice Handbook for Construction.

2.2 PLANTING MATERIALS

A. Seeding, Soil Supplements, and Mulch: Furnish and install in accordance with Caltrans Standard Specifications Section 20 "Landscape" and Section 21 "Erosion Control."

B. Use native grass seed to reseed disturbed areas and match existing vegetation to the extent possible.

C. Refer to planting requirements in Project Revegetation, Mitigation, Monitoring, and Reporting Plan for planting requirements associated with impacts to wetland and sensitive habitat areas

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that the site is suitably prepared to receive BMP materials and products.

B. Verify compacted subgrade, granular base, and stabilized soil is acceptable and ready to support equipment and stabilization activities.

C. Verify gradients and elevations of base or foundation for other work are correct.

D. Verify that native topsoil, stockpiled during earth disturbing activities, has been properly installed over the finished sub-grade.

3.2 SITE STABILIZATION

A. Incorporate temporary erosion control devices (BMPs) for all areas that will be disturbed as necessary to stabilize the Work area.

B. Erosion control BMPs shall be incorporated into construction and shall be maintained in-place until final surfacing is completed and vegetation is re-established.

C. All long-term erosion control features and materials must be installed by October 15.

D. Construct, stabilize, and activate erosion controls before site disturbance within tributary areas of those controls.

E. Ground Disturbing activities shall be limited to the dry season (April 15–October 15).

F. Stockpiles:

1. Stockpile and waste pile heights shall not exceed 10 feet.

2. Slope stockpile sides at 2H:1V (horizontal to vertical) or flatter.

3. Soil stockpiles shall be covered, stabilized, or protected with soil stabilization measures and a perimeter sediment barrier at all times during the wet weather season, and prior to a predicted precipitation event during the non-wet weather season.

4. Stockpiles of contaminated soil shall be managed in accordance with Caltrans BMP for "Contaminated Soil Management."

G. Stabilize any disturbed area on which construction activity has ceased and which will remain exposed for more than 14 days.

1. During non-germinating periods, apply mulch at recommended rates.

2. Stabilize disturbed areas with no topsoil, that are not at finished grade, and that will be disturbed within 1 year, in accordance with the SWPPP recommendations and of CASQA Stormwater Best Management Practice Handbook for Construction.

3. Stabilize disturbed areas that either are at finished grade or will not be disturbed within 1 year, in accordance with SWPPP recommendations and CASQA Stormwater Best Management Practices Handbook for Construction using long-term stabilization and seeding procedures.

H. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.3 FIELD QUALITY CONTROL

A. Inspect erosion control devices on a daily basis, and before and after each precipitation event that produces runoff. Make necessary repairs to ensure erosion and sediment controls are in good working order. Remove and replace damaged and ineffective erosion control devices immediately.

1. BMPs at inactive sites shall be inspected and maintained a minimum of once a week, unless a formal suspension request is approved by the California State Water Resources Control Board, prior to any forecast storm, and within 24 hours following a storm event. When sediment accumulation in sedimentation control structures has reached a point one-third (⅓) depth of sediment structure or device, remove and dispose sediment.

B. Clean channels when depth of sediment reaches approximately one half (½) channel depth.

Remove and dispose of sediment.

C. Furnish and apply erosion control re-vegetation materials according to Caltrans Standard Specifications Section 21 “Erosion Control.”

D. Contractor shall promptly address any deficiencies identified by the Owner, the Engineer, or their Authorized Representative within one working day, or prior to a precipitation event, whichever occurs earlier.

E. Contractor will be responsible for any fees or fines associated with noncompliance with the Stormwater Pollution Prevention Plan (SWPPP), regardless of when they are assessed.

3.4 CLEANING

A. Do not damage sediment control structure or device during cleaning operations.

B. Do not permit sediment transport into construction site areas, drainages, or natural waterways.

C. Regularly maintain all construction BMPs to prevent sediment transport from the Site.

D. Street cleaning shall be performed by vacuum sweeper. Street washing is not allowed. Contractor shall perform street cleaning on paved streets daily, or as deemed necessary by the Owner’s Representative, and at the end of daily construction.

3.5 PROTECTION

A. “Section 01 70 00 Execution and Closeout Requirements”: Protecting Installed Construction

B. Seeded areas shall be covered with straw, rice, or coir mulch and kept moist until grasses have successfully germinated and established.

C. Irrigate long-term erosion control and re-vegetation areas until adequate moisture is available from incident precipitation. Reseed areas of unsatisfactory germination as required.

END OF SECTION

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SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.1 DESCRIPTION

A. This section covers requirements for trench and excavation shoring and construction techniques for general safety, worker protection, and protection of adjacent property from the hazards of caving ground. These requirements include all items covered by the U.S. Department of Labor and the California Occupational Safety and Health Administration (Cal-OSHA), including, but not limited to, the following:

1. Embankment Excavations
2. Trench Excavations
3. Structure Excavations

1.2 CONTRACTOR'S RESPONSIBILITIES FOR SAFETY

A. The Contractor shall be solely responsible for conditions of the Project Site, the safety of all workers and the public, and property for the duration of the Project. This responsibility shall be in effect 24 hours a day, 7 days a week.

B. Safety provisions shall conform to U.S. Department of Labor Occupational Safety and Health Administration (OSHA); Cal-OSHA; Chapters 18, 32, and 33 of the latest edition of the Uniform Building Code as adopted by the Owner; and all other applicable federal, state, county, and local laws, ordinances, codes, the requirements set forth herein, and any other regulations detailed in other sections of these Specifications.

C. Where conflicts are found between any of the provisions above, the more stringent requirement, as determined by the Engineer, shall be followed.

1.3 PERMITS REQUIRED

A. The Contractor shall obtain a permit from the State Division of Industrial Safety (Cal-OSHA) for any excavation that falls under its jurisdiction and shall file a copy of the approved permit to the Engineer prior to initiating any Work covered under the permit.

B. If the Contractor has obtained an annual permit covering the Work being done, a copy of the annual permit shall be filed with the Engineer. In addition, the issuer of the permit shall be notified of the type of Work being done under this Contract.

1.4 SAFETY ORDERS

A. The Contractor shall have at the Project Site, either complete copies or suitable extracts of the Construction Safety Orders by Cal-OSHA.

1.5 SUBMITTALS

A. Refer to “Section 01 33 00–Submittal Procedures: Requirements for Submittals”

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

C. For structural excavations, where required, The Contractor shall submit to the Engineer for review, a shoring and/or soil stabilization plan, including Drawings, sealed, and signed by a Civil or Structural Engineer currently registered in California. The Contractor’s proposed plan may include combinations of different mechanisms or methods of shoring, sheeting, and slope stabilization systems where lay-back of the sides of the excavation may not be allowed due to Site constraints, including, but not limited to, soldier pile wall, secant wall, spiral nail wall systems, soil nailing systems, other mechanical reinforced soil systems, and anchored shotcrete-stabilized faces of excavation.

D. For trenches and excavations requiring protection, the Contractor shall submit to the Engineer a detailed plan showing the proposed design of shoring, bracing, or other provisions to be made to protect the Work area from caving ground.

E. Signed and sealed copies of calculations necessary to qualify the system shall be included with the plans

F. Shoring and bracing plans shall be submitted at least 10 working days before the Contractor intends to begin trenching or excavation Work.

1.6 SAFETY PLAN

A. If the Contractor proposes to use trench jacks or speed shores, shoring and bracing plans shall show the length and type of shoring, vertical and horizontal spacing, and any vertical or horizontal wales. Trench shields, when proposed or used, shall specify maximum allowed depth for the soils expected to be encountered.

1.7 ENGINEER'S REVIEW

A. The Engineer shall review the Contractor’s shoring and bracing plans to verify the general scope of the Work only. This review is not intended to include approval of the shoring system, or a review of the adequacy of the Contractor's safety supervisor, the safety program, or any safety measures taken in, on, or near the construction Site. This review shall not in any way relieve the Contractor from sole responsibility for the design, construction, or installation; proper maintenance; and safety of such shoring.

1.8 CONTRACTOR'S SUPERVISOR

A. The Contractor shall appoint a qualified supervisory employee who shall be responsible for determining the type of shoring system to be used depending on local soil type, water table, and other pertinent parameters. This supervisor shall have a minimum of 5 years experience in the directing of such trenching, excavation, and shoring work.

B. The Contractor shall provide the name and certification of training for the designated, onsite competent person to the Engineer and the Owner’s representative.

PART 2 PRODUCTS–NOT USED

PART 3 EXECUTION

3.1 PERFORMANCE

A. For support trenches more than 5 feet deep excavated through unstable, loose, or soft material, provide sheeting, shoring, bracing, or other protection to maintain stability of excavation. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Design sheeting and shoring to be removed at completion of excavation Work.

C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

E. Repair damage to new and existing Work from installation and maintenance of sheeting, shoring, or bracing, or other provisions made to protect the Work area from caving ground.

3.2 STRUCTURAL EXCAVATION

A. Components of the Contractor's Excavation Support and Protection System(s) shall not cause damage to existing structures or buried utilities/infrastructure not scheduled for demolition. Contractor is responsible for repairing damage to utilities, structures or fencing impacted by excavation Work.

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Exterior Improvements

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SECTION 32 12 16

ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all material, equipment and labor required to construct hot mix asphalt pavement, including, but not limited to, placement of hot mix asphalt paving and tack coat.

B. Related Sections:

1. Section 01 74 19—Construction Waste Management and Disposal
2. Section 31 00 00—Earthwork
3. Section 31 23 33—Trenching and Backfill

1.2 REFERENCES

A. California Building Code (CBC):

1. Chapter 11B–California Building Code: Accessibility to Public Buildings, Public Accommodations, Commercial Buildings and Public Housing

B. California Department of Transportation (Caltrans):

1. Standard Specifications, Current Edition.
2. California Test 216—Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates
3. California Test 231—Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates Using Nuclear Gages
4. California Test 309—Method of Test for Determining Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt
5. California Test 375—Determining the In-Place Density and Relative Compaction of Hot Mix Asphalt Using Nuclear Gages

C. California Occupational Safety and Hazard Administration (Cal-OSHA):

1. Title 8, Section 1590 (e).

D. Any Work within the street, highway or right-of-way shall be performed in accordance with the requirement of the governmental agencies having jurisdiction, and shall not begin until all of those governing authorities have been notified.

1.3 SUBMITTALS

A. Refer to “Section 01 33 00 Submittal Procedures.”

B. Job mix formula in accordance with Caltrans Standard Specifications for all hot mix asphalt material being used on the Project.

C. Load slips for all material delivery trucks shall be delivered to the job Site with the truck. The Contractor shall retain all load slips and shall make them available to the Engineer upon request.

D. Sieve analysis from testing laboratories identifying rock/sand percentages.

E. Sieve analysis from a testing laboratory identifying rock/sand percentages within the Class 2 aggregate base rock.

1.4 QUALITY ASSURANCE

A. All materials shall conform to the applicable sections of the Caltrans Standard Specifications unless otherwise specified in these Specifications or on the Drawings.

B. Use only new materials and products unless existing materials or products are specifically shown otherwise on the Drawings to be salvaged and re-used.

C. All materials, components, assemblies, Work quality, and installation are to be observed by the Owner's Inspector of Record. Work not so inspected is subject to uncovering and replacement.

D. The representatives of the Owner’s testing lab will not act as supervisor of construction, or direct construction operations. Neither the presence of the Owner’s testing lab representatives nor the testing by the Owner’s testing lab shall excuse the Contractors or Subcontractors for defects discovered in their Work during or following completion of the Project. Correcting inadequate compaction is the sole responsibility of the Contractor.

E. Contractor shall provide verification that asphalt mix temperature meets the requirements of this Specification at time of application.

F. Contractor shall be solely responsible for all subgrades built. Any repairs resulting from inadequate compaction are the responsibility of the Contractor.

G. Sieve analysis from testing laboratories identifying rock/sand percentages within the asphalt mix shall have a testing date within 90 days of Contract signing.

H. Sieve analysis from a testing laboratory identifying rock/sand percentages within the Class 2 aggregate base rock shall have a testing date within 90 days of Contract signing.

1.5 WARRANTY

A. Refer to General Conditions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Transport, store, and handle in strict accord with the local jurisdiction.

B. Make delivery to Project Site when notified by Contractor verifying that the Project is ready to

receive the Work of this Section and that arrangements have been made to properly store, handle, and protect such materials and Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aggregate Base: See "Section 31 00 00 Earthwork."

B. Hot Mix Asphalt (HMA): Shall be Type "A" HMA and shall conform to the requirements for Type "A" HMA with 1/2-inch HMA Type A grading as specified in Caltrans Standard Specifications Section 39-2.02.

C. Asphalt Binder: Asphalt binder for Type "A" HMA shall be PG 64-16 as specified in Caltrans Standard Specifications Section 92 "Asphalt Binders."

D. Prime Coat: Prime coat on aggregate base will not be required.

E. Tack Coat: Tack coat shall conform with Caltrans Standard Specifications Section 94 "Asphaltic Emulsions" and shall be applied in conformance with Caltrans Standard Specifications Section 39-2.01C(3)(f) "Tack Coat." Tack coat shall be Grade SS1 or RS1 and shall be applied to all vertical surfaces of existing pavement, curbs, gutters, and construction joints.

F. Seal Coat: No seal coat will be required.

G. Pavement Reinforcing Fabric: If pavement reinforcing fabric is required, it shall conform to Caltrans Standard Specifications Section 96-1.02J "Paving Fabric."

H. Crack Treatment:

1. Crack Seal, if required, shall conform to Caltrans Standard Specifications Section 37-6 "Crack Treatments" and Section 41-5 "Joint Seals."

2. Crack seal treatment shall be "hot-applied" type.

3. The Contractor shall provide the Engineer with a Certificate of Compliance for each shipment of crack sealant. The certificate shall certify that the sealant conforms to the Specifications and shall be accompanied with storage and heating instructions and calculations for the material.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

A. Environmental Requirements:

1. Base Course: Do not lay base course on muddy subgrade, during wet weather, or when atmospheric temperature is below 40 degrees Fahrenheit (^{o}F).

2. Asphalt Surfacing: Do not apply asphaltic surfacing on wet base, during wet weather, or when atmospheric temperature is below 50 ^{o}F.

3.2 PROTECTION OF WORK

A. Curbs and other Work shall be covered with suitable material and protected from staining or damage by equipment or contact with oil, emulsion, and asphalt.

B. All manholes, catch basins, and gratings shall be covered with suitable material so that no asphalt or emulsion will come in contact with the inside walls or floors of the structures.

3.3 PAVEMENT GRINDING

A. Pavement grinding, when required, shall be performed in accordance with the requirements of Section 39-3.04 and Section 42-3 of the Caltrans Standard Specifications, as specified in these Specifications, and as directed by the Engineer.

B. The Contractor shall exercise care to avoid damaging existing concrete curbs and drainage facilities during all grinding operations. Damage to existing improvements shall be repaired at the Engineer's direction, and at the sole expense of the Contractor.

C. Prior to conducting grinding operations, the Contractor shall remove all weeds and dirt in the gutters and in cracks in the existing pavement surface to the satisfaction of the Engineer. The Contractor will not be permitted to use herbicides, and the method of weed removal shall be subject to the approval of the Engineer.

D. The Contractor shall completely remove all existing raised reflective markers from the areas being ground.

E. The ground areas shall be swept throughout the course of the grinding operations and shall be left thoroughly clean and clear of all grindings at the end of each working day. The Contractor shall exercise care to avoid spilling grindings into drainage inlets and culverts and shall promptly clean out any grindings that do spill into inlets or culverts.

F. Prior to initiation of grinding operations, the Contractor shall lower all traffic boxes and manhole lids and frames within the limits of the Work.

G. Abrupt edges shall not be left in place when traffic is allowed back into the grinding area. Where abrupt edges exist (mid-block or on cross streets or alleys), or where directed by the Engineer, the Contractor shall build a transition ramp no shorter than 25 feet long that spans the entire length or width of the abrupt edge, lifting traffic out of the ground area and onto the surrounding pavement.

3.4 PAVEMENT SAWCUTTING

A. Pavement saw cutting shall be performed with a wheel roller, pneumatic pavement cutter, or other saw cutting equipment approved by the Engineer.

B. All pavement saw cutting shall be to the full depth of the pavement, regardless of depth. All pavement material inside the saw cut limits shall be completely removed. Saw cuts shall be straight and shall provide clean, solid, vertical faces free from loose or cracked material. All damaged or disturbed adjoining pavement shall be saw cut and removed.

C. When saw cutting is necessary for utility, storm drain, or culvert installation, saw cutting shall be made 6 inches wider on all sides than the width of the excavation.

D. When possible, saw cuts shall be either parallel or perpendicular to the roadway centerline.

E. The number of jogs in the saw cut lines shall be held to minimum and shall be subject to approval by the Engineer. The Contractor may be required to remove additional undisturbed pavement if, in the opinion of the Engineer, the lines are too erratic or contain too many jogs.

3.5 INSTALLATION

A. Subgrade shall be prepared in accordance with “Section 31 00 00 Earthwork” of these Project Specifications. Compaction and moisture content shall be verified immediately prior to placement of aggregate base.

B. Cleaning: Existing surfaces and new surfaces shall be clean of all dirt, sand, oil, or grease. All cracks shall be cleaned and free of all debris and vegetation.

C. Base Placement

1. Install in accordance with Caltrans Standard Specifications, Section 26. Compact to relative compaction of not less than 95 percent according to Caltrans 216/231.

   a. The material shall be deposited on the subgrade in such a manner as to provide a uniform section of material within five (5) percent tolerance of the predetermined required depth. Deposition will be by spreader box or bottom dump truck to prevent segregation of the material. The material so deposited on the subgrade shall have sufficient moisture, which in the opinion of the Engineer, is adequate to prevent excessive segregation. It shall then be immediately spread to its planned grade and cross-section.

   b. Undue segregation of material, excessive drifting or spotting of material will not be permitted.

   c. If in the opinion of the Site Geotechnical Engineer, the material is unsuitably segregated, it shall be removed or completely reworked to provide the desired uniformity.

2. Moisture content and compaction of base material shall be tested immediately prior to placement of asphalt paving.

D. Liquid Asphalt Tack Coat: Apply as "tack coat" to all vertical surfaces of existing paving, curbs, walks, and construction joints in surfacing against which paving is to be placed.

1. When being applied for paving fabric installation, tack coat shall extend 3 inches beyond the width of the paving fabric on all sides.

2. Tack coat shall be applied in one application at a rate according to Caltrans Standard Specifications Section 39-2.01C(3)(f) “Tack Coat.”

E. Pavement reinforcing fabric, when specified, shall be installed immediately after the tack coat is applied, in accordance with Section 39-2.01C(3)(g), “Geosynthetic Pavement Interlayer” of the Caltrans Standard Specifications, and in accordance with the manufacturer’s instructions.

F. Hot Mix Asphalt Construction

1. All HMA shall be installed in accordance with Section 39-2.01C, “Construction” of the Caltrans Standard Specifications.

    a. Type “A” HMA shall be placed only when the ambient temperature is above 50 °F. Failure to meet temperature restrictions is grounds for rejection of the Work by the Engineer.

2. Theoretical maximum specific gravity and density of HMA shall be determined in accordance with Caltrans California Test 309.

3. In-place density and relative compaction shall be determined using a nuclear gage in accordance with Caltrans California Test 375.

4. The completed surface shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. Any ridges, indentations or other objectionable marks left in the surface of the HMA by rollers, rakes, or other equipment shall be eliminated immediately.

5. Contractor shall schedule and attend a pre-paving meeting at least 2 hours in advance of the paving operation.

6. Placement and Adjustment of Frames, Covers, Boxes and Grates: The Contractor shall set and adjust to finish grade all proposed and existing frames, covers, boxes, and grates of all manholes, drop inlets, drain boxes, valves, cleanouts, electrical boxes, and other appurtenant structures prior to placement of asphaltic concrete.

G. Hot Mix Asphalt (HMA) Acceptance

1. Acceptance of HMA shall be as specified in Caltrans Standard Specifications Section 39-2.02A(4) “Quality Assurance” except as modified below:

    a. Final gradation shall be smooth, uniform, and free of ruts, humps, depressions, or irregularities.

    b. Maximum variation in slopes shall be 0.5 percent.

    c. Water Testing: All paved areas shall be water tested, to check drainage, in the presence of the Inspector of Record.

    d. The surface elevations of asphalt paving shall not vary more than 1/8 inch above or below the elevations established on the Drawings.

    e. In no case shall grades in accessible areas, including accessible parking stalls and accessible path of travel, exceed the maximum allowable grades for accessibility in accordance with CBC Chapter 11B.

    f. Pavement thickness shall be within ¼ inch of the specified thickness.

    g. Suitable corrective actions must be agreed upon by the Owner and the Engineer and may consist of full-depth removal and replacement, or overlaying.

3.6 DEFECTIVE ASPHALT

A. Contractor is responsible for replacing or modifying defective asphalt, using method approved by the Engineer. Contractor is responsible for costs associated with replacing or modifying defective asphalt.

B. Defective asphalt is as described below:

1. Exposed rock pockets on the finished surface.
2. Asphalt not placed to the design grades or elevations.
3. Asphalt that ponds water.
4. Asphalt that was compacted below the minimum required temperatures.
5. Asphalt that fails to meet the minimum compaction requirements.
6. Asphalt that lacks the minimum thickness required according to the Drawings.
7. New asphalt contaminated by a petroleum product, or spilled paint.
8. Asphalt that has depressions, cracks, raveling, segregation, slippage, bleeding, or potholes.
9. Asphalt placed on pumping, unstable sub-grades.

3.7 CLEANING

A. Refer to “Section 01 74 19 Construction Waste Management and Disposal” for disposal requirements.

B. Upon completion of Work of this Section promptly remove from the working area all scraps, debris, and surplus material of this Section.

C. Clean excess material from surface of all concrete walks and utility structures.

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SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Traffic lines and markings
2. Legends
3. Paint
4. Glass beads

B. Related Sections:

1. Section 01 33 00—Submittal Procedures
2. Section 01 50 00—Temporary Utilities/Facilities
3. Section 32 12 16—Asphalt Paving

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M247—Standard Specification for Glass Beads Used in Traffic Paint

B. ASTM-International (ASTM):

1. ASTM D34—Standard Guide for Chemical Analysis of White Pigments
2. ASTM D126—Standard Test Methods for Analysis of Yellow, Orange, and Green Pigments Containing Lead Chromate and Chromium Oxide Green
3. ASTM D562—Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
4. ASTM D711—Standard Test Method for No-Pick-Up Time of Traffic Paint
5. ASTM D713—Standard Practice for Conducting Road Service Tests on Fluid Traffic Marking Materials
6. ASTM D969—Standard Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint
7. ASTM D1301—Standard Test Methods for Chemical Analysis of White Lead Pigments

8. ASTM D1394—Standard Test Methods for Chemical Analysis of White Titanium Pigments
9. ASTM D1475—Standard test Method for Density of Liquid Coatings, Inks, and Related Products
10. ASTM D1640—Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature
11. ASTM D2202—Standard Test Method for Slump of Sealants
12. ASTM D2371—Standard Test Method for Pigment Content of Solvent-Reducible Paints
13. ASTM D2621—Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints
14. ASTM D2743–Standard Practices for Uniformity of Traffic Paint Vehicle Solids by Spectroscopy and Gas Chromatography

C. California Building Code (CBC):

1. Chapter 11B–California Building Code: Accessibility to Public Buildings, Public Accommodations, Commercial Buildings and Public Housing

D. California Department of Transportation (Caltrans):

1. Standard Specifications, current edition.

E. Master Painters Institute (MPI):

1. Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.

1.3 DEFINITIONS

A. Pavement Stripe: Includes traffic control, materials, and all appurtenances not otherwise specified.

B. Pavement Markings: Includes traffic control, setup, materials, and all appurtenances not otherwise specified in the bid schedule.

1.4 SUBMITTALS

A. “Section 01 33 00 Submittal Procedures:” Requirements for Submittals

B. Product Data: Submit paint formulation for each type of paint.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

D. Test and Evaluation Reports: Submit source and acceptance test results in accordance with AASHTO M247.

E. Manufacturer's Instructions: Submit instructions for application temperatures, eradication requirements, application rate, line thickness, type of glass beads, bead embedment and bead application rate, and any other data on proper installation.

1.5 QUALITY ASSURANCE

A. All pavement striping, pavement marking shall be installed in accordance with manufacturer's instructions.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years of documented experience.

B. Applicator: Company specializing in performing Work of this Section with minimum 3 years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

C. Invert containers several days prior to use when paint has been stored more than 2 months. Minimize exposure to air when transferring paint. Seal drums and tanks when not in use.

D. Glass Beads. Store glass beads in cool, dry place. Protect from contamination by foreign substances.

PART 2 PRODUCTS

2.1 MATERIALS

A. Furnish materials in accordance with Caltrans Standard Specifications.

B. Performance /Design Criteria:

1. Paint Adhesion: Adhere to road surface forming smooth continuous film 1 minute after application.

2. Paint Drying: Tack free by touch so as not to require coning or other traffic control devices to prevent transfer by vehicle tires within 2 minutes after application.

C. Thermoplastic Paint in accordance with Caltrans Standard Specifications, current accepted edition.

D. Glass Beads: AASHTO M247, Type 1, coated to enhance embedment and adherence with paint.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

3.2 EXAMINATION

A. Do not begin installation until substrates have been prepared properly.

B. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.3 JOB CONDITIONS

A. Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees Fahrenheit (°F) for oil-based materials, 50 °F for water-based materials, and not exceeding 95 °F.

B. Sequencing, Scheduling: Coordinate with paving Work. Verify that paint type is compatible with asphalt paving surfaces.

1. Do not apply pavement markings for 14 days after installation of hot mix asphalt (HMA).

2. Do not apply pavement markings until concrete has cured for 30 days.

C. Protection: After application, protect from traffic until thoroughly dry.

3.4 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the Project conditions.

B. Clean surfaces thoroughly prior to installation:

1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.

C. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.

D. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.

E. Maintenance and Protection of Traffic:

1. Provide short-term traffic control in accordance with “Section 01 50 00 Temporary Utilities/Facilities.”

2. Prevent interference with marking operations; prevent traffic on newly applied markings before markings dry.

3. Maintain access to existing businesses and other properties requiring access.

3.5 INSTALLATION

A. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.

B. Spot location of final pavement markings as specified and as indicated on the Drawings by applying pavement spots 25 feet on center.

C. Notify Engineer after placing pavement spots and minimum 3 days prior to applying traffic lines.

D. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.

E. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the Drawings true, sharp edges and ends:

1. Apply paint in one coat only.

2. Wet Film Thickness: 0.015 inch, minimum.

3. Width Tolerance: Plus or minus 1/8 inch.

F. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on the Drawings:

1. Mark the International Handicapped Symbol at indicated parking spaces.

2. Hand application by pneumatic spray is acceptable.

3.6 DRYING, PROTECTION, AND REPLACEMENT

A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.

B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.

C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.

D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.

E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.

F. Replace removed markings at no additional cost to Owner.

3.7 FIELD QUALITY CONTROL

A. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.

B. Repair lines and markings, which after application and curing do not meet following criteria:

1. Incorrect Location: Remove and replace incorrectly placed patterns.

2. Insufficient Thickness, Line Width, Paint Coverage, Glass Bead Coverage or Retention: Prepare defective material by grinding or blast cleaning (in an acceptable manner) to remove substantial number of beads and to roughen marking surface. Remove loose particles and debris. Apply new markings on cleaned surface in accordance with this Section.

3. Uncured or Discolored Material, Insufficient Bonding: Remove defective markings in accordance with this Section and clean pavement surface 1 foot (300 millimeters [mm]) beyond affected area. Apply new markings on cleaned surface in accordance with this Section.

C. Replace defective pavement markings as specified throughout the 1-year warranty period. Replace markings damaged by anti-skid materials, studded tires, tire chains, chemical deicers, snow plowing, or other loss of marking material regardless of cause. When markings are damaged by pavement failure or by Owner's painting, crack sealing, or pavement repair operations, Contractor is released from warranty requirements for damaged Work.

D. A 3-member team will evaluate warranty provisions. Team will consist of 1 member from Owner, 1 member from Contractor, and 1 person who is mutually acceptable to Owner and Contractor. Any costs for third person will be equally shared between Owner and Contractor. At least once during the warranty period, the team shall:

1. Observe Owner taking readings by retro-reflectometer, or review Owner records of such evaluation. The number of readings will be as large as necessary to ensure that minimum criteria are satisfied. Readings will be during period from May 15 through October 31, when pavement is clean and dry.

2. Determine color fade, discoloration, or pigment loss based on visual color comparison between original sample plates with glass beads and in-place pavement markings.

3. Determine magnitude of material loss.

E. Prepare list of defective areas and areas requiring additional inspection and evaluation to decide where material may need to be replaced. Provide traffic control as necessary if markings require more detailed evaluation.

F. Replace failed or defective markings in entire section of defective markings within 30 days after notification when any of the following exists during warranty period:

1. Average retro-reflectivity within any 528-foot (161 m) section is less than 1,225 millicandela per square meter per lux (mcd/m^2/1x) for white pavement markings and 100 mcd/m^2/1x for yellow pavement markings.

2. Marking is discolored or exhibits pigment loss and is determined to be unacceptable by 3-member team based on visual comparison with beaded color plates.

3. More than 15% of area of continuous line, or more than 15% of combined area of skip lines, within any 528-foot (161-m) section of roadway is missing.

G. Replace pavement marking material under warranty using original or better type material. Continue warranty to end of original 1-year period even when replacement materials have been installed as specified.

H. When eradication of existing paint lines is necessary, eradicate by shot blast or water blast method. Do not gouge or groove pavement more than 1/16 inch (1.5 mm) during removal. Limit area of removal to area of marking plus 1 inch (25 mm) on all sides. Prevent damage to transverse and longitudinal joint sealers and repair any damage according to requirements in "Section 32 12 16 Asphalt Paving."

I. Maintain daily log showing Work completed, results of above inspections or tests, pavement and air temperatures, relative humidity, presence of any moisture on pavement, and any material or equipment problems. Make legible entries in log in ink, sign, and submit by end of each workday. Enter environmental data into log prior to starting Work each day and at two additional times during day.

END OF SECTION

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33 Utilities

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SECTION 33 01 10

DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Disinfection of potable water distribution and transmission system
2. Testing and reporting

B. Related Sections:

1. Section 01 33 00—Submittal Requirements
2. Section 01 60 00—Product Requirements
3. Section 01 70 00—Execution and Closeout Requirements
4. Section 02 22 00—Existing Conditions Assessment
5. Section 33 14 11—Water Utility Transmission Piping
6. Section 33 14 19—Valves and Hydrants for Water Utility Service

1.2 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA C651—Disinfecting Water Mains
2. AWWA C655—Field Dechlorination

1.3 SUBMITTALS

A. Refer to "Section 01 33 00 Submittal Requirements."

B. Disinfection and Bacteriological Test Plan: The Contractor shall submit for review and approval a detailed work plan outlining the proposed procedures and schedules for disinfection and bacteriological testing 2 weeks before the start of pipe installation. The Submittal shall include, but not be limited to:

1. All aboveground sample points to be used during the disinfection and bacteriological testing period(s):

a. At a minimum, Contractor shall provide temporary ½-inch sample taps at each blow-off.

b. After the bacterial test has been passed, the temporary sample taps shall be removed, plugged, or capped.

2. Details of temporary piping to be used to fill and drain the pipeline
3. Sequence of flushing, disinfection, testing, and disposal activities
4. Proposed chemicals and treatment levels
5. Source of water flushing and disinfection
6. Method of disinfection in accordance with AWWA 651, subject to the approval of the Engineer and Owner.
7. Method for control, dechlorination, and disposal of water used for disinfection
8. Sample collection, storage, and transportation procedures
9. Applicable approvals from authority having jurisdiction for disposal of disinfection water

C. Test Reports: Submit results of bacteriological and residual chlorine laboratory test reports.

D. Manufacturer's Certificate:

1. Certify products meet or exceed specified requirements.
2. Certify disinfectants meet or exceed AWWA Standards requirements.

1.4 CLOSEOUT SUBMITTALS

A. Refer to “Section 01 70 00 Execution and Closeout Requirements.”

B. Disinfection Report:

1. Type and form of disinfectant used
2. Date and time of disinfectant injection start and time of completion
3. Test locations
4. Name of person collecting samples
5. Initial and disinfectant residuals in treated water in milligrams per liter (mg/L) free available chlorine for each test location in accordance with the AWWA 651 method selected.
6. Date and time of flushing start and completion
7. Disinfectant residual after flushing in ppm for each location tested

C. Bacteriological Report (s):

1. Date issued; Project name; and testing laboratory name, address, and telephone number
2. Time and date of water sample collections

3. Name of person collecting samples and chain-of-custody form
4. Test location(s)
5. Initial and disinfectant residuals in mg/L free available chlorine for each outlet tested in accordance with AWWA 651 method selected.
6. Coliform bacteria test results for each outlet tested
7. Certify water conforms, or fails to conform, to bacterial standards of the California Department of Public Health (CDPH), Office of Drinking Water
8. Two sets of samples shall be required in accordance with AWWA 651.

D. Water Quality Certificate: Certify water conforms to quality standards of the CDPH, Office of Drinking Water, suitable for human consumption.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651 and California Department of Public Health.

1.6 QUALIFICATIONS

A. Company specializing in disinfecting potable water systems specified in this Section with minimum 3 years of documented experience

B. Testing Firm: Company specializing in testing potable water systems, certified by State of California.

C. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chlorine Forms: In accordance with AWWA C651

B. Dechlorination Chemicals: in accordance with AWWA C655

2.2 DELIVERY, STORAGE, AND HANDLING

A. “Section 01 60 00 Product Requirements:” Requirements for transporting, handling, storing, and protecting products

B. Store disinfectants in cool, dry place away from combustibles (such as wood, rags, oils and grease).

C. Handle disinfectants with caution; protect skin and eyes from contact; avoid breathing vapors; wear gloves, aprons, goggles, and vapor masks.

2.3 BACKFLOW PREVENTION

A. If the Contractor uses water from the Owner’s distribution system during the course of this

Project, the use of a backflow preventer shall be required. Coordinate with Owner for acceptable equipment and procedures.

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to "Section 02 22 00 Existing Conditions Assessment."

B. Verify piping system has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with start-up; water pressure testing, adjusting, and balancing; and demonstration procedures, including coordination with related systems.

3.2 DISINFECTING WATER MAINS

A. Bacteriological testing will be required for all new water mains and new water service piping that can be isolated from the existing water system and for all temporary water service pipe. Bacteriological testing of other portions of the construction may be required and shall be performed as directed by the Engineer.

B. All disinfection procedures shall be accomplished by methods approved by the Engineer in accordance with AWWA C651 and shall be fully witnessed by the Engineer's Authorized Representative.

1. The pressure test shall be completed successfully in accordance with the requirements "Section 33 01 12 Inspection and Testing of Water Utilities," before bacteriological testing may begin.

2. After a successful pressure test of the new main is conducted, the system shall be chlorinated. The method of chlorination shall be approved by the Engineer in accordance with AWWA C651.

3. The Contractor shall achieve a free chlorine residual in accordance with the AWWA 651 method selected. During the chlorination process, all valves within the area being tested shall be operated unless they are attached to the Owner's existing water distribution system.

4. After successful chlorination, the chlorinated water shall be flushed from the lines at the extremities until the residual chlorine level in the new water main is equal, both chemically and bacteriologically, to that of the permanent water supply in the surrounding area. Refer to Section 2.3 above for backflow prevention information and requirements.

5. Chlorinated water shall be disposed of off-site or as directed by the Owner. Refer to Section 3.3 for handling and disposal requirements.

6. When disinfection and flushing are complete, and before the new piping is connected to the existing system or placed in service, the Contractor shall take samples and employ an approved independent testing laboratory to perform bacteriological testing and certify the results in accordance with the bacteriological test plan. If any bacteria test is failed, the main shall be chlorinated and flushed again, and the bacteria test, repeated. The Contractor shall

be responsible for all lab testing fees, chain-of-custody documentation and sample transport. This process shall be repeated as necessary at the Contractor's expense until the new water main passes the bacteriological test.

3.3 HANDLING AND DISPOSAL OF WATER

A. Contractor shall legally dispose of chlorinated water. Water used for disinfection and chlorinated water drained from any pipeline shall not be directly discharged to the ground or into a watercourse without prior approval. Coordinate with Owner for disposal of waters used for disinfection.

B. No water shall be discharged to the sanitary sewer system with a chlorine residual greater than 0.5 mg/L. Contractor shall monitor the water prior to discharge to ensure that this criterion is met. A dechlorination facility or mechanism shall be provided as necessary to meet this requirement in accordance with AWWA C655. Holding tanks, if used, shall be a minimum of 100 feet from any surface waters or storm drains and shall be removed immediately after use.

C. The proposed methods and locations of discharge, erosion control, dechlorination in accordance with AWWA C655, and chlorine residual monitoring shall be described in the Contractor's disinfection and bacteriological test plan.

D. Contractor shall be responsible for all costs, including fines and legal fees, resulting from the improper handling and disposal of water.

3.4 FIELD QUALITY CONTROL

A. The Contractor shall pay for all costs associated with testing, sample collection, and laboratory analysis related to this Specification.

B. All test results shall be provided to the Engineer and Owner within two (2) working days of test completion.

C. The Contractor shall notify the Engineer and Owner immediately upon discovery of failed test results.

END OF SECTION

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SECTION 33 01 11

DISINFECTION OF WATER UTILITY STORAGE TANKS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water tank disinfection

B. Related Sections:

1. Section 01 33 00—Submittal Procedures
2. Section 01 60 00—Product Requirements
3. Section 01 70 00—Execution and Closeout Requirements
4. Section 33 01 10—Disinfection of Water Utility Piping Systems
5. Section 33 16 13—Bolted Steel Water Storage Tank

1.2 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA C652—Disinfection of Water Storage Facilities
2. AWWA C655—Field Dechlorination
3. AWWA M20—Water Chlorination/Chloramination Practices and Principles

1.3 DEFINITIONS

A. CDPH: California Department of Public Health

B. Coliform Bacteria: Total Coliform Bacteria

C. Disinfection Water: Water used to fill the tank that is dosed with a chlorinated disinfecting agent

D. mg/L: milligrams per liter

1.4 SUBMITTALS

A. “Section 01 33 00 Submittal Procedures:” Requirements for Submittals

B. Disinfection and Bacteriological Test Procedure: The Contractor shall submit for review and approval a detailed work plan outlining the proposed procedures and schedules for

disinfection and bacteriological testing two (2) weeks before the start of tank disinfection including:

1. Type of disinfectant proposed for use
2. AWWA C652 method of chlorination, subject to the approval of the Engineer and Owner.
3. Calculations indicating quantities of disinfectants required to produce specified chlorine concentration in accordance with AWWA C652
4. Details of water source to be used for disinfection
5. Details of water disposal procedures, if applicable, including:
    a. Dechlorination chemicals to be used
    b. Calculations indicating quantities of dechlorination chemicals
    c. Location for Disinfection Water disposal
    d. Applicable approvals from authority having jurisdiction for disposal of Disinfection Water
6. Details of temporary piping and storage
7. Sequence of flushing, disinfection, testing, and disposal activities

C. Manufacturer's Certificate:

1. Certify products meet or exceed specified requirements.
2. Certify disinfectants meet or exceed AWWA Standards requirements.

D. Disinfection Company: Company specializing in disinfecting potable water tanks specified in this Section with minimum three (3) years of documented experience. Submit disinfection company qualifications.

1.5 CLOSEOUT SUBMITTALS

A. Refer to “Section 01 70 00 Execution and Closeout Requirements.”

B. Disinfection Report:

1. Type and form of disinfectant used
2. Date and time of disinfectant injection start and time of completion
3. Test locations
4. Name of person collecting samples
5. Disinfectant residuals in treated water in milligrams per liter (mg/L) free available chlorine for each test location in accordance with the AWWA 652 method selected
6. Date and time of flushing start and completion

7. Disinfectant residual after flushing in mg/L free available chlorine for each location tested

C. Bacteriological Report(s):

1. Date issued; Project name; and testing laboratory name, address, and telephone number
2. Time and date of water sample collection
3. Name of person collecting samples and chain of custody form
4. Test locations
5. Disinfectant residuals in mg/L free available chlorine for each outlet tested in accordance with the AWWA 652 method selected.
6. Coliform bacteria test results for each outlet tested
7. Certify water conforms, or fails to conform, to bacterial standards of the CDPH, Office of Drinking Water
8. Two sets of samples may be required in accordance with AWWA 652.

D. Water Quality Certificate: Certify water conforms to quality standards of the CDPH, Office of Drinking Water, suitable for human consumption.

E. Perform Work in accordance with AWWA C652 and CDPH.

1.6 QUALIFICATIONS

A. Disinfection Company: Company specializing in disinfecting potable water systems specified in this Section with minimum three (3) years of documented experience. Submit disinfection company qualifications.

B. Testing Firm: Company specializing in testing potable water systems, certified by State of California.

C. Submit bacteriologist's signature and authority associated with testing

PART 2 PRODUCTS

2.1 CHEMICALS

A. Chlorine Forms: in accordance with AWWA C652, Section 4.2

B. Dechlorination Chemicals: in accordance with AWWA C652, Appendix C

2.2 DELIVERY, STORAGE, AND HANDLING

A. “Section 01 60 00 Product Requirements:” Requirements for transporting, handling, storing, and protecting products.

B. Store chemicals in cool, dry place away from combustibles (such as wood, rags, oils, and grease).

C. Handle chemicals with caution; protect skin and eyes from contact; avoid breathing vapors; wear gloves, aprons, goggles, and vapor masks.

2.3 BACKFLOW PREVENTION

A. If the Contractor uses water from the Owner's distribution system during the course of this Project, the use of a backflow preventer shall be required. Coordinate with Owner for acceptable equipment and procedures

PART 3 EXECUTION

3.1 SCHEDULING

A. Notify the Owner and Engineer in writing a minimum of ten (10) working days before water is required for disinfection.

B. Coordinate with Owner to arrange for filling of tank and timing of water quality testing.

C. Coordinate with Owner for location, allowable flow rate, and schedule of discharge of any Disinfection Water or hydrostatic testing water. Contractor shall provide all necessary personnel, piping, adapters, traffic control and protective barriers to facilitate disposal to Owner's approved location.

3.2 CLEANING AND INSPECTION

A. All materials not part of the structural or operating facilities of the tank shall be removed. Then the surface of the walls, floors, and operating facilities of the storage tank shall be cleaned thoroughly in accordance with the tank manufacturer's and coating manufacturer's cleaning instructions.

1. Conduct inspection of tank interior before beginning disinfection.

2. Verify tank is clean and free of polluting materials.

3. Verify tank pipe and vent connections are properly made and clear of obstructions.

4. Verify tank screens are in place to prevent birds, insects, and other contaminants from entering.

B. High solids epoxies can produce an amine blush which must be removed prior to disinfection in accordance with the coating manufacturer's specifications.

3.3 ENVIRONMENTAL REQUIREMENTS

A. Furnish personnel working inside tank during disinfection with equipment to comply with federal and state regulations for Work conducted in hazardous atmosphere and confined space.

B. Handle and dispose of any disinfection and dechlorination chemicals in accordance with AWWA C655, all regulations, safety standards, and manufacturer recommendations.

C. Neutralize and dechlorinate Disinfection Water before disposal in accordance with AWWA C655.

D. Repair any damage caused by disinfection, including erosion caused by discharge of Disinfection Water.

3.4 CHLORINATION PROCEDURE

A. Contractor shall disinfect tanks in accordance with approved chlorination method (AWWA C652) and the pre-approved disinfection procedure.

B. Contractor shall furnish all cleaning and disinfection materials and all equipment and labor necessary for the cleaning and disinfecting operations.

C. The Garberville Sanitary District (District) will assist the Contractor in filling the tanks and the Contractor shall allow five (5) consecutive working days for the District to fill the tank.

D. After the appropriate retention time has elapsed, the District will take samples of the water from the tank inlet and tank outlet to be used for bacteriological contamination testing. Refer to AWWA 652 for verification requirements.

E. If the test results return positive (presence of coliform bacteria), the Contractor shall, at no cost to the District, take corrective measures necessary until the test for coliform bacteria is negative as follows:

1. Inlet Water Sample Failure: Eliminate source of contamination in water supply, repeat disinfection, and retest water quality.

2. Outlet Water Sample Failure: Repeat disinfection, and retest water quality.

3. Repeating disinfection due to a failed test result shall follow the following procedure:

    a. In accordance with AWWA C652, Section 4.3, follow procedures for application and retention for the selected method of chlorination.

    b. The Contractor shall be responsible for treating and disposing of all chlorinated disinfection water in accordance with all regulations and these Specifications.

F. The tank shall be refilled and allowed to soak for the appropriate retention time in accordance with the chlorination method selected; after which, another set of bacteriological samples will be taken for testing. Refer to AWWA 652 for verification requirements.

    a. This process shall be repeated until the tank is satisfactorily disinfected in compliance with AWWA C652.

G. Chlorinated water must be de-chlorinated by the addition of a reducing agent to neutralize the chlorine residual before it may be discharged.

H. Coordinate with owner for discharge location, schedule, and maximum flow rate. Water shall be discharged into Garberville sewer system. Contractor is responsible for installing piping to discharge to nearest sewer manhole. The allowable discharge rate into the sewer shall be determined by GSD. Contractor shall not exceed discharge rate specified by GSD.

3.5 FIELD QUALITY CONTROL

A. “Section 01 70 00 Execution and Closeout Requirements:” Field inspecting, testing, adjusting, and balancing.

B. All additional costs for corrective measures required to meet these standards are the Contractor’s responsibility.

END OF SECTION

SECTION 33 01 12

INSPECTION AND TESTING OF WATER UTILITIES

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section specifies the hydrostatic and leakage testing of process piping and other piping, where required by Technical Specification Sections.

B. Related Sections:

1. Section 01 33 00—Submittal Requirements
2. Section 33 01 10—Disinfection of Water Utility Piping Systems
3. Section 33 14 11—Water Utility Transmission Piping
4. Section 33 14 19—Valves and Hydrants for Water Utility Service
5. Section 40 05 24- Steel Process Pipe

1.2 REFERENCES

A. ASTM-International (ASTM):

1. ASTM E 1003—Standard Test Method for Hydrostatic Leak Testing

B. American Water Works Association (AWWA):

1. AWWA C600—Installation of Ductile-Iron Water Mains and Their Appurtenances
2. AWWA C605—Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

1.3 SUBMITTALS

A. Refer to “Section 01 33 00 Submittal Requirements.”

B. Refer to “Section 33 01 10 Disinfection of Water Utility Piping Systems” for disinfection procedure requirements and Submittals.

C. Testing Plan: Submit a comprehensive leakage testing procedure at least two (2) weeks prior to testing any process piping. Plan shall include all piping systems to be tested. For each system, the plan shall include at least the following information:

1. System name
2. Identification of pipeline material

3. Test type and test equipment
4. Test fluid, pressure, and duration
5. Sequence of testing
6. Description or sketch demonstrating how test sections will be isolated, where pressure will be measured, and method of isolation
7. Criteria for successful test

D. Certification of Calibration: Testing Equipment.

E. Certified Test Reports including:

1. Test date
2. Identification and description of pipe material
3. Test fluid and pressure
4. Test start time, end time, and duration
5. Drawing markup showing section of pipe which was tested
6. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
7. Signed by Contractor and Engineer to represent that test has been satisfactorily completed

1.4 TEST PRESSURES AND MEDIA

A. Refer to section 3.2 for test pressures. Media shall be potable water in all cases.

PART 2 MATERIALS

2.1 TESTING EQUIPMENT

A. Pressure Gauges Shall:

1. be calibrated within 30 days of the pressure test,
2. be accurate to within 1% of full scale, and
3. read at least 1.5X but not more than 4X the maximum test pressure to be used.

B. Volumetric Measuring Equipment Accuracy: ±½-gallon water leakage under specified conditions.

2.2 TESTING FLUIDS

A. Water: Potable water in all cases. Water should be of the same water quality as the overall distribution system.

B. Air: Clean air free of compressor lubricating oils, and at ambient temperatures.

PART 3 EXECUTION

3.1 TESTING PREPARATION

A. General:

1. The Contractor shall furnish all necessary equipment and material to complete the Work, including a hydraulic force pump with a calibrated test gauge.

2. The Contractor shall notify Engineer in writing five (5) days in advance of testing.

3. All testing shall be performed in the presence of the Engineer.

4. Refer to “Section 40 05 24 Steel Process Pipe” for applicable procedures.

5. Test piping systems as follows:

   a. Test permanently exposed piping systems after the piping has been completely installed, including all supports and hangers.

   b. Test permanently exposed, insulated piping systems upon completion of system but prior to application of insulation.

   c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.

   d. Test buried piping after backfilling, but prior to any permanent surfacing.

   e. Under slab piping must be tested prior to placing concrete slab.

6. Isolate equipment which may be damaged by the specified pressure test conditions.

7. Test section may be filled with water and allowed to stand under low pressure prior to testing. Filling of pipe shall proceed in accordance with AWWA 600 or 605 as applicable.

8. Flush pipe at blowoffs and dead ends in accordance with AWWA 600 or 605 as applicable

9. Completely assemble and test new piping systems prior to connection to existing pipe systems.

10. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.

11. Contractor is to bear the cost of all testing and inspecting, locating, and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Piping:

1. The Contractor shall conduct combination hydrostatic pressure and leakage tests on all new water mains, new water services, and temporary water service piping, in accordance with AWWA C600 or C605 as applicable. Refer to “Section 40 05 24 Steel Process Pipe” for inspection and testing procedures

2. Pressure and bacteria testing of new water mains shall be performed successfully prior to

placing the new pipeline into service. Disinfection and bacteria testing requirements are specified in "Section 33 01 10 Disinfection of Water Utility Piping Systems."

3. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.

4. When testing mortar-lined piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

5. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

6. New Piping Connected to Existing Piping: Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.

C. Backflow Prevention:

1. If the Contractor wishes to use water from the Owner's water distribution system during the course of this Project, the use of a backflow preventer shall be required. Coordinate with Owner for acceptable equipment and procedures for approval.

2. The backflow preventer valve shall be tested and certified by a certified tester and approved by the Engineer prior to use.

3. The Contractor shall be responsible for the maintenance and protection of any backflow prevention devices.

4. Backflow prevention device shall be removed prior to testing.

3.2 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Test Procedure:

1. Slowly fill with water portion of piping to be tested, expelling air from piping at high points.

3. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.

4. Vent piping during filling. Open vents at high points of piping system, loosen flanges using at least four (4) bolts, use equipment vents, or install corporation cocks to purge air pockets.

5. Close air vents and corporation cocks after air is expelled.

6. Raise pressure to specified test pressure.

7. Hydrostatically test each portion of pressure piping, including valved section, The hydrostatic test pressure shall not be less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated sustained working pressure at the lowest elevation of the test section.

8. In no case shall the test pressure exceed the rated pressure for any joint, thrust restraint, valve, fitting or other connected appurtenance of the test section unless they are removed

during the test.

9. Conduct hydrostatic testing for at least two (2) hours.

10. Examine joints, fittings, and valves for leakage.

11. Correct visible leakage and retest for full test duration.

12. If testing of piping indicates leakage, locate source of leakage, make corrections, and retest until no leakage occurs.

B. Allowable Leakage:

1. Leakage for ductile iron pressure pipe shall not exceed the allowable leakage as calculated in AWWA C600 by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:

L= allowable leakage, gallons per hour
S= length of pipeline tested, feet
D= nominal diameter of pipe, inches
P = average test pressure, pounds per square inch, gauge

2. Leakage for PVC pressure pipe shall not exceed the allowable leakage as calculated in AWWA C605 by the following formula:

$$Q = \frac{LD\,(P)^{1/2}}{148{,}000}$$

Where:

Q= allowable leakage, gallons per hour
L= length of pipeline tested, feet
D= nominal diameter of pipe, inches
P = average test pressure, pounds per square inch, gauge

3. When the pressure test is conducted against closed metal-seated valves, an additional leakage allowance of 0.0078 gal/hour/inch nominal valve diameter for each closed valve within the section being tested shall be made.

If the pressure test discloses leakage greater than that allowed, the Contractor shall, at the Contractor's sole expense, locate and repair the defective joints until the leakage is within the specified allowance. After the defects are corrected, the pressure test shall be repeated at the location and to the test pressure shown on the Drawings for a minimum of two (2) hours. This process shall be repeated as necessary until the new water main passes the pressure test.

3.3 DIELECTRIC TESTING METHODS AND CRITERIA

A. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.

B. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity, and correct the condition.

3.4 FIELD QUALITY CONTROL

A. Test Report Documentation:

1. Test date
2. Description and identification of piping tested
3. Test fluid and pressure
4. Test start time, end time, and duration
5. Drawing markup showing section of pipe which was tested
6. Remarks, including:
    a. Leaks (type, location)
    b. Repair/replacement performed to remedy excessive leakage
7. Signed by Contractor and Engineer to represent that test has been satisfactorily completed

END OF SECTION

SECTION 33 14 11

WATER UTILITY PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section describes the piping materials required for all plastic and ductile iron potable water piping throughout the Project.

B. Section Includes:

1. Water Pipe and fittings
2. Underground pipe markers and trace wire
3. Joint restraints
4. Pipe supports and anchoring
5. Accessories

C. Pipe installation Related Sections:

1. Section 01 33 00—Submittal Requirements
2. Section 01 60 00—Product Requirements
3. Section 01 70 00—Execution and Closeout Requirements
4. Section 09 90 00—Painting and Coating
5. Section 31 23 33—Trenching and Backfill
6. Section 33 01 10—Disinfection of Water Utility Piping Systems
7. Section 33 01 12—Inspection and Testing of Water Utilities
8. Section 33 14 19—Valves and Hydrants for Water Utility Service
9. Section 40 05 24—Steel Process Pipe

1.2 REFERENCE STANDARDS

A. ASTM-International (ASTM):

1. ASTM A36—Standard Specification for Carbon Structural Steel
2. ASTM-A53—Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

3. ASTM A123—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A193—Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
5. ASTM A194—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
6. ASTM A307—Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
7. ASTM A563—Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
8. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
9. ASTM D1785—Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
10. ASTM D3139—Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
11. ASTM F477—Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
12. ASTM F593—Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
13. ASTM F594—Standard Specification for Stainless Steel Nuts
14. ASTM F1674—Standard Test Method for Joint Restraint Products for Use with PVC Pipe

B. American Water Works Association (AWWA):

1. AWWA C104—Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. AWWA C105—Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110—Ductile-Iron and Gray-Iron Fittings
4. AWWA C111—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C115—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
6. AWWA C151—Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
7. AWWA C153—Ductile-Iron Compact Fittings for Water Service
8. AWWA C207—Steel Pipe Flanges for Waterworks Service–Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm)
9. AWWA C600—Installation of Ductile-Iron Water Mains and Their Appurtenances
10. AWWA C605—Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVC) Pressure Pipe and Fittings

11. AWWA C900—Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. through 60 in., for Water Distribution

12. AWWA C901—Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ in. through 3 in., for Water Service

13. AWWA C906—Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 65 in., for Waterworks

14. AWWA M6-Water Meters—Selection, Installation, Testing, and Maintenance

15. AWWA M23-PVC Pipe—Design and Installation

C. National Sanitation Foundation (NSF):

1. NSF 14—Plastics Piping System Components and Related Materials

2. NSF 61—Drinking Water System Components: Health Effects

3. NSF 600—Health Effects Evaluation And Criteria For Chemicals In Drinking Water

D. Uni-Bell

1. UNI-PUB-08—PVC Pressure Pipe Tapping Guide

1.3 SUBMITTALS

A. Refer to "Section 01 33 00 Submittal Requirements."

B. Product Data: Submit data on pipe materials, pipe fittings, valves, and accessories. Include pipe size, dimensions, pressure rating, and, as appropriate for material, minimum bending radius, and maximum safe pull force.

C. Manufacturer's Certificates: Submit Statement of Compliance, supporting data from material suppliers attesting that products and materials provided meet or exceed AWWA standards, and specification requirements.

D. Submit verification of fusion technical qualification by pipe manufacturer.

E. Temporary water service connection plan (if applicable): the Contractor shall submit for review and approval a detailed plan showing the materials and layout of all temporary water service connections. Temporary water service connection plan shall be approved by Owner and the Engineer before the start of pipe installation.

F. Submit product data sheets for dielectric isolation kits.

1.4 CLOSEOUT SUBMITTALS

A. "Section 01 70 00 Execution and Closeout Requirements:" Requirements for Submittals.

B. Project Record Documents: Contractor shall record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

D. Fusible PVC

1. Approved datalogger device reports

2. Fusion joint documentation containing the following information:

a. Pipe Size (Diameter) and Thickness

b. Fusion Machine Make, Model and Serial Number

c. Fusion Technician Identification

d. Job Identification (Name, Location and/or Project Number)

e. Fusion Joint Number

f. Fusion, Heating, and Drag Pressure Settings

g. Heat Plate Temperature

h. Time Stamp

i. Heating and Cool Down Time of Fusion

j. Ambient Temperature and weather conditions

1.5 QUALITY ASSURANCE

A. All materials shall be new, of current factory manufacture (unless otherwise shown on the Drawings), the product of a supplier regularly engaged in the manufacturing of pipe and water products, and guaranteed against defects or work quality in accordance with the General Provisions, unless more stringently specified herein. The materials and Work performed in this Section shall conform to the following standards:

1. American National Standards Institute (ANSI)

2. American Association of State Highway Officials (AASHTO)

3. American Water Works Association, Inc. (AWWA)

4. American Society of Mechanical Engineers (ASME)

5. ASTM-International (ASTM)

6. California Plumbing Code (CPC)

7. Plumbing and Drainage Institute (PDI)

8. Underwriters Laboratories, Inc. (UL)

9. Uniform Plumbing Code (UPC)

B. All materials testing performed to provide quality assurance shall be performed in accordance with requirements of the individual Specification sections.

C. Fusible PVC Requirements:

1. Fusion Technician Requirements

a. Fusion technician(s) shall be qualified by the pipe supplier to install fusible polyvinylchloride (PVC) pipe of the type(s) and size(s) specified. Qualification shall be current as of the actual date of fusion performance on the Project.

2. Specified Fusion Process and Pipe Suppliers

a. The pipe fusion joining process shall be that of Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051.

b. The pipe manufacturers shall be fully experienced, reputable, and qualified in the manufacture of fusible polyvinyl chloride (PVC) products for Underground Solutions, Inc., Poway, CA, (858) 679-9551. Fusible polyvinyl chloride (PVC) pipe marking shall include either Fusible PVC®, Fusible C-900®, or FPVC®.

3. Warranty

a. The pipe shall be warrantied for one year per the pipe supplier's standard terms.

b. In addition to the standard pipe warranty, the fusion services shall be warrantied for one year per the fusion service provider's standard terms.

1.6 DELIVERY, STORAGE, AND HANDLING

A. "Section 01 60 00 Product Requirements:" Requirements for transporting, handling, storing, and protecting products.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

D. Store all plastic materials out of sunlight.

E. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the Site. Any pipe damaged in shipment shall be replaced as directed by the Owner or Engineer.

F. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify Owner or Engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, pressure rating, color, and type.

G. Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.

H. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

I. During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.

J. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to ensure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

K. Any length of pipe showing a crack or that has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the Work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the Owner or Engineer.

L. Any scratch or gouge greater than 10 percent of the wall thickness will be considered significant and can be rejected unless determined acceptable by the Owner or Engineer.

M. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job Site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

N. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.

O. If metallic pipe is to be stored for periods of one (1) year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe with a material that allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.

P. Pipe shall be stored and stacked per the pipe supplier's guidelines.

1.7 EXISTING CONDITIONS

A. Verify field measurements prior to fabrication. Indicate field measurements on Project Record Documents.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials shall be from new stock, delivered in new condition. Where no method of tests for materials is specified, the latest applicable test specified by ASTM shall be followed.

B. Material Specifications listed on the Drawings, where applicable, shall supersede those listed in this Section.

2.2 WATER PIPING

A. Ductile Iron Pipe: AWWA C151, class 53 minimum

1. Coating and Lining:

a. Exterior Coating:

i. Buried pipe and fittings: AWWA C110 asphaltic coating with Polyethylene encasement per AWWA C105, 10-mil polyethylene tape

ii. Exposed pipe and fittings: Epoxy Primer AWWA C151, see "Section 09 90 00 Painting and Coating" for top coating.

b. Cement Mortar Lining: AWWA C104, double thickness

2. Fittings:

a. Ductile iron: AWWA C110

b. Compact fittings: AWWA C153

3. Joints:

a. Mechanical and Push-On Joints: AWWA C111

b. Flanged Joints: AWWA C115

4. Gaskets for ductile iron pipe shall conform to AWWA C111. Gasket material shall be ethylene propylene terpolymer with a diene monomer (EPDM), commonly referred to as ethylene propylene rubber.

5. All bolts, nuts, accessories, and appurtenances for joints, elbows, and fittings shall be according to test pressure:

a. Test Pressure greater than or equal to 150 psi:

i. ASTM A193 Grade B7 bolts with ASTM A194 Grade 7 nuts or AWWA C111 hardware.

b. Test Pressure less than 150 psi:

i. ASTM A307 Grade B bolts with ASTM A563 Grade A or B heavy hex nuts or AWWA C111 hardware.

c. Apply rubberized undercoating on <u>all</u> buried hardware and full polyethylene wrap per AWWA C105

6. Any stainless-steel hardware shall be installed with dielectric isolation kits including dielectric washers and dielectric sleeves.

B. Polyvinyl Chloride (PVC), 3-inch diameter and smaller: ASTM D1785 Schedule 80:

1. Fittings: PVC, Schedule 80

2. Joints: Solvent-welded

C. Polyvinyl Chloride (PVC), 4-inch through 12-inch: AWWA C900, DR18, except where otherwise specified in the Drawings.

1. Fittings: AWWA C111, ductile iron, fully restrained.

2. Joints: ASTM D3139 Bell with F477 flexible elastomeric seals.

    a. Solvent-cement couplings are not permitted.

    b. Provide joint restraint per Drawings.

D. Steel Piping

1. See "Section 40 05 24 Steel Process Pipe"

E. Fusible Polyvinyl Chloride (PVC): AWWA C900, DR18, DIPS

1. Fusible PVC is intended to be used only for utility under-crossing locations to ensure 10 feet minimum clearance free of joints from the outer dimensions of the existing utility. Fusible PVC is extruded in 45-foot (ft) segments; therefore, no field fusing is expected for these crossing locations or at any other location in this project.

    a. This 10-ft clearance requirement at the under-crossings is mandatory by the California State Regional Water Quality Control Board Division of Drinking Water.

2. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. When field fusing segments, there shall be no bell or gasket of any kind incorporated into the pipe.

3. Fusible polyvinylchloride pipe shall be manufactured in a standard 45-ft nominal length.

4. Fusible polyvinylchloride pipe shall be blue in color for potable water use.

5. Pipe shall be marked as follows:

    a. Nominal pipe size

    b. PVC

    c. Dimension Ratio

    d. AWWA pressure class/rating

    e. AWWA standard designation number

    f. NSF-61 mark verifying suitability for potable water service

    g. Extrusion production-record code

    h. Trademark or trade name

    i. Cell Classification 12454 and/or PVC material code 1120 may also be included.

6. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

7. Unless otherwise specified, singular factory-extruded continuous segments of fusible PVC shall be utilized at the under-crossing locations and connected to non-fusible PVC project piping with restrained joints or restrained couplers.

    a. Any segments proposed for field fusing shall be assembled with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this Specification.

2.3 UNDERGROUND PIPE MARKERS AND TRACE WIRE

A. Plastic ribbon tape and trace wire shall be buried with all pipe regardless of material.

B. Plastic Ribbon Tape: Blue color, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service, continuously printed with the words, "Caution—Buried Water Piping."

C. Trace Wire: Electronic detection materials for non-conductive piping products.

1. 10 AWG copper clad steel (CCS), coated with HDPE or high molecular weight polyethylene (HMWPE), blue-insulated copper wire.

2.4 JOINT RESTRAINTS

A. Acceptable Manufacturers:

1. Romac

2. EBAA Iron

3. Or Approved Equal

B. Install joint restraints as shown on the Drawings. Joint restraint devices shall be used in lieu of thrust blocking except where thrust blocking is called for on the Drawings or preapproved by Engineer. Extent of restrained joints shall be as shown on the Drawings.

C. Joint restraints for use with PVC pipe shall meet or exceed the requirements of ASTM F1674 of the latest revision.

D. Joint restraints shall be full circumferential serrated mechanical restraints consisting of multiple gripping wedges incorporated into a follower gland conforming to AWWA C110.

E. All buried fittings shall be mechanical joints on both ends except where flanges are noted on the plans.

F. Pressure rating shall be equal to that of the pipe in accordance with AWWA C111.

G. Gland and Ring: Ductile iron

H. Grip Coating: minimum of two (2) coats of liquid thermoset epoxy coating with heat cure to follow each coat

I. Gland Coating: electrostatically applied and heat cured polyester based powder.

J. Hardware: ASTM A193 Grade B7 bolts with ASTM A194 Grade 2H nuts

K. NSF 61 certified

2.5 ADAPTERS

A. Restrained Flange Coupling Adapter

1. Manufacturers:

a. Romac

b. EBBA Iron

c. Or Approved Equal

2. Description

a. Material: ductile iron ASTM A536

b. Compatibility: AWWA C110 bolt circle

c. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

d. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

e. Pressure Rating: for PVC pipe, rating shall be equal to pipe at minimum; for ductile iron pipe, rating shall have a 2:1 minimum safety factor.

B. Transition Coupler

1. Manufacturers:

a. Romac

b. Hymax

c. Or Approved Equal

2. Description

a. Material: ductile iron ASTM A536

b. Compatibility: Gasket shall accommodate and be approved for existing and new pipe material and diameter. Contractor shall pothole and confirm existing material and size prior to ordering materials.

c. Pressure Rating: for PVC pipe, rating shall be equal to pipe; for ductile iron pipe, rating shall have a 2:1 minimum safety factor.

C. Dismantling Joints

1. Manufacturers

a. Romac

b. Or Approved Equal

2. Description

a. Material: ductile iron ASTM A536

b. Compatibility: AWWA C110 bolt circle

c. Gasket: NBR or SBR compatible with chlorinated potable water service

d. Hardware: ASTM A193 Grade B7 bolts with ASTM A194 Grade 2H nuts

e. Coating: Fusion Bonded Epoxy, NSF 61 certified

f. Tie-Rods: contingent on fitting design

2.6 PIPE SUPPORTS AND ANCHORING

A. Pipe supports and anchoring shall be as indicated in the Drawings. Contractor shall provide all necessary supports to ensure that piping is not supported by equipment connections. The plans show general locations of supports but the locations shall not be considered comprehensive.

B. Metal for pipe supports: Stainless Steel, Type 316

C. Metal tie rods and clamps or lugs: Stainless Steel, Type 316

D. Pipe support brackets, tie rods, and/or clamps shall include a rubberized coating or plastic spacer to prevent direct metal-to-metal contact with pipe. Metal coating systems shall not be considered sufficient protection.

2.7 ACCESSORIES

A. Steel rods, bolt, nuts, washers, lugs, and brackets: high-strength low alloy steel with rubberized undercoat applied after assembly, unless noted otherwise on the Drawings or Specifications.

B. Dielectric Isolation: Provide pre-manufactured dielectric isolation kits in all locations where dissimilar metallic piping is joined. This includes, but is not limited to, bolt sleeves, washers, and flange seals. Coatings shall not suffice as dielectric isolation. Submit product data sheet for dielectric isolation kits.

PART 3 EXECUTION

3.1 EXAMINATION

A. “Section 01 70 00 Execution and Closeout Requirements:" Requirements for installation examination”

B. Verify that existing utility water main size, location, and inverts are as indicated on the Drawings.

3.2 PREPARATION

A. “Section 01 70 00 Execution and Closeout Requirements:” Requirements for installation preparation

B. Cut pipe ends square and remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION—PIPE, GENERAL

A. Install pipe and fittings in accordance with AWWA C600 or AWWA C605, whichever is applicable.

B. Handle and assemble pipe in accordance with manufacturer’s instructions and as indicated on the Drawings.

C. Maintain ten (10) feet horizontal separation of water main from sewer piping in accordance with State of California Department of Public Health code, unless otherwise stated on the Drawings or as directed by the Engineer.

D. Maintain four (4) feet horizontal separation between potable water main and raw water piping in accordance with State of California Department of Public Health code.

E. Maintain vertical separation of one (1) foot between potable water main and other fluid carrier pipes with potable main located above in accordance with State of California Department of Public Health Code. Water main shall be above other fluid carrier pipes unless otherwise stated on the Drawings or as directed by the Engineer.

1. Where new potable water piping is specifically shown in the Drawings crossing underneath stormdrain or other utilities, new piping shall be DR18 C900 and be free of any joints 10’ clear either side of the crossing utility outer dimensions. 20’ long piping segments will not be accepted. New piping shall have a minimum vertical separation of 1-ft.

F. Install pipe to indicated elevations to within tolerance of ½ inch.

G. Fitting sizes and end connections shall be as shown on the Drawings.

H. Route pipe in straight line, unless shown otherwise on the Drawings. Re-lay pipe that is out of alignment or grade.

I. Install pipe to have bearing along entire length of pipe. Excavate bell holes to permit proper joint installation. Do not lay pipe in wet or frozen trench.

J. Prevent foreign material from entering pipe during placement.

K. Install pipe to allow for expansion and contraction without stressing pipe or joints.

L. Close pipe openings with watertight plugs during work stoppages.

M. Install plastic ribbon tape continuous buried within two (2) feet below finish grade, above pipe.

N. Do not exceed manufacturer's specified maximum allowable pipe deflection.

O. Install trace wire continuous over top of pipe. Tape trace wire to top of pipe. Bring trace wire to surface at tie-in locations, valve boxes, vaults, and meter boxes, as shown on the Drawings. Positively attach trace wire to trace wire associated with existing piping and protect with shrink wrap insulation.

3.4 INSTALLATION—FUSIBLE PVC

A. General:

1. Fusible polyvinylchloride pipe will be installed in a manner so as not to exceed the recommended bending radius.

2. Where fusible polyvinylchloride pipe is installed by pulling in tension, the recommended Safe Pulling Force established by the pipe supplier shall not be exceeded.

B. Fusion Process:

1. Fusible polyvinylchloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this Specification and pipe supplier's guidelines.

2. Fusible polyvinylchloride pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.

3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.

4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:

a. HEAT PLATE: Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.

b. CARRIAGE: Carriage shall travel smoothly with no binding at less than 50 pounds per square inch (psi). Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

c. GENERAL MACHINE: The entire fusion machine shall be examined for defects, missing parts, or potential safety issues. All issues shall be rectified prior to use.

d. DATA LOGGING DEVICE: An approved datalogging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

5. Other equipment specifically required for the fusion process shall include the following:

    a. Pipe rollers shall be used for support of pipe to either side of the machine.

    b. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, in accordance with the pipe supplier's recommendations.

    c. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.

    d. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

    e. Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

C. Joint Recording:

1. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these Specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

D. Fusion and Layout

1. Whenever possible, pipe lengths shall be fused in their entirety and staged prior to installation in the trench. Fused pipe lengths shall be determined by Contractor preference, pipe supplier's guideline and site constraints.

2. The allowable length and width of open trench or excavation shall adhere to all applicable jurisdictional standards and the construction documents.

E. Excavation and Trenching

1. See "Section 31 23 33 Trenching and Backfill."

F. Handling and Placement

1. Fused lengths of pipe shall be installed by lowering into the trench or excavation, using approved strapping per the construction documents and the pipe supplier's guidelines. Once initiated, the lowering operation shall proceed until the entire length of the fused section of pipe is installed.

2. Coordination of lifting equipment shall ensure that the fused pipe does not exceed the bending and buckling limitations of the pipe, per the pipe supplier's guidelines.

    a. Equipment shall be utilized and staged per the pipe supplier's guidelines.

    b. Under no circumstances will the pipe be "dropped" or "rolled" into the trench or excavation.

3. If the length of the fused pipe is longer than what the available equipment can lower into the trench or excavation at one time, equipment shall be staged so that lowering shall begin at one end of the installation, and proceed along the trench or excavation, so that the entire fused length is installed without exceeding the minimum bend radius of the fused pipe.

4. Pipe may also be installed by pulling it into the end of the trench via a sloped section that is constructed so as not to exceed the minimum bending radius of the pipe. Pipe may be pulled using a pull head and winch or piece of equipment as recommended by the pipe supplier.

5. Unless otherwise specified in the Project Documents, fused pipe shall be bedded and backfilled per AWWA C605. Initial lengths of installed fused polyvinylchloride pipe shall be bedded and backfilled before any connections are made between adjacent lengths. Initial lengths of installed fused polyvinylchloride pipe shall be allowed to come to thermal equilibrium with the temperature at burial depth, by waiting at least 4 hours after installation prior to making connections such as service lines and laterals.

G. Fusible Polyvinylchloride Pipe Storage & Care

1. The use of cables or hooks directly on the pipe are prohibited

2. Visibly damaged pipe sections and sections with suspected damage, shall be segregated and set aside for thorough evaluation.

3. Any damage, scratch or gouge that is deeper than 10% of the wall thickness shall be significant and is basis for rejection unless determined acceptable by the owner or engineer. Significantly damaged pipe sections shall be rejected or cut out. Cutting shall be performed according to the pipe supplier's recommendations.

4. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution shall be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

5. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut into, gouge, scratch or otherwise abrade the pipe.

6. If pipe is to be stored for a period in excess of 1 year, the pipe should be shaded or otherwise shielded from direct sunlight. If pipe is shielded with a cover, adequate air circulation above and around the pipe shall be provided to prevent excess heat from accumulating.

7. Pipe shall be stored and stacked per the pipe supplier's guidelines.

H. Connections to Adjoining Pipe Systems

1. Unless otherwise specified in the project contract documents, the new fusible polyvinyl chloride (PVC) pipeline shall be completely assembled and successfully tested prior to making connections into adjoining pipe systems.

2. Locations for adjoining piping systems shall be shown in the construction documents. The sizes, type and locations of adjoining piping systems, as shown in the project construction documents, shall be verified in the field prior to making connections.

3. All required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents shall be delivered to their respective connection location(s) as shown on the project construction drawings.

4. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the project contract documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

3.5 COATING—PIPE

A. Coating in accordance with "Section 09 90 00 Painting and Coating."

B. All coatings shall comply with pipe manufacturer's specifications.

C. Apply rubberized undercoating on all buried hardware and full polyethylene wrap per AWWA C105

D. Polyethylene encasement in accordance with AWWA C105.

3.6 JOINT RESTRAINTS

A. Install mechanical joint restraint systems in accordance with AWWA C600 and manufacturer specifications.

B. Provide valves, tees, bends, caps, reducers, and plugs with restrained mechanical joints.

C. Install as indicated on the Drawings.

D. Install joint restraints at dead ends of water main.

E. Apply rubberized undercoating on all buried hardware and full polyethylene wrap per AWWA C105

3.7 FIELD QUALITY CONTROL

A. Refer to "Section 33 01 12 Inspection and Testing of Water Utilities."

END OF SECTION

SECTION 33 14 19

VALVES AND HYDRANTS FOR WATER UTILITY SERVICE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient Wedge Gate Valves
2. Butterfly Valves
3. Ball Valve
4. Pressure Reducing Valves
5. Swing Check Valves
6. Silent Check Valves
7. Hydrants
8. Hydrant Breakaway Assembly
9. Expansion Joints
10. Valve Boxes for Buried Valves
11. Accessories

B. Related Sections:

1. Section 01 30 00—Administrative Requirements
2. Section 01 33 00—Submittal Procedures
3. Section 01 40 00—Quality Requirements
4. Section 01 60 00—Product Requirements
5. Section 01 70 00—Execution and Closeout Requirements
6. Section 33 01 10—Disinfecting of Water Utility Piping Systems
7. Section 33 01 12—Inspection and Testing of Water Utilities
8. Section 33 14 11—Water Utility Transmission Piping

1.2 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA C110—Ductile-Iron and Gray-Iron Fittings
2. AWWA C116—Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
3. AWWA C500—Metal-Seated Gate Valves for Water Supply Service
4. AWWA C502—Dry-Barrel Fire Hydrants
5. AWWA C504—Rubber-Seated Butterfly Valves
6. AWWA C508—Swing Check Valves for Waterworks Service, 2 in. through 24 in.
7. AWWA C515—Reduced-Wall, Resilient-Seated Gate Valves for Water-Supply Service
8. AWWA C510—Double Check Valve Backflow Prevention Assembly
9. AWWA C512—Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
10. AWWA C550—Protective Interior Coating for Valves and Hydrants

B. National Sanitation Foundation (NSF):

1. NSF 61—Drinking Water System Components: Health Effects
2. NSF 600—Health Effects Evaluation And Criteria For Chemicals In Drinking Water

C. National Fire Protection Association (NFPA):

1. NFPA 281—Recommended Practice for Water Flow Testing and Marking of Hydrants

1.3 SUBMITTALS

A. Refer to “Section 01 33 00 Submittal Procedures:” Requirements for Submittals.

B. Product Data: Submit manufacturer information regarding component materials, fittings, assembly and parts diagram, and accessories.

C. Manufacturer’s Certificates: Submit Statement of Compliance, supporting data from material suppliers attesting that valves and accessories provided meet or exceed AWWA standards and Specification requirements.

1.4 CLOSEOUT SUBMITTALS

A. Refer to “Section 01 70 00 Execution and Closeout Requirements:” Requirements for submittals.

B. Field Quality-Control Submittals: Provide documentation and results of Contractor-performed tests and inspections.

C. Project Record Documents: Record actual locations of valves and fire hydrants.

D. Provide Operation and Maintenance Data for valves, hydrants, and appurtenances.

1.5 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing products specified in this Section with minimum three (3) years of documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three (3) years of documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to “Section 01 60 00 Product Requirements:” Requirements for transporting, handling, storing, and protecting products.

B. Prepare valves and accessories for shipment according to AWWA standards; seal valve and ends to prevent entry of foreign matter into product body.

C. Delivery:

1. Seal valve and hydrant ends to prevent entry of foreign matter.

2. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.

D. Store materials according to manufacturer’s instructions. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; and handle products to prevent damage to interior or exterior surfaces.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Refer to “Section 01 60 00 Product Requirements” for environmental conditions affecting products on Site.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.8 COORDINATION

A. Refer to “Section 01 30 00 Administrative Requirements:” Requirements for coordination.

B. Coordinate Work with Owner and other utilities within construction area.

1.9 MAINTENANCE MATERIALS

A. Refer to “Section 01 70 00 Execution and Closeout Requirements:” Requirements for maintenance materials.

B. Furnish two (2) AWWA 2-inch nut buried valve tee wrenches of required length to Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. Valve manufacturer's name, pressure rating, and year of fabrication shall be cast into valve body.

2.2 RESILIENT WEDGE GATE VALVES

A. Acceptable Manufacturers:

1. Mueller Company
2. Clow Valve Co.
3. Milwaukee Valve
4. American Cast Iron Pipe Company
5. M&H Valve Company
6. Or Approved Equal

B. In accordance with AWWA C515:

1. Pressure Rating: sizes 16-inch diameter and smaller: 200 pounds per square inch gauge (psig), minimum
2. Body: Ductile iron
3. Ends: Flanged, unless noted otherwise on the Drawings
4. Coating: Fusion bonded epoxy in accordance with AWWA C116 and AWWA C550; interior/exterior
5. Stem: Non-rising bronze stem or outside screw and yoke (OS & Y) rising stems as specified in the Drawings.
6. Operating Nut: Square; open counterclockwise
7. Trim and fasteners: Type 316 stainless steel
8. NSF 61 certified

2.3 BUTTERFLY VALVES

A. Manufacturers:

1. Nibco
2. Bray
3. DeZurik
4. Mueller Co.

5. Or Approved Equal
6. For Substitutions, see “Section 01 60 00 Product Requirements” and “Section 01 25 00 Substitution Procedures”

B. Butterfly valves: AWWA C504; ductile iron body, type 316 stainless steel shaft
   1. Ends: Lug-type, flanged, unless noted otherwise on Drawings
   2. Pressure Rating: 200 pounds per square inch (psi) minimum bi-directional dead-end service
   3. Coating: Fusion bonded epoxy in accordance with AWWA C550; interior/exterior
   4. Mechanism: Gear operator with handwheel, unless specified with motor operator, all 316 stainless steel trim and fasteners. Valves provided with handwheels shall include visual indication of valve position.
   5. Seals: EPDM rubber seats
   6. Disc: 316 stainless steel disc
   7. NSF 61 certified
   8. Motor Actuators, where specified:
      a. Basis of Design: Bray Series 70-E121 6-inch valve size
      b. Opening speed: 30 seconds
      c. Function Type: Open/close
      d. Options:
         i. Integral anti-condensation heater
         ii. Two dry contact auxiliary limit switches for PLC confirmation of valve position
      e. Automated valves used for control of the system zone flow with pumping shall be butterfly type and incorporate a motor actuator integrated with the pump station control system.
      f. Automated valves and their actuator/positioner shall be certified by the manufacturer to be acceptable for use up to 1,000,000 cycles in water service.
      g. Motor actuators shall include a position indicator, and a declutchable manual override handwheel with end of travel mechanical stops that when activated, lock out remote control.
      h. Actuator shall be “fail in place” style with power to open and power to close configuration.
      i. Contractor is responsible for confirming compatibility of butterfly valve shaft connection and torque requirements with the actuator.

j. Actuator shall be factory-mounted with butterfly valve and be from the same manufacturer.

k. Power shall be 120VAC single phase. Contractor to coordinate all control and power requirements for a complete system.

2.4 BALL VALVES

A. Manufacturers:

1. Apollo: Model 76F-100 Series
2. American Valve, Inc
3. Or Approved Equal

B. Materials and Construction:

1. Two-Piece Construction
2. Style: Full Port
3. Material: Stainless steel
4. Two (2) inches and smaller: MSS SP 110, Class 150

2.5 COMBINATION AIR/VACUUM VALVES

A. Manufacturers:

1. Valmatic Series 200
2. Flomatic
3. Or Approved Equal

B. Combination Air Valves shall be automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both Air Release and Air/Vacuum Valves and furnished as a single body.

C. Valves shall be manufactured and tested in accordance with AWWA C512.

D. Valves used in potable water service shall be certified to NSF/ANSI 61.

E. Connections:

1. Single body valve sizes 4 inches (in.) and smaller shall have full size NPT inlets and outlets equal to the nominal valve size. The body inlet connection shall be hexagonal for a wrench connection.

2. The valve shall have two additional NPT connections for the connection to gauges, testing, and draining.

F. Design

1. Valves shall provide a through flow area equal to the nominal size. Floats shall be unconditionally guaranteed against failure including pressure surges. The cover shall be bolted to the body and sealed with a flat gasket.

2. The Air Release Valve shall have a leverage mechanism with sufficient mechanical advantage so that the valve will open under full operating pressure. Simple lever designs shall consist of a single pivot arm and a resilient orifice button. Compound lever designs shall consist of two levers and an adjustable threaded resilient orifice button.

3. Single body combination valves shall have an expanded outlet to provide full flow area around the guide mechanism. The valve shall have a double guided plug on 2 in. and larger sizes, and an adjustable threaded orifice button. The plug shall be protected against direct water impact by an internal baffle. On valve sizes 4 in. and smaller, the plug shall have a precision orifice drilled through the center stem.

G. Materials

1. The valve body and cover shall be constructed of ASTM A126 Class B cast iron for Class 125 and Class 250 valves.

2. The float, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Non-metallic floats, linkage, or bushings are not acceptable. Resilient seats shall be Buna-N.

H. Supplied Options

1. A Regulated Exhaust Device shall be provided to reduce pressure surges due to column separation or rapid changes in velocity and pressure in the pipeline.

   a. The Regulated Exhaust Device shall be mounted on the inlet of the Combination Air Valve, allow free air flow in and out of the valve, close upon rapid air exhaust, and control the air exhaust rate to reduce pressure surges.

   b. The device shall have a flanged globe-style body with a center guided disc and seat assembly. The disc shall have threaded holes to provide adjustment of the air exhaust rate through the valve. The holes shall provide for a flow area of 5% of the nominal valve size.

   c. The material of the body shall be consistent with the Combination Air Valve. The seat and disc shall be bronze.

2. A stainless-steel screened outlet shall be provided.

3. An isolation valve shall be furnished under the combination air valve per this specification. For sizes with threaded inlets, the isolation valve shall be fully ported.

4. Valve interiors and exteriors shall be coated with an NSF/ANSI 61 certified fusion bonded epoxy in accordance with AWWA C550.

2.6 PRESSURE REDUCING VALVES

A. Acceptable Manufacturers:

1. Cla-Val 90-01KO series
2. Or Approved Equal

B. Materials and Features:

1. Body: Ductile Iron ASTM A536
2. Diaphragm: EPDM or Buna-N
3. Fasteners: stainless steel
4. Trim: stainless steel
5. Coating: fusion-bonded epoxy
6. Connections: Flanged 150 Class
7. Type: Anti-Cavitation

C. Operating Conditions:

1. 6-inches
    a. Pressure setting: 155 psi inlet, 51 psi outlet
    b. Flow: 1500 gallons per minute (gpm), approximate
2. 4-inches
    a. Pressure setting: 155 psi inlet, 56 psi outlet
    b. Flow: 400 gpm, approximate

D. Accessories:

1. Furnish each PRV with inlet and outlet pressure gauges with ball valve shutoffs.
2. Furnish each PRV with a dual position limit switch to positively indicate open and closed positions. Cla-Val X105L2 Series.

2.7 FOOT VALVES

A. Acceptable Manufacturers

1. Flomatic 302S6
2. Or Approved Equal

B. Description:

1. The Foot Valve shall be of the full flow globe style designed to provide silent operation,

positive seating, and full flow area.

2. NSF 61 certified

3. The Foot Valves shall be provided with flanges in accordance with ANSI B16.1. Contractor to coordinate flange compatibility with connected piping

4. The valve design shall incorporate a center guided disc, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe size.

5. All component parts shall be field replaceable without the need of special tools. A replaceable guide bushing shall be provided and held in position by threaded bushing retainer.

6. The valve disc shall be concave to the flow direction providing for disc stabilization, maximum strength, and a minimum flow velocity to open the valve.

7. Am EPDM seal shall be provided on the seat to provide for zero leakage at both high and low pressures without overloading or damaging the seal.

8. A heavy-duty basket type screen shall be bolted to the inlet flange outside diameter and provide 3-4 times the pipe area.

9. The valve body and Basket screen shall be constructed of Stainless Steel

2.8 NON-SLAM SWING CHECK VALVES

A. Acceptable Manufacturers:

1. Valmatic 7200 Surgebuster Check Valve

2. Or Approved Equal

B. In accordance with AWWA C508:

1. Pressure Rating: Sizes 12-inch and smaller: 250 psig

2. Body: Ductile iron

3. Ends: Flanged, unless noted otherwise on the Drawings

4. Coating: Fusion bonded epoxy in accordance with AWWA C116 and AWWA C550; interior/exterior

5. Seating: 35-degree short stroke

6. Cracking Pressure: 0.3 psig

7. Trim and fasteners: Type 316 stainless steel

8. Waterway: Clear waterway

9. Disc: NBR rubber

10. NSF 61 certified

2.9 SILENT CHECK VALVE

A. Acceptable Manufacturers:

1. Flomatic 888VFD Series

2. Or Approved Equal

B. Description:

1. Wafer style silent check valves shall be of silent operating type that closes as flow is reduced and fully closes at zero velocity stopping reverse flow which reduces or eliminates water hammer shock.

2. Valve shall be specifically approved for VFD pump station applications and designed for quiet and efficient operation across a wide range of flow velocities.

3. All component parts shall be field replaceable and without the need of special tools. A replaceable guide bushing shall be provided and held in position by the valves spring.

4. Valve shall be approved for direct mounting of butterfly shutoff valve on the downstream side.

5. Cracking pressure shall be less than 1 psi.

6. Valves shall be certified to NSF/ANSI 61 Drinking Water System Components and also certified to be lead free in accordance with NSF/ANSI 372.

7. Body Material: Ductile Iron ASTM A536

8. Coating: Fusion-Bonded epoxy

9. Interior Materials: Stainless Steel with bronze bushings

10. Seat Ring: EPDM

11. End Type: Compatible with ASME B16.1 & AWWA flanges. Contractor to coordinate flange type/compatibility with connected equipment and piping at the required pressure rating.

12. Working Pressure Rating: 200 psi minimum

2.10 HYDRANTS

A. Acceptable Manufacturers:

1. Clow

2. Or Approved Equal

B. Hydrant Head:

1. Body: Ductile Iron

2. Hydrostatically tested to 300 psi

3. Outlet Connection Size: one 4-1/2 inch & two 2-1/2 inches male National Standard Fire Hose Coupling Threads

4. Attach nozzle caps by separate chains.

5. Contractor shall confirm bury depth prior to ordering.

C. Accessories:

1. Provide Owner with one replacement valve wrench

2.11 HYDRANT BREAKAWAY ASSEMBLY

A. Acceptable Manufacturers:

1. AVK

2. Or Approved Equal

B. Options:

1. Flange: Ductile iron, AWWA C110

2. Break ring: Ductile iron, AWWA C110 bolt pattern

3. Hardware: Type 316 stainless steel

4. Coating: Blue, fusion-bonded epoxy in accordance with AWWA C116 and AWWA C550; interior/exterior

5. NSF 61 certified

2.12 SERVICE SADDLES

A. Acceptable Manufacturers

1. Romac 202S

2. Or Approved Equal

B. Description

1. Working Pressure: equal or greater than pipe rating

2. Materials: Ductile Iron body with stainless steel hardware

3. Attachment: Dual Stainless Steel Straps, compatible with host pipe

4. Gasket: NBR, NSF61 Certified

2.13 EXPANSION JOINTS

A. Forced-Balanced Expansion Joints

1. Acceptable Manufacturers

a. EBBA Iron Flex-Tend

b. Or Approved Equal

2. Flexible expansion joints shall be installed in the locations indicated on the Drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.

3. Joint shall be approved by the manufacturer for buried installations to the depth shown on the Drawings.

4. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (applies to 3-16 inches; 250 psi for 18 inches or greater). A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.

5. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection 20 º for 4-12 inch; 15 º for 14-36 inch, 12 º for 48 inch. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts. The minimum total linear travel shall be 8-inches.

6. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.

7. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

8. Polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

B. Arch-Style Expansion Joints

1. Acceptable Manufacturers:

a. Proco Products, Inc

b. Mercer

c. Or Approved Equal

2. Requirements:

a. Refer to tank manufacturer designs for required deflection specifications.

b. 316 stainless steel retaining rings

c. 316 stainless steel limit rods and hardware compatible with retaining ring materials to prevent overextension

d. Materials: EPDM rubber cover and tube, NSF 61 certified

e. Connecting Ends: Flanged, unless noted otherwise on the Drawings

f. Pressure rating: 145 psig, minimum

g. NSF 61 certified

2.14 VALVE BOXES FOR BURIED VALVES

A. Reinforced concrete valve box, with cast or ductile iron two-piece frame/cover, screw attachment, traffic-rated for intended installation. The cover shall rest on a machined surface and shall be equipped with legs that extend approximately 1½ inches down into the body to prevent traffic flip out.

B. Manufacturers:

1. 8-inch and smaller diameter buried valves: Christy/ Oldcastle Model G05

a. or Approved Equal

2. 10-inch to 12-inch diameter buried valves: Christy/ Oldcastle Model G08,

a. or Approved Equal

C. Ductile or cast iron cover marked "WATER" and traffic rated for intended installation

D. Valve box riser:

1. Install high-strength plastic or concrete extensions designed to center valve box base and prevent it from shifting off center during backfilling. Extensions to grade may be reinforced concrete valve box extension segments or odd lengths of 8- or 10-inch high-density polyethylene (HDPE) or polyvinyl chloride (PVC) pipe as risers.

E. Valve box will be set in a concrete ring, approximately 24 inches in diameter upon completion.

2.15 ACCESSORIES

A. Steel rods, bolt, nuts, washers, lugs, and brackets: high-strength low alloy steel with rubberized undercoat applied after assembly, unless noted otherwise on the Drawings or Specifications.

B. Dielectric Isolation: Provide pre-manufactured dielectric isolation kits in all locations where dissimilar metallic piping is joined. This includes, but is not limited to, bolt sleeves, washers, and flange seals. Coatings shall not suffice as dielectric isolation. Submit product data sheet for dielectric isolation kits.

PART 3 EXECUTION

3.1 EXAMINATION

A. Determine exact location and size of valves from Drawings; obtain clarification and directions from Engineer prior to execution of the Work.

B. Verify invert elevations of existing work prior to excavation and installation of valves.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities to remain from damage.

C. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Engineer not less than five (5) working days in advance of proposed utility interruption.

2. Do not proceed without written permission from the Owner/Engineer.

D. Remove scale and dirt on inside and outside before assembly.

3.3 INSTALLATION—VALVES AND VALVE BOXES, GENERAL

A. Install valves in conjunction with pipe laying; set valves plumb.

B. Provide buried valves with valve boxes installed flush with finished grade.

3.4 INSTALLATION—HYDRANTS AND HYDRANT BREAKAWAY ASSEMBLY

A. Provide support blocking and drainage gravel while installing dry barrel hydrants; do not block drain hole.

B. After main-line pressure testing, flush hydrants and check for proper drainage.

C. Set hydrant lower break-away assembly flange not less than 1½ inches, and not more than 3½ inches above finished grade.

3.5 INSTALLATION—EXPANSION JOINTS

A. Refer to manufacturer's installation instructions. Expansion joints are not intended to compensate for piping misalignment errors. The pipe system must be rigidly anchored and supported on both sides of the expansion joint to control expansion or contraction of the line and avoid placing any weight on expansion joint.

3.6 FIELD QUALITY CONTROL

A. Refer to "Section 01 40 00 Quality Requirements:" Field inspecting, testing, adjusting, and balancing.

B. Perform pressure test on water system in accordance with "Section 33 01 12 Inspection and Testing of Water Utilities."

C. Perform disinfection of potable water distribution piping in accordance with "Section 33 01 10 Disinfection of Water Utility Piping Systems."

END OF SECTION

SECTION 33 16 23

BOLTED STEEL WATER STORAGE TANK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Factory-Bolted Steel Water Tank
2. Cathodic Protection
3. Tank Foundation
4. Tank Inspection and Testing

B. The furnishing of all labor, material, equipment, tools, services, and erection of a factory-coated bolted steel water storage tank with galvanic cathodic protection system.

C. Tank manufacturer is responsible for the design, provision and installation of the tank and the design of the tank foundation.

D. The Contractor shall construct the reinforced concrete foundation, complete and in place. All required labor, materials, and equipment shall be included.

1.2 RELATED SECTIONS

A. Section 01 30 00—Administrative Requirements

B. Section 01 33 00—Submittal Procedures

C. Section 01 41 00—Regulatory Requirements and Permits

D. Section 01 60 00—Product Requirements

E. Section 01 70 00—Execution and Closeout Requirements

F. Section 02 22 00—Existing Conditions Assessment

G. Section 33 01 11—Disinfection of Water Utility Storage Tanks

H. Section 40 70 00—Instrumentation for Process Systems

I. Project Geotechnical Report: Proposed Water System Improvements for the Garberville Sanitary District-Revision 1 (SHN, 2023).

1.3 REFERENCE STANDARDS

A. The latest edition in effect at time of Contract award of the following standards shall be

applicable where referenced within this specification:

B. National Sanitation Foundation (NSF):

1. NSF 61: Drinking Water System Components–Health Effects

2. NSF 600- Health Effects Evaluation and Criteria in Drinking Water

C. American Society of Civil Engineers (ASCE):

1. ASCE 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

D. American Society for Testing and Materials (ASTM):

1. ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

E. American Water Works Association (AWWA):

1. AWWA D103: Factory-Coated Bolted Carbon Steel Tanks for Water Storage

2. AWWA D106: Sacrificial Anode Cathodic Protection Systems for the Interior of Submerged Surfaces of Steel Water Storage Tanks

F. California Building Code

G. National Association of Corrosion Engineers International (NACE)

1. NACE SPO196: Galvanic Anode Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks

H. National Electric Code (NEC)

I. Occupational Safety and Health Administration (OSHA):

1. OSHA 29 CFR 1910: Occupational Safety and Health Standards

1.4 DEFINITIONS

A. DDW: California State Water Resources Control Board Division of Drinking Water

B. Purchaser referred to in AWWA D103 means Owner, Garberville Sanitary District

1.5 COORDINATION

A. Refer to “Section 01 30 00 Administrative Requirements:" Requirements for coordination.

B. Coordinate Work of this Section with location and placement of utilities, piping, tank appurtenances and tank foundation as shown on the Project Drawings.

C. Coordinate with Owner to obtain potable water for testing.

D. Coordinate with Owner for location, schedule, and flow rate of disposal of disinfection and hydrostatic water.

E. Disinfection of the tank shall not take place until Work on the potable distribution system is complete and the Contractor has prepared the potable distribution system to enter into service.

1.6 PREINSTALLATION MEETINGS

A. Refer to “Section 01 30 00 Administrative Requirements” for preconstruction meeting.

B. Convene minimum one (1) week prior to commencing Work of this section.

C. Attendance of the Owner, Engineer, Contractor, and Tank Manufacturer Representative is mandatory.

1.7 SCHEDULING

A. Refer to “Section 01 30 00 Administrative Requirements” for requirements for scheduling.

B. Schedule Work of this section after Work for foundation has been constructed and concrete test results confirm the foundation meets the design requirements.

1.8 SUBMITTALS

A. Refer to “Section 01 33 00 Submittal Procedures:" Requirements for Submittals.

B. With Bid: Qualifications Statements:

1. Submit qualifications for tank manufacturer, installer, and licensed professional.

2. Submit manufacturer's approval of installer.

C. Design Submittals:

1. Submit structural calculations for tank and tank foundation, as described in AWWA D103, signed and sealed by a Professional Engineer licensed in the State of California. Calculations shall include evaluation of freeboard requirements and seismic displacement for piping connections.

2. Submit design calculations for sacrificial anode galvanic corrosion protection system, as described in AWWA D106, signed and sealed by a Registered Professional Corrosion Engineer licensed in the state of California and certified NACE Corrosion Specialist.

D. Shop Drawings

1. Contractor shall prepare and submit Shop Drawings to the Engineer for review and approval prior to proceeding with any fabrication or construction.

2. Bolted Steel Water Storage Tank:

a. Shop Drawings of bolted steel water tank and foundation, signed and sealed by a Registered Professional Civil or Structural Engineer licensed in the State of California. Shop Drawings shall align with design calculations for the tank and foundation.

b. Field Dimensions: Refer to “Section 02 22 00 Existing Conditions Assessment.”

c. Complete plan, elevation, and sectional drawings showing critical dimensions.

d. Structural plate and support member sizes and thickness.

e. Panel layout and bolting details.

f. Water inlet, outlet, overflow piping and tank drain details, including fittings, pipe support methods, and locations.

g. Ladder and ladder safety device details, including fall prevention systems and appurtenances.

h. Handrail details.

i. Access hatch details.

j. Liquid level indicator.

k. Level instrumentation mounting fitting details.

l. Roof layout drawing with attachment details.

m. Vent location and details.

n. Plans showing dimensions and details for tank foundations, including anchor bolt spacing, rebar layout, and concrete strength.

o. Handrail mounting details for electrical enclosures, see electrical plans for equipment

3. Galvanic Corrosion Protection System:

a. Specific anode core to lead wire connections.

b. Handhole locations and sizes.

c. Handhole cover and sealing details.

d. Anode suspension and support assembly details.

e. Anode spatial location and suspension depth within each tank.

E. Product Data:

1. All products and materials in contact with potable water shall indicate NSF 61 and NSF 600 certification.

2. Submit data for pipe specialty fittings and supports.

3. Submit data for ladder, ladder safety devices and ladder climbing safety gear.

4. Submit tank information concerning materials and fabrication, including mill tests on steel plates and structural members.

5. Submit data for tank appurtenances.

6. Tank and appurtenance coating materials, application methods, and factory testing.

7. Tank plate seam seal and gasket materials.

8. Galvanic corrosion protection system: description of system components and product data sheets.

F. Manufacturer Instructions:

1. Tank, foundation, and appurtenances: submit detailed project-specific installation, handling, storage, anchoring, and layout procedures.

2. Galvanic corrosion protection system: submit detailed project-specific installation, handling, storage, and testing procedures.

G. Manufacturer's Certificates:

1. Certify that tank and appurtenances meet or exceed specified requirements.

2. Certify foundation, anchor bolts, and tank have been properly installed and leveled.

3. Certify that tank has been installed according to manufacturer instructions.

H. Test and Evaluation Reports:

1. Submit certified reports of all factory tests and inspections including factory coating thickness and other inspection and testing reports for the project-specific tank.

2. Submit mill test reports for materials used in the construction of the tank.

3. Written Report Certifying Work: Prepare and submit as indicated in AWWA D103.

4. Submit Installation Certificate from equipment manufacturer's representative.

5. Submit vacuum and hydrostatic leak test results.

6. Submit leak location drawings and descriptions (if any) along with leak repair plan.

7. Cathodic protection field installation report with test results.

8. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections including hydrostatic and vacuum leak tests.

1.9 CLOSEOUT SUBMITTALS

A. Refer to “Section 01 70 00 Execution and Closeout Requirements:" Requirements for Submittals.

B. Project Record Documents: Record actual location and orientation of tank and appurtenances, including “as-built” cathodic protection Drawings.

C. An Owner’s Maintenance Manual shall be submitted for Engineer’s review for the tank and cathodic protection system.

1.10 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to “Section 01 70 00 Execution and Closeout Requirements:" Requirements for maintenance materials.

B. Furnish two (2) safety harnesses for ladder safety rail system.

C. Furnish locking mechanisms for the exterior ladder/cage assembly, for the two (2) manways in the bolted steel tank lower ring, and for the roof access hatch. Provide padlocks keyed to the Owner’s requirements.

D. Furnish all OSHA-required apparatus, associated with the exterior ladder system and manways that are necessary for entry into the bolted steel tank.

1.11 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA D103.

B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 600 Standards.

C. Maintain working copies of all Project documents on Site.

1.12 QUALIFICATIONS

A. Tank Manufacturer: Company specializing in manufacturing products specified in this section with minimum 10 years' documented experience, including completed installations in the State of California. The manufacturer shall have an active ISO-9001, certified by a 3rd party company.

B. Tank and Foundation Designer: Professional Civil or Structural Engineer with minimum five (5) years’ experience with design of this Work and presently licensed in State of California.

C. Tank and Foundation Installer: Company specializing in performing Work of this section with minimum ten (10) years' documented experience and approved by manufacturer.

D. Cathodic Protection System Designer: Registered Professional Corrosion Engineer licensed in the state of California and certified NACE Corrosion Specialist.

E. Cathodic Protection System Installer: The Contractor performing all cathodic protection system installations, testing, and inspections shall be a licensed Electrical Contractor in the State of California (C-10 minimum classification) and shall have minimum ten (10) years’ practical experience with successful histories of similar cathodic protection tank Work.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Refer to “Section 01 60 00 Product Requirements:" Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials in areas protected from weather and moisture and according to manufacturer instructions.

2. Do not store products directly on ground.

D. Handling: Handle materials in a manner to prevent damage to interior or exterior surfaces.

E. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to manufacturer instructions.

1.14 EXISTING CONDITIONS

A. Refer to “Section 02 22 00 Existing Conditions Assessment.”

B. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

1.15 WARRANTY

A. Refer to “Section 01 70 00 Execution and Closeout Requirements:" Requirements for warranties.

B. Furnish one (1)-year warranty for bolted steel tank, the period of which shall not commence until the tank has been fully tested, disinfected, and placed in service and following Substantial Completion.

1.16 PERFORMANCE AND DESIGN CRITERIA:

A. Tank manufacturer shall provide calculations and drawings signed and sealed by a Professional Civil or Structural Engineer licensed in the State of California.

B. Tank shall be designed in conformance with applicable requirements of AWWA D103, including, but not necessarily limited to, tank shell design, bolted joints, roof supports, reinforcements around openings and foundation anchorage, unless supplemented or modified in this Section:

1. Nominal Capacity: As required to meet minimum usable capacity, diameter, and minimum freeboard constraints.

2. Minimum useable capacity: 70,000 gallons. Minimum useable capacity refers to capacity of tank net of freeboard required for sloshing wave height in accordance with AWWA D103 and local seismic design criteria.

3. Liquid to be stored: Chlorinated Potable Water.

4. Tank diameter: Maximum of 24 feet; Refer to Drawings.

5. Tank height: As required to meet maximum diameter and minimum usable capacity constraints.

6. Maximum water level (MWL): As required based on tank base elevation tank diameter, and minimum useable capacity.

7. Seismic Design Criteria: Tank and foundation shall comply with AWWA D103 and ASCE 7. Refer to Project Geotechnical Report for site-specific seismic design criteria.

8. Design Wind Loading: in accordance with AWWA D103 Section 15, ASCE 7, and California Building Code.

9. Roof live load: In accordance with AWWA D103 and ASCE 7

10. Snow Loading: in accordance with AWWA D103 Section 5.2.4, and ASCE 7; for low-sloped roofs.

11. Minimum Freeboard: in accordance with AWWA D103 Section 14.4 for sloshing wave height requirement (see Project Geotechnical Report for seismic design criteria).

12. Allowable Soil Bearing Pressure: Refer to Project Geotechnical Report.

PART 2 PRODUCTS

2.1 BOLTED STEEL WATER STORAGE TANK

A. Manufacturers:

1. Superior Tank Company Inc.

2. CST Industries

3. Paso Robles Tank, Inc.

4. Or “Approved Equal.”

a. Contractor shall submit manufacturer qualifications with Bid.

B. Bolted steel water storage tank shall meet or exceed the minimum standards established in AWWA D103.

2.2 TANK FOUNDATION

A. Foundation to be designed by tank manufacturer.

B. Refer to Project Geotechnical Report.

2.3 TANK INTERIOR AND EXTERIOR COATING SYSTEMS

A. Tank interior and exterior coating systems shall be factory-coated with thermoset powder coatings in compliance with the requirements of the current version of AWWA D103.

1. Coordinate color selection with the Owner.

2. Field coating, other than touch-up, shall not be permitted.

2.4 TANK ROOF

A. The tank roof shall be supplied by the tank manufacturer and installed by the tank manufacturer's qualified installation crew.

B. Roof Vent:

1. In accordance with AWWA D103, Section 7.7

2. Minimum capacity of roof vent shall be 2,000 gallons per minute (gpm).

3. A pressure-vacuum screened vent or pressure-vacuum relief mechanism to allow vent operation in the case of screen clogging are required for the tank vent shall be provided.

4. Vent Screen: No. 24 mesh, non-corrodible.

C. Roof Hatch:

1. Roof hatch cover shall be upward opening and be located near the ladder.

2. The hatch cover shall be hinged and have locking provisions.

3. Hatch opening shall have a clear dimension of at least 30 inches square.

4. Hatch curb shall extend at least 4 inches above the tank with the hatch cover lip overlapping by a minimum of 2 inches.

D. Cathodic protection handholes: To be coordinated with Tank Manufacturer in consultation with cathodic protection system supplier.

E. Level instrument connection: Refer to Drawings. Cable penetrations shall be coordinated with Tank Manufacturer in consultation with Contractor.

2.5 TANK APPURTENANCES

A. Comply with requirements listed in AWWA D103, unless supplemented or modified below:

1. Corrosion Allowance: None.

2. Pipe and Pipe Connections:

a. Connections shall be in accordance with AWWA D103, and as shown on the Drawings.

b. Provide other accessories as indicated on Drawings.

c. Steel pipe with flanged or welded connections for fluid conductors may be used unless otherwise shown on the Drawings.

d. Overflow and Drain Pipe:

i. ASTM A53/A53M, Grade B, Schedule 40, steel pipe, welded joints, suitably supported along the tank shell.

ii. Nominal Diameter: As indicated on Drawings.

iii. Fusion epoxy coated inside and outside after fabrication.

e. Inlet and Outlet Pipe:

i. ASTM A53/A53M, Grade B, Schedule 40 steel, welded or flanged joints, suitably supported along the tank shell.

ii. Nominal Diameter: As indicated on Drawings.

iii. Fusion epoxy coated inside and outside after fabrication.

3. Overflow:

a. Provide overflow weir box and overflow pipe designed to handle flow rate of 200 gpm at high water level. Notify Engineer immediately if required overflow pipe sizing is greater than shown on the Drawings.

b. Provide elbow and No. 24-mesh non corrodible screen and screen holder over air break opening in accordance with the Drawings.

4. Roof Ladder: According to AWWA D103, and as indicated on Drawings.

a. Provide a galvanized steel exterior ladder with cable fall arrest system as shown in the Drawings. The ladder shall have a lockable closure at the bottom.

5. Safety Devices:

a. Furnish safety rail along entire ladder length and extending a minimum of 42 inches above tank roof.

b. Furnish cable system and harness.

c. Furnished safety devices shall Comply with OSHA standards.

6. Level instrumentation: The tank shall be supplied with level instrumentation in accordance with Project Electrical Drawings. Contractor shall coordinate with Tank Manufacturer to ensure all necessary mounting hardware for level instrument mounting is integrated into the tank design.

7. Alarms: Refer to “Section 40 70 00 Instrumentation for Process Systems.”

8. Cathodic protection system: The tank shall be supplied with a galvanic cathodic protection system. Tank manufacturer shall coordinate with Cathodic Protection System Supplier to ensure all necessary mounting hardware and tank penetrations are integrated into the tank design.

2.6 CATHODIC PROTECTION SYSTEM

A. Cathodic Protection System shall be furnished in accordance with AWWA D103 and D106.

B. System Components

1. Control Panel Enclosure: NEMA 4X rated fiberglass enclosure w/ stainless steel hinge and latch suitable for padlock

2. Guarantee: All workmanship, equipment, and materials furnished by the cathodic protection constructor shall be guaranteed for one (1) year. The 1-year period shall commence at the time of substantial completion and after the system has been tested and properly adjusted for operation by the Corrosion Engineer.

2.7 SOURCE QUALITY CONTROL

A. Refer to “Section 01 40 00 Quality Requirements:" Testing and Inspection Services

B. Provide shop inspection and testing of component parts.

PART 3 PART 3 EXECUTION

3.1 FABRICATION

A. Materials, Design, Fabrication, and Testing: According to AWWA D103 and D106.

B. Tank Appurtenances:

1. Overflow/Drain Pipe: Terminate pipe a minimum of 1 foot above finished grade to provide air-break in accordance with the Drawings.

3.2 EXAMINATION

A. Refer to “Section 02 22 00 Existing Conditions Assessment”

B. Verify existing conditions before starting Work.

C. Verify elevations and grading for bolted steel tank and location of bolted steel tank.

D. Refer to “Section 31 00 00 Earthwork” for excavation backfill requirements.

3.3 PREPARATION

A. Refer to “Section 02 22 00 Existing Conditions Assessment”

B. Prepare subgrade in accordance with the Project Geotechnical Report. Subgrade shall be approved by Geotechnical Engineer or authorized field representative prior to the construction of the tank foundation.

C. Verify tank foundation meets the layout requirements and concrete compressive strength prior to the installation of the tank.

D. Support Pad:

1. Thoroughly clean tank pad–removing loose concrete, dust, and other debris.

2. Place building fiberboard or other protective material on pad according to tank manufacturer's recommendations prior to placing tank.

3.4 INSTALLATION

A. Install tank foundation and tank in accordance with AWWA D103, as indicated on Drawings, and according to manufacturer instructions.

B. Connect piping to tank with dielectric isolation flange and bolt kits.

C. To complete installation, install tank accessories not factory mounted.

D. Touch-up painting and coating in accordance with manufacturer instructions and according to AWWA D103.

3.5 FIELD QUALITY CONTROL

A. Refer to “Section 01 40 00 Quality Requirements:" Testing and Inspection Services.

B. Refer to “Section 01 70 00 Execution and Closeout Requirements:" Closeout Procedures.

C. Furnish field representative experienced in installation of tank to supervise installation.

1. Furnish installation certificate attesting tank, tank foundation, and anchor bolts are properly installed and leveled.

D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

E. Inspection and Testing:

1. Clean interior and exterior of tank to remove debris, construction items, and equipment.

2. Holiday test: Prior to placing water in the tank, a “holiday” inspection of the entire tank will be provided and performed by the tank manufacturer’s representative, in accordance with NACE SP0188 and ATSM D6152, and in the presence of the Engineer. Touch-up coating shall be done per the coating manufacturer’s recommendations where needed and as directed to achieve 100% holiday-free surface. Field coating, other than touch up, shall not be permitted.

3. Contractor shall verify electrical continuity of all sections of bolted tank in contact with water prior to commissioning of the cathodic protection system by the cathodic protection system contractor.

4. Leak Testing:

a. Tank hydrostatic leak testing may be completed concurrently with tank disinfection procedure. Contractor shall consult with Engineer for coordination and scheduling of disinfection, leak, and holiday testing activities.

b. Water for hydrostatic testing will be provided by the Owner. Notify the Owner a minimum of two (2) weeks prior to the scheduled hydrostatic testing.

c. Perform Vacuum testing in accordance with AWWA D103 prior to filling the tank.

d. Test completed and cleaned tank for liquid tightness by filling tank to its MWL with water provided by Owner. Completed storage tank shall show no leaks at the end of

24-hour test period. The Contractor shall locate and repair all leaks located below the MWL disclosed by this test in accordance with the manufacturer's recommendations.

i. Correct leaks disclosed by this test.

e. Retesting: If the tank fails to pass the leakage test, the reservoir shall be emptied, repaired, refilled, and retested at the Contractor's expense. Contractor shall submit a leakage repair plan for review and approval. Contractor shall be responsible for supplying new test water or the Owner will charge the Contractor for test water and test water disposal.

f. Contractor shall drain and legally dispose of test water in accordance with Owner's instructions.

5. Disinfection: Tank shall be disinfected in strict accordance with "Section 33 01 11 Disinfection of Water Utility Storage Tanks." Tank may not be placed in service until disinfection has been successfully completed and bacteriological test results have been approved by DDW.

F. Equipment Acceptance:

1. The Contractor shall submit a written report to the Owner of all test results and shall not place into service without Owner approval.

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40 Process Interconnections

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SECTION 40 68 00

PROCESS CONTROL SOFTWARE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Applications Programming Software for PLC. Programming for the PLC is herein referred to as programming controller PLC programming. PLC programming shall be provided by Contractor.

B. SCADA programming for SCADA, SCADA I/O drivers, data access software, and autodialer configuration for the System are herein referred to as SCADA configuration. SCADA configuration will be provided by Others.

1.2 RELATED SECTIONS

A. Section 26 00 00 – Electrical

1.3 SUBMITTALS AND DRAWINGS

A. Provide submittals per Section 16010.

B. Provide the following three separate processor programmable controller (PLC) applications programming software for each processor program:

1. Preliminary Submittal – PLC hardware and software configuration shall be submitted at 10 percent complete level for a preliminary courtesy check by the Owner. This check will not entail a detailed check of all performance features and will not absolve the Contractor of his Contract responsibilities. It is required that the PLC applications software be fully annotated with complete description of control logic, explanation of symbology and convention, including legend list.

2. Formal Submittal - This is the submittal for review per Contract Requirements and is to be submitted after approval by Owner of the preliminary submittal. This submittal shall be approved for basic content (not for correctness of ladder logic code) by Owner prior to start of any PLC factory tests.

3. Final Submittal - This submittal will be part of O & M manual. The software documentation shall be the as-finished records of the formal submittal and other documents used during testing and startup.

C. Ten (10) weeks (minimum) prior to the start of the factory tests, the Contractor shall submit for approval the following software information:

1. Submit PLC software submittal showing the structure of the application programs and the purpose of each module.

    a. English description, flowchart, and index of each major ladder logic program section illustrating subsection of program organization.

    b. Include high level block diagram and English description of PLC file structure.

    c. Include comments for each block of code explaining purpose of individual lines.

    d. Include a listing of all setpoints with their corresponding English description.

    e. Manual shall include complete explanation on the set-up and configuration of the PLC hardware and software.

    f. Include a description of the PLC diagnostic and Ladder Logic programming functions available through the diagnostic computer.

2. PLC software submittal documentation shall include machine printed ladder diagrams and listings. This documentation shall detail the following:

    a. An "Input/Output List," tabulating the module location, terminal points, channel number, address number, point type, point voltage, input/output designation “nickname” and/or number, and a textual description for each item of input and output.

    b. A "Constant Memory Assignment List," tabulating the assigned register name, location number, and textual description for each constant stored in memory.

    c. A "Variable Memory Assignment List," tabulating the assigned register name, location number, and textual description for each variable stored in memory.

    d. A "Cross Reference List" tabulating the rung locations for the usage of each symbol throughout the ladder logic. For each coil, the rung locations for each of its contacts shall be listed. For each input all the rungs in the ladder logic in which it is used shall be listed.

    e. A brief description on a describing all symbols and functions used on the ladder diagram.

    f. A written description of lookup table data for each lookup table. Include the source of data used for each table.

    g. A brief description, on each page of "Special Function" listings, including:

    h. A textual description of input variables and/or constants.

    i. A textual description of output variables and/or constants.

    j. A textual description of the functions.

k. Reference(s) to any specific locations on the ladder diagram listings where the special functions apply.

3. Submittal content shall comply with the following:

a. Listing of all setpoints with proposed initial numeric entry values and corresponding Engineering Units for control strategies. Submit spreadsheet style setpoint list for all pressure, flow, level, timers, etc.

b. Listing of all digital and analog registers, bits, timers etc., their respective description, I/O tagnames, and full addresses for development of factory test screen.

c. Complete commented ladder logic program.

d. Map all analog and digital inputs/outputs including spares.

e. Transfer all data to existing PLC units and SCADA for a complete and operable system. Modify existing PLCs as required for a complete and operable system.

4. The Contractor shall submit for approval the resume of the application programmer listing all relevant experience. Application programmer that does not have relevant experience to this project will be rejected by Engineer and the Contractor shall submit the resume of a qualified application programmer.

D. Original PLC programmer shall be participate in the Factory Test to verify the SCADA screens, PLC program, interface with Motor Controls, etc.

E. Exceptions to the Contract control strategies shall be clearly defined by the equipment supplier. Description of changes shall contain sufficient details so a proper evaluation may be made by the Engineer.

F. The Supplier shall coordinate software submittals with the work so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another.

G. No PLC or SCADA software will be allowed to be installed at the job site until the submittal for such items has been favorably reviewed by the Engineer and witness factory tests have been completed.

1.4 OPERATIONS AND MAINTENANCE MANUALS

A. Submit software Operations and Maintenance Manual per Section 16010.

1.5 MAINTAINABILITY

A. Submit software Operations and Maintenance Manual per Section 16010.

B. Design and code programs to allow the Owner to maintain software over the life of the system. This includes the following requirements:

C. Clearly comment each rung of code. Include module headers detailing the purpose of the module, programmer name, and date of last revision, revision history, and description of sequence of events.

D. Provide an "Input/Output List," tabulating the module location, terminal points, channel number, address number, point type, point voltage, input/output designation “tagname” as shown on P&ID and/or number, and a textual description for each item of input and output.

E. Provide cross reference tables with tagnames and I/O addresses to summarize usage of AIs, AOs, DIs, DOs, setpoints, timers, etc. These tables shall indicate the line numbers where AIs, AOs, DIs, DOs, setpoints, timers, etc., are located with the ladder logic program.

F. Tagnames utilized in PLC programs shall match Contract P&IDs, specifications and Owner standard format. Only tagnames for spare I/O shall be based on location (i.e. PLC5_RIOB_R2_S6_0). PLC tagnames shall be descriptive of actual I/O listing tag description, and corresponding On/Off state.

G. All software, including firmware, diagnostic, configuration, and applications programming software shall be licensed directly to and become the sole property of the Owner for their use on this and future Owner projects.

H. No software or documentation shall be labeled proprietary.

I. Provide complete hardware and software manuals describing how to use the configuration software.

1.6 MEDIUM

A. Provide two (2) sets of PLC applications programs on DVD-ROMs, Windows operating system compatible with each hardcopy software submittal and at the end of the project for as-programmed final documentation for O & M manuals. Each disk shall have a typed label clearly stating the contents, date, filenames, and submittal (i.e., initial or as-programmed final).

B. A hard copy listings of PLC applications programs (with comments) shall be printed with standard laser print 8½" x 11" paper and supplied with the “preliminary” and “final” submittals and for as-programmed final documentation for O&M manuals. Copy and binding method shall not cut off any parts of ladder logic and comments. Print shall be sized so that the complete ladder logic run fits on one sheet, rungs extending to multiple sheets will not be accepted and will be returned without review. Submittal shall include English description of each Control Strategy per Section 26 05 00.

PART 2 - MATERIALS

2.1 APPLICATIONS PROGRAMMING

A. Provide applications programs in the PLC to implement the following control strategies. The contractor is responsible to provide an application program that meets the intent of the descriptions given along with any additional implementations for a fully operational system at no additional cost to Owner. The contractor is responsible for modifying the existing PLC system to meet the intent of these control strategies and to coordinate with the SCADA developer.

B. PLC Software Configuration: The Supplier shall provide the PLC completely configured and programmed for the monitoring and control of the process. The PLC shall be setup as defined herein. The PLC shall be ready to be placed in operation at the time of factory test. The programming, setup and configuration of the PLC shall be done by the PLC supplier. All programming shall be performed by an application programmer with prior experience on similar PLC projects. Owner reserves the right to judge if the application programmer assigned to this project is adequate for the task. If the programming performed is deemed inadequate by Owner, then the supplier shall provide a qualified application programmer to meet these requirements. The application programmer that will be responsible for providing the programming scope is required to submit reference projects and certifications for similar programming projects for Owner's review and approval prior to any programming activities take place.

C. The setup details given for the PLC are intended as guidelines for the supplier to use to configure the system. The setup details were prepared with the available information on the software package and may not be the best way to accomplish the task. Errors and omissions in these details shall be the supplier's responsibility to correct, at no additional cost to Owner (i.e. provide programming for the third level transmitter, similar to the first two level transmitters, when it is shown on the P&IDs, even though it was not explicitly listed in the Control Strategies, etc.). The supplier shall meet the intent of the setup specified, making modifications as necessary to provide an operational system, at no additional cost to the Owner.

D. There are two types of alarms; variable alarms and discrete alarm.

1. Variable alarms are alarms where a variable input (i.e. level, pressure, etc.) has exceeded its predetermined high/low setpoint. Each variable alarm will have a time delay to prevent false alarms and an alarm enable/disable condition.

2. Discrete alarms are alarms where a condition has occurred (i.e. pump fail, etc.). Each discrete alarm shall have a time delay to prevent false alarms and an alarm enable/disable condition.

E. All referenced setpoints shall be displayed and changeable on Operator Interface and SCADA PC.

F. The PLC ladder logic applications program shall meet the intent of the P&IDs on Contract Drawings. The following additional program functions shall be provided (minimum):

1. All setpoints, enable/disables, time delays and registers shall be adjustable from SCADA, and PLC.
2. Display of all analog values.
3. High and Low alarms for all analog values. Provide High High alarms for analog per Owner's request.
4. Automatically call the standby pump when the lead pump is unavailable.
5. Transducer fail alarms for all analog inputs.
6. Enable/disables and settable time delays for all alarms.
7. Scaling (minimum) to engineering values of all variables:
    a. Level in 1/100s feet resolution.
    b. Pressure 1/10s PSI resolution
    c. Flow in 1/100s MGD, 1/10s SCFM, 1/100s GPH or 1s GPM resolution
    d. Flow 1/10s Kgal or 1/100s MG resolution
    e. Speed in 1/10s % resolution
8. Sequential start time delay between similar equipment and pumps.
9. Equipment Fail to start alarm
10. Flow calculations for all flowmeters (today's flow, yesterday's flow, resettable flow, non-resettable flow). The flowmeters shall not totalize until their respective pump is running.
11. Runtime counters for all pumps and mixers (today's hours, yesterday's hours, resettable hours, non-resettable hours) 1/10s hours resolution.
12. Start counter for all pumps and mixers (today's starts, yesterday's starts, resettable starts)
13. Valve operation counter for all isolation valves (today's operation, yesterday's operation)
14. SCADA Auto/Manual and SCADA Start/Stop pushbuttons for all pumps.
15. Pump Sequence selection:
    a. Limit number of equipment running on utility per load calculation table. Standby pump to operate only if lead pump is unavailable.
    b. When equipment have different start/stop setpoints, Operator to select which individual equipment to be lead, lag, lag2, etc. or alternate. (I.e. alternate all, fix Pump 1 as lead and alternate Pump 2 and 3, etc.)

c. Equipment Alternating can be selected either as Time Mode or Last Off:

1) Time Mode: Equipment to alternate when lead equipment has exceeded a settable maximum run timer (X.X hours).

2) Last Off Mode: Equipment to alternate when the lead has stopped.

16. Equipment load shedding while operating on generator.

17. Pump Degreasing – After every 10 pump starts (operator adjustable) disable local low low float shutdown and pump wetwell down for and adjustable time. Low Low float shutdown condition will be reenabled and pumps placed back in normal operation.

18. Local station alarm light to flash on new alarm. Alarm light to change to steady solid when new alarm has been acknowledged. Light turn off when all alarms have cleared.

19. Transfer Plant Influent Flow (F6170) input to sampler control (FI6170) output.

G. Provide a complete PLC program for all new points shown on the P&IDs for the project. The format of this program shall match that of the existing PLC program. Contractor shall make changes to program to meet the intent of that shown on the P&ID diagrams and the following:

1. See Control strategies listed in general appendix.

2. All alarms shall originate from the PLC code. No alarms shall originate from the SCADA.

2.2 CONTROL STRATEGIES

A. Provide applications programs in the PLC to implement the control strategies specified herein. The Contractor is responsible to provide an application program that meets the intent of the descriptions given along with any additional implementations illustrated on P&IDs for a fully operational system at no additional cost to the Owner.

B. Global strategies are typical strategies for similar pieces of equipment/instruments. The tagnames, registers, setpoints, etc. for that equipment/instrument shall follow the referenced strategy's format, but shall be modified accordingly for the referenced equipment/instrument.

C. Each control strategy that utilizes an analog process variable for purposes of start/stop, on/off or PID/proportional control shall be assigned registers for simulating the process variable along with a test bit to enable switching between the real process variable and the simulated process variable. Program logic shall be setup such that if the real process variable hits an abnormal condition (i.e. a high wetwell level float); the process variable automatically is switched from test mode back to the real value to insure that process variable is not inadvertently left in test mode.

CONTROL STRATEGY INDEX	
CS#	Title
400	Wallan Pump Station
500	Alderpoint Pump Station

D. Control Strategy 400 – Wallan Pump Station

1. General

a. The pumps are used to pump water into the Wallan Tank. The two pumps operate in lead / standby configuration and alternate operation.

2. Calculations

a. Provide flow calculations as described herein.

3. Controls

a. Wallan Tank level is transmitted via radio to the Wallan Pump Station.

b. Automatic Remote: In automatic control:

1) The lead Pump shall be started by the PLC when the Wallan Tank Level is below the Pump's Lead Pump Start Level setpoint.

2) The lead Pump will be stopped by the PLC when the Wallan Tank Level rises above the Lead Pump's Stop Level setpoint.

3) Similar for Lag Pump.

4) Lead pump shall start automatically on low low discharge pressure and stop on Lead Pump's Stop Pressure Setpoint.

c. Interlocks:

1) The Pump (s) shall be automatically stopped under any of the following conditions:

a) Pump Alarm is active

b) Low Low Suction Pressure

c) High High Discharge Pressure

d) High High Wallan Tank Level

4. Alarms – No additional alarms

E. Control Strategy 500 – Alderpoint Pump Station

1. General

a. The pumps are used to pump water into the Zone 1A/1B Distribution and Alderpoint Tank. The two pumps operate in lead / standby configuration and alternate operation.

2. Calculations

a. Provide flow calculations as described herein.

3. Controls

a. Pump Automatic Remote: In automatic control:

1) The lead Pump shall be started by the PLC when the discharge pressure is below the Pump's Lead Pump Start Pressure setpoint.

2) The lead Pump will be stopped by the PLC when the discharge pressure rises above the Lead Pump's Stop Pressure setpoint or when lead pump is operating a minimum speed too long.

3) Pump shall modulate to meet desired discharge pressure setpoint.

4) If lead pump is running at maximum speed past desired length of time, start lag pump.

5) The lag Pump will be stopped prior to the Lead pump by the PLC when the discharge pressure rises above the Lead Pump's Stop Pressure setpoint or when pump are operating a minimum speed too long.

6) Lead pump shall start automatically on low low discharge pressure and stop on Lead Pump's Stop Pressure Setpoint.

b. Interlocks:

1) The Pump (s) shall be automatically stopped under any of the following conditions:

a) Pump Alarm is active

b) Zone 1A MOV is not fully closed.

c) Low Suction Pressure Alarm.

d) High High Discharge Pressure

e) High Pressure Tank 1 Pressure

c. Zone 1A MOV Automatic Remote: In automatic control:

1) When pumps are off, MOV shall be called to open.

2) When

3) The lead Pump will be stopped by the PLC when the discharge pressure rises above the Lead Pump's Stop Pressure setpoint.

4. Alarms – No additional alarms

PART 3 - EXECUTION

3.1 SOFTWARE DEVELOPMENT

A. General Programming

1. The program structure shall utilize a main program file, subroutine files, a fault routine file, and an I/O configuration control file.

2. Program logic shall be separated by function into subroutine files. The main program file shall execute subroutine calls as required to properly implement the control strategy. The following functions should be implemented in separate subroutine files:

   a. Analog and discrete input processing.

   b. Analog and discrete output processing.

   c. Pump monitor and control

   d. Miscellaneous monitor, alarm and control.

   e. Alarm processing

   f. Supervisory control and data acquisition communications.

   g. Generate typical communication fails between new and existing PLC based on Owner PLC Standard

3. The fault routine file shall be executed immediately after the system is powered up and in response to major faults, providing a programmed response to these conditions and report to SCADA, the type of fault.

4. Analog input out-of-range conditions shall be monitored and alarmed by the relay ladder logic.

5. All program rungs shall be commented clearly. The first rung comment of every file should include a brief description of the program file function in addition to the rung comment.

6. All program instructions shall be commented clearly.

7. Memory locations specifically for displaying at SCADA shall be commented with the item description + "for SCADA". Analog data shall include the scaling used by the analog module as part of the comment (e.g., Flow 1 (0-2000, raw) for SCADA).

8. The ladder diagrams shall be provided as specified herein.

B. Analog Input & Output I/O Processing:

1. Data Format shall be read from the module in two's complement data format.

2. Scaling shall be accomplished within the module setup for all analog inputs and outputs in engineering units. (e.g., 0-200 E.U. = 0-2000 raw data).

3. All internal setpoints used in conjunction with analog data shall incorporate the same scale.

4. Physical I/O addresses (i.e. I:001/00 for a digital input) shall be placed on their corresponding loop and elementary diagrams.

5. The data out-of-range bits provided by the analog modules shall be utilized for alarming purposes within the ladder program.

C. PLC Memory Register Design

1. To maximize the efficiency in which data is transferred between PLCs and between PLCs and the SCADA, the ladder logic program shall be designed to use contiguous memory locations within the PLC. This may include but is not limited to moving data such as discrete I/O into 16-bit integer words.

2. Efficient use of bit instructions shall be used in place of word logic whenever possible to reduce memory usage.

D. Before beginning SCADA software development, meet with the Owner for a four-hour Design Definition Meeting at the Owner's facility.

1. Ensure that the Contractor Project Manager, System Supplier Engineer, System Integrator PLC software programmer, SCADA Developer, Engineer & Owner are in attendance.

2. Discuss SCADA & PLC format, programming and setup requirements to ensure that parties involved have a clear understanding of the Contract requirements. This discussion is to cover graphic screen layout, color conventions, text display menu system, PLC ladder logic etc.

3. System Integrator to provide schedule for Preliminary Design Review and Critical Design Review.

4. Verify units of measurement (i.e. gpm) with Owner for each analog input.

5. Confirm alarms and conditions that require autodialer callout.

E. Meet with the Owner for a 4-hour SCADA & PLC Preliminary Design Review meeting at the Owner's facility each process area.

1. Ensure that the Contractor Project Manager, System Supplier Engineer, System Integrator PLC software programmer, SCADA Developer and Engineer & Owner are in attendance.

2. Provide SCADA & PLC software preliminary design submittals for review and discussion 10 working days prior to meeting.

3. SCADA Developer to demonstrate SCADA screen color and graphic layout to Owner and PC loaded with SCADA graphics to the meeting.

4. System Integrator by bringing a configured PLC loaded with latest application software to the meeting.

5. System Integrator to demonstrate complete understanding of PLC control sequence of operations and setup.

6. System Integrator to assign action items with required completion date. Contractor to submit report of completed action items to the Owner on or before designated date.

F. Meet with the Owner for a 4-hour SCADA & PLC Critical Design Review meeting at the Owner's facility prior to start of any factory test each process area.

1. Ensure that the Contractor Project Manager, System Supplier Engineer, System Integrator PLC software programmer, SCADA Developer and Engineer & Owner are in attendance.
2. Provide preliminary SCADA & PLC Software Operations and Maintenance Manual.
3. SCADA Developer to demonstrate complete SCADA setup with System Integrator PLC software programmer to Owner.
4. System Integrator to demonstrate the complete PLC setup. All station display and setpoint parameters will be checked for completeness by bringing PC and PLC both fully programmed & setup to the meeting.
5. SCADA Developer to demonstrate all SCADA screens for review and comment.
6. Demonstrate that all software correctly implements the sequence of operations and control strategies.
7. System Integrator to assign action items with required completion date. Contractor to submit report of completed action items to the Owner on or before designated date.

G. The Contractor shall include in his bid price an additional 80 hours of PLC, and other program changes to be designated during testing and start-up by the Owner. Programming changes made during factory testing shall not be deducted from these hours unless agreed upon by Engineer. Field program changes shall be made by original programmer within five (5) working days after notification in writing by Engineer. All programming configuration changes shall be performed by the original programmer and shall be made as directed by the Engineer in writing. A weekly report shall be prepared by System Integrator listing extra hour utilized, dates when work was done, description of work performed, and remaining number of extra hours. None of the hours shall be used for documentation, paperwork, travel, overhead, construction management, etc. that are not related to programming changes since this is included in the hourly rate without written approval from Engineer. All hours not used shall be allocated for additional program changes as directed by Owner during the one year warranty period.

H. No passwords shall be enabled on PLC software or hardware developed for this project. All electronic disk copies provided to Owner shall not have any password protection enabled on them or the software. Software submitted with password protection will be removed by Owner and the Contractor will be backcharged for the cost thereof.

I. It is the System Integrator’s responsibility to obtain PLC configuration software, licenses, manuals, and disks necessary for the System Integrator to program and configure the PLC. Owner’s configuration software, manuals and disks shall not be available to the System Integrator for use.

J. Contractor shall modify PLC analog input ranges and setpoints, from those listed in Section 26 05 00 Appendix “C” PLC I/O List, at the direction of the Engineer/Owner to match operating conditions at no additional cost to the Owner.

K. System Integrator PLC software programmer and electrician shall be scheduled for at least one (1) day on-site prior to Final Acceptance to address any and all PLC, wiring issues, and minor modification of station control & Central interaction.

3.2 WARRANTY

A. Hardware and Software Support:

1. The System Integrator shall have a staff of experienced personnel available to provide service in 1 working days’ notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the hardware and software delivered; and of implementing corrective measures.

2. If the System Integrator "fails to respond" in 2 working days, the Owner at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. "Fail to respond" shall be defined as: The Contractor has not shown a good faith effort and has not expended adequate resources to correct the problem. The use of other resources, as stated above, shall not change or relieve the Contractor or Supplier from fulfilling the remainder of the warranty requirements.

B. Software support which shall be provided by the Supplier:

1. Free technical PLC software and hardware configuration phone support for a period of one year after acceptance of project completion. PLC phone support shall be provided directly from the group that configured the PLC. Phone support shall be available between 8 a.m. and 5 p.m. Pacific Standard Time Monday through Friday.

2. The Supplier shall correct any PLC software configuration error that is discovered within the warranty period, at no additional cost to Owner. Updated documentation for each "operation and maintenance" manual and two sets of new DVDs of updated software shall be provided for each correction.

3. Program changes made by Owner or under direction of Owner by others shall not relieve or void Contractor of warranty requirements for parts of software programmed under this Contract.

C. Each time the Supplier's repair person responds to a system malfunction during the warranty period, he or she must contact the designated Owner maintenance supervisor for scheduling of the work, access to the jobsite, and permission to make repairs. Operation of facilities necessary to test equipment shall only be performed by or under the direction of Owner staff. Owner reserves the right at its sole discretion to deny operations requested by the Supplier. A written description of all warranty

work performed shall be documented on a field service report to be given to Owner prior to the repair person leaving job site. This field service report shall detail and clearly state problem, corrective actions taken, additional work that needs to be done, data, repair person name and Owner.

D. Provide warranty as specified in Section 26 00 00 – Electrical, WARRANTY.

3.3 TRAINING

A. Training shall be provided as specified in Section 26 00 00.

END OF SECTION

SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide all devices, wiring, terminal blocks, accessories, and enclosures as specified herein and as shown on Contract E-Series Drawings for the instrumentation system. The Contract Documents are intended as an outline for the work and are descriptive of the type of hardware and software configuration to be provided. Any error or omission of detail shall not relieve the Contractor from the obligations thereunder to provide and install in correct detail any and all materials necessary for a complete operational instrumentation system, at no additional cost to the Owner.

B. The major components in the instrumentation scope of work are:

1. Provide/install instrumentation system as shown, and specified herein and in Division 26 and 40 and shown on Contract I-Series Drawings.
2. Supply and install the processor logic controller (PLC) system specified in herein.
3. SCADA Central PC (OI) graphic and programming additions.
4. The System Supplier shall provide all instrumentation and devices as listed in Appendix "A" Device (Instrument) Index for this Section 40 70 00. Instrumentation devices may not be shown on Mechanical Drawings. All instrumentation devices shall be provided and installed by the Contractor at the locations in the process as shown on the Contract I-Series Drawings. It is the Contractor's responsibility to install all new instruments per manufacturer's installation requirements even if not specifically shown on the Contract Drawings.
5. All necessary piping and valves to complete installation.
6. Instrument supports and enclosures per Contract Drawings E-Series details.

C. The contract documents are not intended to cover every detail of materials, software, hardware, configuration, or construction. The Contractor shall furnish all tools, temporary utilities, materials, setup, parts, labor, and other incidentals necessary to fully complete the entire work, whether or not said details are particularly shown or specified, all at no additional cost to the Owner.

D. Ranges for instruments shall be as shown on Device (Instrumentation) Index in Appendix "A" or as marked-up during Submittal. Process setpoints will be provided by Owner during Submittal process, testing, and startup.

E. All equipment, hardware, and software shall be licensed to the Owner. Contractor shall provide all programming cables, interconnecting cables and software licenses for all PLC and VFD to the Owner Staff as part of start-up. Licenses shall be made in Owner's name.

F. It is the System Supplier's responsibility for obtaining instrumentation transmitter configuration software, manuals, USB drives and disks necessary for the Contractor to program and configure the instrumentation transmitters.

G. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the instrumentation equipment provided under other Sections. The following shall be done by the Contractor at no additional cost to the Owner:

1. Provide additional devices, wiring, conduits, relays, isolators to complete interfaces of the instrumentation system.
2. Changing normally open contacts to normally closed contacts or vise-versa.
3. Adding additional relays to provide more contacts as necessary.
4. Provide junction boxes to accommodate the conduit and wires shown in the Conduit & Wire Routing schedule at no additional cost to Owner.
5. Provide all necessary miscellaneous shut off, sample, and calibration valves to sensors.

1.2 RELATED WORK

A. Installation of primary elements which require placement into or taps off of a process flow line are included under other Divisions. Electrical equipment interface and conduit for instrumentation is covered in Section 26 00 00 Electrical. All of the wiring and component requirements of Division 26 & 40 apply to this Section.

1.3 SUBMITTALS

A. Provide submittals and drawings as specified in Section 26 00 00 - Electrical, SUBMITTAL AND DRAWING REQUIREMENTS.

B. Submit for approval a mounting, piping, and valving detail drawing for each instrument. These drawings shall be dimensioned, drawn to scale with a material list of all components and supports.

C. Contractor shall submit letter listing all flowmeter element (FE) pipe sizes, flange types, and ANSI ratings signed by Contractor and System Supplier to certify coordination for proper installation prior to flow elements being purchased.

D. Submit load calculations of all connected 24VDC loads listed individually in a spreadsheet showing UPS run time with all UPS listed loads in operation.

1.4 OPERATION AND MAINTENANCE MANUALS

A. Provide operating instructions as specified in Section 26 00 00 - Electrical, OPERATION AND MAINTENANCE MANUALS.

1.5 DEVICE INDEX

A. The Device Index spreadsheet in Appendix “A” is a tabulation of the major pieces of instruments required for this project.

PART 2 - PRODUCTS

2.1 QUALITY

A. It is the intent of the Contract specifications and drawings to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. Provide the manufacturer’s latest design that conforms to these Specifications.

B. Quality included that specified in Section 26 00 00 – Electrical.

C. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting or operator interaction when power is restored.

D. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, sourced by a 24 VDC loop supply from the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.

E. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission.

2.2 CONDUCTORS AND WIRE MARKERS

A. Conductors and wire markers shall be as specified in Section 26 05 19 – Low Voltage Electrical Power Conductors & Cables.

2.3 CONTROL PANEL

A. Control Panels shall consist of the PLC system, operator interface, power supply, radio, and other devices for a complete and operational system. No equals are allowed for Control Panel components since they are required to match Owner standards.

1. Programmable Logic Controller (PLC) to be Allen-Bradley (AB) MicroLogix, provided with to meet the I/O as shown on Contract drawings (plus 25% spare):
    a. Processor – 2080-LC50-48AWB
        1) 28 each 120VAC digital inputs
        2) 20 relay outputs
        3) Built-in RJ45 Ethernet connector port, programming port & RS-232 serial port.
    b. 24VDC Power Supply
    c. Power supply terminal blocks.
    d. Digital Input card: 8 channel digital input card 2085-IA8, 120VAC.
    e. Analog Input card: 8 channel analog input card 2085-IF8, 4-20mA.
    f. Analog Output card: 4 channel analog input card 2085-OF4, 4-20mA.
    g. Place covers over all unused slots.
    h. PLC End Cap.
    i. All wiring from the control unit terminals shall be wired to interface terminal blocks, including all spares. Direct field wiring to PLC I/O cards and other control panel devices is not allowed.
    j. See I/O List in Appendix "C".
2. Operator Interface:
    a. Provide Operator Interface (OI) Automation Direct (C-More) EA9-T7CL-R, 7" TFT Color Touchpanel system, or approved equal. OI to be panel mounted through cutout in Control Panel door. Provide all cables, configuration software, user manual and mounting hardware necessary for a complete and operable system.
    b. Provide an operator interface that meets the following requirements:
        1) Touch screen operator interface with built-in serial, Ethernet Communication Port, USB port (2) and memory card slots (2).
        2) Operator interface with 7" TFT color liquid crystal display with analog resistive NEMA 4X touch screen.
        3) 24VDC powered
        4) Compatible with Allen-Bradley MicroLogix.
        5) Operator terminal capable of setup using standard PC.
        6) Full programming software to be licensed and delivered to Owner.
    c. Graphic format shall match that of existing screens supplied by Owner.

B. PLC program for operation for station shall follow the Owner Standard.
1. Provide alarms for all instruments that differ from standard program.
2. Any software developed for this project shall be non-proprietary.

3. Modify existing OI applications screens to incorporate any new PLC applications program modifications. Graphic format shall match that of existing screens supplied by Owner.

4. Group all telemetry tables together for efficient data transfer to SCADA Central. Submit proposed communications data tables in Excel format for approval by Owner.

5. Top of Operator Interface, pilot devices, etc. shall be maximum of 66" above finished floor.

C. Miscellaneous Devices

1. Provide terminal blocks, fuses, nameplates, pushbuttons, selector switches, indicating lights, relays and timers as specified in other Sections of Division 26 and 40.

2. Ethernet Switches shall be provided for PLC system as shown on Contract Drawing SCADA block diagram. Ethernet switches shall be have 6 ports (unless otherwise noted), 10/100 Base T. Managed Ethernet switches shall be N-Tron 700-Series, to match Owner standard.

3. Ethernet cables from outside Control Panel shall land on surface mounted Ethernet jacks, Panduit, Leviton or approved equal. Provide patch cable between surface mounted Ethernet jack and Ethernet switch.

4. Connection between Ethernet Port and Ethernet hub shall be made with Cat 6 patch cable. Patch cable shall be 4 pair stranded PVC cable with HI-FLEX conductors. Length shall be 5 feet minimum. Color of cable shall be red.

5. Receptacle to be duplex and rated 20 amps, 120 VAC, 2 pole, 3 wire grounding, NEMA 5-20R configuration, specification grade, and side wired to screw terminals.

6. DC Power Supplies:

   a. The DC power supply shall use a "linear" type power conversion. "Switching" type power supplies are not acceptable. The 12 & 24 VDC power supplies shall be capable of providing a minimum amperage as shown on Contract Drawings and not over 50% loaded. Submit load calculations of all connected 12VDC & 24VDC loads showing power supplies are adequately sized.

   b. All power supplies shall be U.L. recognized.

   c. Provide Redundant Switching DC power supplies with switching module, rated per Contract drawings at 24VDC, Eaton, Mean Well, or approved equal.

7. RFI filters to be for power line radio frequency protection, CORCOM VK series or approved equal.

8. Ethernet patch cables shall be labeled with primary devices it is connected to (i.e. "PLC", "OI", "RADIO", etc.).

9. The 120 VAC power feed to all Uninterruptible Power Supplies (UPS) shall be fed through an RFI power line filter. Size equal to or larger than amp rating of the power source fuse. The filter shall remove line-to-ground and line-to-line noise present in the power feed. The filter shall effectively remove pulsed, continuous, and/or intermittent RFI interference. The filter shall be a Corcom "K" Series or approved equal.

10. Uninterruptible power supply:

    a. The Uninterruptable Power Supply (UPS) to provide VA shown on Contract drawings (minimum) backup power upon power failure to the 24 VDC power supply, Operator Interface (OI), 120VAC powered instruments & displays, and the processor logic controller (PLC) and PLC I/O cards in the Control Panel for 15 minutes (minimum).

    b. Mount UPS in control compartment and provide all necessary power wiring. Plug cords and receptacles shall be provided so that the UPS can be readily bypassed with power being obtained directly from the panelboard.

    c. UPS to have temperature rating compatible with expected internal enclosure temperature. Provide enclosure with adequate ventilation fans or AC unit to keep enclosure internal temperature within UPS temperature rating.

    d. UPS to be APC Smart-UPS, Allen-Bradley, Marathon or approved equal.

11. Isolator shall provide complete isolation of the 4-20 mA output signal from the input signal and isolator power supply. Each isolator shall have all solid state circuitry mounted in a plug-in module. The 4-20 mA output signal shall be capable of driving a 600 ohm load. Both accuracy and linearity shall be +/- 0.10% of span. The isolator shall be powered as shown on Contract Drawings. Each isolator shall be as manufactured by AGM Electronics, Action Instruments, or approved equal.

12. Autodialer

    a. Autodialer to be a Raco Alarm Agent, Sensaphone Sentinel, Bentek Systems Protalk Alarm Dialer CV3 or approved equal.

    b. Autodialer shall monitor 8 digital inputs and two analog 4-20mA loops) and send phone, or text alarms via cellular connection.

    c. Autodialer shall have 4 call out directories and 16 phone numbers per directory.

    d. Allow remote interrogation of status of inputs and outputs,

    e. Full-length user-recordable messages for each input and output.

    f. The Supplier shall program the Autodialer as directed by Owner during startup. Cell phone service associated with autodialer shall be field verified to confirm coverage acceptable to Owner.

D. Provide metal data pocket within each enclosure to hold as-built drawings.

E. Top of operator interface (pilot devices / breaker) to be maximum 66" above finished floor.

2.4 I/O RADIO SYSTEM

A. I/O Radio System

1. Wireless I/O radio modem shall be unit-directional with transmitter and receiver units factor-configured as a matching pair. Units shall have secure data encryption, 10-30VDC, 900MHz, Unit shall have four digital inputs, four digital contact outputs, two analog inputs and two analog outputs. Radio shall be din rail mounted, and have SMA connection.
2. Unit shall have the two LEDs indicating status or faults.
3. Mated I/O Radio shall be Banner DX80K9M6-PM2 to match Owner standard.
4. Third I/O Radio shall be Banner DX80N9X6S-PM2 to match Owner standard.
5. Radio shall be configured by Contractor with parameters provided by Owner.

B. Antenna

1. Each antenna system shall be furnished and installed complete and functional for the intended use. An antenna system shall include but not be limited to, antenna, antenna pole, mounting hardware, lightning arrestor, and coaxial cables with connectors.
2. Antenna system shall meet the following specifications:
   a. Antenna shall be installed and supported as shown on the Contract Drawings. Support members shall have sufficient strength to withstand local wind conditions and shall be protected from sun exposure and corrosive chemical damage.
   b. Support hardware such as clamps, orientation mounts, and offset brackets shall be steel protected with a hot dip galvanized finish or stainless steel. Clamps and mounts shall be heavy duty in order to transfer the full antenna load to the support tower or mast. Bolts and screws shall be stainless steel.
3. The directional radio antenna shall be SCALA 3dB Yagi TY-900, or approved equal.
4. The omni directional radio antenna shall be L-Com 900MHz 3dB, or approved equal.

C. Transmission Cable

1. Provide per terminated coaxial cable from lightning arrestor to antenna. The coax cable shall be compatible with radio. The coax cable shall be super flexible, with a minimum bending radius of 5 inches. The cable shall be installed as one continuous length from the antenna to the flange mounted lightning arrestor. Use Cooper Industries CC3-SMA, Times Microwave Systems coax cable, or approved equal.

2. A backpan mount antenna lightning “N” connector arrestor shall be furnished on the antenna coaxial transmission line. The lightning arrestor shall be grounded to the panel ground bus with a #8 AWG or larger bonding wire. The lightning arrestor shall be a PolyPhaser IS-50NX-C2 or approved equal.

3. Provide miscellaneous hardware such as grounding kits, hanger kits, and feed through assemblies.

4. The cable shall be carefully installed to prevent damage to the jacket and routed with a minimum bending radius of 8 inches.

5. Provide connector weatherproofing kits for outdoor exposed connectors and grounding strap attachments. All mating connectors that are exposed to weather shall be wrapped with a sealing material designed to protect against water and dirt entry into the connectors.

2.5 FIELD DEVICES

A. Submersible Level Transmitter

1. Submersible level probes to be range shown in Instrument Index with minimum accuracy of ±1%. Transmitter shall be provided with a 3” 316 stainless steel sensing diaphragm with dual internal diaphragm. Transmitter shall be 4-20 mA output loop powered.

2. Transmitter shall be 35°F to 125°F compensated.

3. Provide hydrophobic filter on the air tube mounted inside the panel. The filter shall be same manufacturer as the submersible level transmitter.

4. Contractor is responsible for determining final manufacturer cable length.

5. Submersible level transmitter shall be Blue Ribbon Birdcage BC001, Druck or approved equal.

B. Level Switching Devices

1. Each level switch shall utilize a Polypropylene float which moves with liquid level to actuate a hermetically sealed (non-mercury) microswitch. The level switch shall have Form “C” contacts with a minimum electrical with switch rating of 16 Amp at 120VAC. The float switch cable shall be secured with stainless steel straps. The level switch shall be MJK7030, Danfoss 7030, or approved equal.

C. Level Cable Supports

1. Provide six hook stainless steel mounting bracket for supporting level instruments to level wall, USA Blue Book 47715 or approved equal.

2. Provide stainless steel cable strain relief clamp/ hanger for each float switch, submersible level sensor, bubbler tubing, etc. USA Blue Book 35AKL801VA or approved equal.

D. Pressure Indicating Transmitter

1. The sensor module:

   a. The pressure transmitter shall incorporate a high-accuracy capacitance sensor. With this sensor, process pressure is transmitted through the isolating diaphragm and fill fluid to the sensing diaphragm in the center of the capacitance cell. Capacitor plates on both sides of the sensing diaphragm detect its position. The differential capacitance between the sensing diaphragm and the capacitor plates shall be directly proportional to process pressure.

   b. The transmitter shall incorporate a temperature measurement to compensate for thermal effects.

   c. The pressure transmitter electronics shall convert the capacitance and temperature input signals directly into digital format for further processing by the electronics module.

   d. The pressure transmitter shall have the HART communication superimposed on the device, which uses an industry standard Bell 202 Frequency Shift Keying (FSK) technique.

   e. Configuration data shall be stored in nonvolatile EEPROM memory in the electronics module of the transmitter.

2. Software functionality:

   a. The PC base HART protocol software shall be provided.

   b. Configuration: The transmitter shall be configured by the System Supplier. Configuration shall consist of operational/parameters and informational data.

   c. Test: The pressure transmitter shall perform continuous self-tests.

   d. Format: The format function is used during the initial setup of a transmitter and for maintenance of the digital electronics.

   e. Requirements:

Output:	Two-wire 4-20 mA output. Digital process variable superimposed on 4-20 mA signal.
Power Supply:	External power supply required.
Indication:	4-digit LCD meter.
Zero Elevation and Suppression:	Anywhere within the sensor limits.
Overpressure Limits:	Limit is 0 psig to 3,626 psig (25 Mpa) without damage to the transmitter.
Temperature Limits:	Process: 0° F to 185°F (-18° C to 85°C) Ambient: -4°F to 175°F (-20° C to 80°C).
Humidity Limits:	0 – 100% relative humidity.
Accuracy:	±0.075% of span for spans from 1:1 to 10:1 of URL.

Stability:	±0.2% of URL for 12 months.
Isolating Diaphragm:	316SS, glass filled PTFE, silicone fill
Process-Wetted Parts:	Isolating Diaphragms: 316 SST.
	Drain/Vent Valves: 316 SST.
	Flanges: 316 SST.
	Wetted O-rings: Glass-filled TFE.

3. The pressure transmitter shall be Rosemount Smart family 3051TG (rated for 300PSI regardless of scaling), to match Owner standard.

E. Pressure Switch

1. Pressure switch shall be a rated minimum of 15 amps @ 120VAC. Pressure switch shall consist of a pressure sensing mechanism and the switch itself enclosed in a NEMA rated housing with ranges as listed in the Pressure Device Index. Pressure switch shall be of the bourdon tube type with stainless steel wetted parts and mechanical snap switch (mercury switches not acceptable). Pressure switch shall be equipped with two independent setpoint adjustments (trip & reset setpoints) settable from exterior of unit. Pressure switch shall have transparent viewing window for visible on-off operation. Switch shall have two tamperproof setpoint adjustments with setpoint indicator calibrated in engineering units. Pressure switch shall be UL listed. The pressure switch shall be Dwyer Mercoid Control DAW series; Square "D" 9012 or approved equal.

F. Magnetic Flowmeter

1. Flange connections shall be ANSI Class 150 as required by mechanical Drawings. Flanges shall be coordinated with Contractor installing piping.

2. Stainless steel grounding rings shall be provided at both ends of the flow tube when required by the manufacturer. The tube internal liner material shall be polyurethane, unless recommended otherwise by the manufacturer for the application and approved by the Owner. Electrode material shall be 316 stainless steel and shall be flush type. The meter shall incorporate a high impedance amplifier of 100,000 Megohms or greater, eliminating the need for electrode cleaning systems.

3. The converter electronics shall be mounted remotely as shown on Contract P&ID Drawings. The converter shall be microprocessor controlled, utilizing digital signal processing with automatic zero correction to provide a linear 4-20 mA signal proportional to the forward and reverse flow rate specified and switched output for flow totalization pulses. Electronics shall provide and control output rated for 24VDC switching for remote monitoring of forward or reverse flow indication. Rangeability shall be field adjustable over a 100 to 1 range. Field adjustable signal dampening shall be provided. Low flow cutoff shall be provided to eliminate flow transients when no flow is present in the pipe. A rate indicator and totalizer scaled in engineering units shall be provided and shall be viewable on a LCD display(s) through a clear window in

the enclosure. The converter shall have self-diagnostics which constantly check for proper operation. If a failure occurs, a fault indication shall be provided to notify the operator of a problem. The converter shall contain a self-test mode to allow the operator to manually simulate the output 4-20 mA signal to any value between 0% and 100% to check out any driven devices in the loop. The converter shall be rated to operate in an ambient temperature range from -4°F to 131°F.

4. The converter electronics shall be designed for operation from a power source of 24 VDC, with a power consumption of less than 24 watts.

5. When converter electronics are shown to be mounted remotely, additional special cabling without any splices (Cabling between flow element and remote mounted flow indicating transmitter), mounting hardware, and devices necessary to complete the installation shall be provided by the manufacturer at no additional cost to the Owner.

6. Electronics shall be provided in NEMA rated enclosures specified in Instrumentation and Device Index.

7. The meter shall be hydraulically calibrated at a facility located in the United States and the calibration shall be traceable to the National Bureau of Standards. A certified copy of the calibration test results shall be submitted to the Owner prior to shipment of the meter.

8. The accuracy of the complete metering system including flow tube and converter electronics shall be 0.25% of rate over the range settings of 0.033 to 33 feet per second. Variations in temperature, voltage, and frequency within the ranges listed herein shall not affect the accuracy in excess of 0.5% of flow rate. Where shown, the flowmeter shall be accidental submergence proof for forty-eight house under 30 feet of water. Conduits between flowmeter element and electronics shall be sealed to retain submergence rating per flowmeter manufacturer's requirements.

9. The flow meter shall be ABB Water Master with remote signal converter/indicator unit, Danfoss, or approved equal.

G. Intrusion System

1. Each intrusion door switch shall have a wide gap magnetic sensor with S.P.D.T. contacts mounted in a rugged steel housing with a 3 foot stainless steel armored cable for wiring to a junction box. Intrusion door switches shall be Sentrol 2507-A or approved equal.

2.6 SOLAR POWER SYSTEM

A. Provide solar power system complete with all cables and mounting hardware. All miscellaneous solar power system accessories shall be provided and installed by the Contractor for complete and operational system.

B. Solar Equipment

1. Photovoltaic (PV) modules shall be 50W, 12VDC nominal with cells beneath low iron glass. Module shall be provided with bypass diodes and plug and sockets pre-installed. Modules shall be provided with quick connectors. Module shall be U.L. listed, Solarland with quick connectors, SunPower or approved equal.

2. Batteries shall be 12V, 50AH, deep cycle Concorde PVX, or approved equal. Batteries shall be placed in a non-corrosive battery rack. Batteries shall be sized for 10 days (240 hours) of backup.

3. Solar Panel Mounting: Solar panels shall be securely mounted on a single pole (double row) support system. System shall utilize welded steel components and stainless steel mounting modules. Provide additional hardware as necessary for a complete and operable system. Mounting system shall be Unirac 400230, Performed Line Products Universal Top of Pole Mount, Direct Power and Water (DPW), Iron Ridge or approved equal.

4. Photovoltaic (PV) charge controller with temperature compensation. Unit shall have a status and 3 stages of change LEDs. Charge Controller shall be Solperk Model HC-F10A, Morning Star or approved equal.

5. DC disconnect switches shall be heavy duty, 3 wire, NEMA 3R, padlockable handle, side opening, UL98 listed, rated for 600V. DC disconnect shall be Eaton, Square D, GE, or approved equal.

2.7 TUBING, FITTINGS AND VALVES

A. Instrument Tubing, Fittings, and Valves

1. Tubing

   a. Seamless 316 stainless steel.

   b. Fully annealed.

   c. Maximum hardness: 80 Rb.

   d. Free from surface scratches and imperfections.

   e. Diameter: 3/8-inch minimum outside diameter (OD) unless specified otherwise.

   f. Wall thickness:

      1) Minimum 0.035 IN for 3/8-inch OD tubing.

2. Fittings

   a. Flareless.

   b. Compression Type.

3. Valves

   a. All shutoff, calibration and sample valves shall be 316 stainless steel with construction rated for its application.

4. Supports

a. Instruments shall be supported independent of connecting piping and valves.

b. Support Angles: 2 x 2 IN stainless steel channel.

c. Tubing Tray or Channel: Aluminum.

d. All hardware shall be stainless steel.

B. Acceptable Manufacturer

1. Subject to compliance with the Contract mechanical specification sections, the following manufacturers are acceptable:

a. Parker CPI.

b. Swagelok.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All instrumentation work in this contract shall conform to the codes and standards specified in Section 26 00 00 - Electrical.

B. The Contractor shall employ personnel who are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to the Owner.

E. The Owner reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

F. Rejected equipment or equipment without approved submittals shall be immediately removed from the delivery or job site by the Contractor.

G. All Manufacturers' instructions are to be followed. One copy of O&M and installation instructions shall be made available to the Owner when equipment is first being installed.

H. All instruments installed by the Contractor shall be in accordance with the Drawings and the manufacturer's recommendations & instructions and shall operate to the Owner's satisfaction. Follow all manufacturer's instructions for handling, receiving, installation, and pre-check requirements prior to energization. After energization, follow manufacturer's instructions for programming, set-up and calibration of

equipment. The Contractor shall be responsible for, and shall correct by repair or replacement, at his own expense, equipment which, in the opinion of the Owner has been caused by faulty mechanical or electrical assembly by the Contractor. Necessary tests to demonstrate that the operation of the instruments is satisfactory and meets the requirements of these Specifications shall be made by the Contractor.

3.2 INSTALLATION

A. General: Install and supply all products necessary, at no additional cost to the Owner, to provide an operational system. This shall include the following:

1. Contract Drawings are intended to show the basic functional requirements of the instrumentation system and do not relieve the Contractor from the responsibility to provide a complete and functioning system.
2. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the proper interface.
3. Provide analog loop isolators where required to eliminate "ground loops."
4. All wires shall be identified with machine printed labels. Plastic wire gutters shall be used for routing of wire bundles. Wiring shall be neat and laced with plastic tie wraps.
5. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings or as approved by the Owner. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.
6. Engineering scales and charts for all instruments shall be provided that match the range of instruments that monitor the process.
7. Power to instruments and instrument loops shall be from a single source if possible providing the highest integrity: e.g., from the loop primary receiving instrument/module, or from a UPS when so specified. A loop shall not be dependent on a diversity of multiple power sources.

B. Instrument Installation Methods

1. Install instruments at the location shown on the Plans or approved by the Owner. Instruments shall be NEMA rated for the installed location.
2. Install instruments per manufacturer’s instructions at all times. Provide a copy of manufacturer’s installation requirements to Owner prior to starting installation.
3. Sunshield: Provide instrument sun shield stainless steel enclosure over field electronic instruments exposed to direct sunlight with padlockable hinged door to view indicators and perform calibrations. All hardware shall be stainless steel and installed to allow easy servicing of instruments.

4. All instruments shall be provided with floor stands or wall brackets as shown or required.

5. Mounting hardware, stands, channels, and spacers shall be either galvanized steel, stainless steel, or non-metallic to match the NEMA rated location.

6. All screws and bolts shall be stainless steel.

7. Instrument and Device Mounting Requirements:

    a. Mount where they will be accessible from fixed ladders, platforms, or grade.

    b. Mount all indictors and controls with face forward towards the normal operating area, within reading distance, and in the line of sight.

    c. Mount level, plumb, and support rigidly.

    d. Mount to provide:

        1) Protection from heat, shock, and vibrations.

        2) Accessibility for maintenance.

        3) Freedom from interference with piping, conduit, and equipment.

    e. Shall be mounted so that they can be readily approached and easily serviced with access to all covers without requiring disassembly of any support or accessory.

    f. Shall be located that they do not restrict access to other equipment.

    g. Instruments and devices not directly mounted shall be mounted on a pipe stand or enclosure supports.

8. Provide cable lengths for instruments listed in Device Index. When called out as manufacturer supplied cable (MNFR CBL); provide cables without splices, the length of the installed conduit run.

9. Instrument enclosures shall be NEMA rated per Device Index.

10. Connections from conduit systems to field instruments shall be made with jacketed metallic liquidtight flexible metallic conduit with a maximum length of 3 feet.

11. All parameter set-up, calibration and programming for all instruments shall be performed by the Contractor at no additional cost to the Owner.

C. Wiring And Raceway Installation Methods

1. Instrumentation wiring shall be carried in conduits provided in compliance with the Section 26 05 19 Low Voltage Electrical Power Conductors & Cables. All analog circuits shall be run as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required. Triads are not to be formed by using two pairs. Terminal blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

2. The number of signal wires listed on the drawings is approximate only, and the Contractor shall determine the required number of signal pairs or triads to properly connect the system furnished, especially when substituting equipment.

3. When stipulated “manufacturer supplied cable” (MNFR CBL) in the conduit schedule, it directs the Contractor to have the manufacturer supply the cable for the entire length of the installed conduit run.

4. All equipment and instrumentation located below grade shall have conduit drain boxes and plug conduit interior sealant to form an effective barrier to keep out water from traveling down conduit into equipment and instrumentation at no additional cost to the Owner.

5. Use bottom entry only for all conduits connected to instruments.

6. Install water proof seals on all conduits to outdoor instruments located below grade. Installation shall be such that liquid shall not enter instrument or enclosure to which the conduit is connected.

D. Tubing Installation Methods

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. Gang multiple tubing runs using common support.

   c. For liquid and steam applications, slope continuously from the process to the instrument with a minimum slope of 1/2” per foot.

   d. For gas and air applications, slope continuously from the instrument to the process with a minimum slope of 1/2” per foot.

   e. If the sensing line cannot be continuously sloped, install high point vents and low point drains.

   f. Keep instrument tubing clean during all phases of work.

   g. Blow out with clean, dry, oil-free air immediately before final assembly.

   h. Remove paint and dirt from tubing before final acceptance.

2. Stainless Steel Tubing:

   a. Cut by sawing tool for tubing and debur.

   b. Make each bend with tube bender of the correct size for the tube.

   c. Make all bends smooth and continuous.

   d. Rebending is not permitted.

   e. Make bends true to angle and radius.

   f. Maintain a true circular cross section of tubing without buckling or undue stretch of tube wall.

g. Allowable tolerance for flattening out of tubing bends: Maximum of 8 percent of the OD.

h. Minimum bending radius:

Minimum Bending Tube OD Inches	Radius, Inches
1/4″	1″
3/8″	1-1/2″
1/2″	2″

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 feet maximum spans for horizontal or vertical runs.

d. Use tubing trays in areas where spans between supports are greater than 5 feet.

e. Support each tubing tray at 10 foot maximum spans.

f. Align tubing in orderly rows and retain in the tray by bolted clips. The use of springs 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 support 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 feet.

b. Locate and orient valves and specialties so that they are accessible for operation and maintenance from the operating floor without the use of a step or ladder. Do not route through or over equipment removal areas, below monorails or cranes nor above or below hatches.

5. Expansion And Vibration Provisions

a. Provide horizontal expansion loops at the process connections.

b. Route tubing parallel to relative motion through sleeved supports that allow linear tube movement.

c. Cold springing of tubing to compensate for thermal expansion is prohibited.

d. Utilize flexible hoses to connect pneumatic tubing to air users which may move or vibrate.

E. Wiring, Grounding, and Shielding Methods

1. It is important to observe good grounding and shielding practices in the generally noisy environment in this application. The following practices shall be observed unless modified by manufacturer's standards:

2. Each electronic equipment chassis shall be grounded to power ground.

3. All analog signals shall be transferred over shielded twisted pair cables.

4. All communication signals shall be transferred over shielded cables.

5. All shields of analog inputs to the PLC shall be connected at the PLC unit only. They shall not contact ground at any other point including the transmitters.

6. All shields of analog outputs from the PLC shall be grounded only at the receiving device. They shall not contact ground at any other point including the PLC.

7. Status and alarm signals routed through noisy environment shall be transferred over shielded twisted pair cables.

8. Each shield which is not connected to ground shall be covered with a heat shrink insulating boot. Shields shall be connected together at each transition from one cable to another for a continuous effective shield circuit. All shields shall be connected on terminal blocks.

9. Isolator modules shall be provided within the panel for field equipment creating a ground loop.

10. Negative side of each power supply shall be solidly bonded to ground bus.

3.3 SUPPLIER SERVICES

A. The Contractor shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. The supplier shall use a qualified instrumentation field technician (sales representatives are not acceptable) to perform services listed herein.

1. Shall use a qualified instrumentation field technician (sales representatives are not acceptable) to perform services listed herein. Technician shall be authorized or certified by instrument manufacturer and factory trained to install and start-up instrument. Provide resume of technician and related experience with related instrument prior to installation.

2. Perform instrumentation field tests as specified in Section 26 00 00.

3. Advise and instruct Contractor on installation requirements.

4. Check, calibrate, and place equipment in operation.

5. All programmable devices shall be programmed and tested prior to startup. Programming shall be adjusted or changed as directed by the Owner, at no additional cost.

6. Coordinate with the Owner and setup all alarm, process, and operation setpoints.

7. Perform the acceptance tests.

8. Visit the job as often as required and spend as much time as necessary to ensure an operational instrumentation system.

9. Be readily available by telephone to answer all questions on supplied equipment.

10. Provide training.

B. The Contractor shall insure each supplier of instrumentation assumes the responsibility for providing primary elements in a timely manner, for insertion into the process line, coordinating size and material type when applicable, overseeing the actual installation, calibration, and acceptance testing.

C. PLC Software Configuration: The instrumentation supplier shall provide the completely configured and programmed PLC.

3.4 ACCEPTANCE TESTS

A. Provide Instrumentation Acceptance testing per Section 26 00 00 - TESTING.

B. The completion of the above tests do not relieve the Contractor from warranties specified elsewhere in this Section.

3.5 TRAINING

A. Each supplier shall provide a minimum of one (1) hour of training to instruct Owner personnel in the use, operation, calibration, programming, and maintenance on each different type of "field" instrument. This applies to field devices listed in Appendix A.

B. Refer to Section 26 00 00-Training for additional training requirements.

3.6 SPARE PARTS

A. Provide spare parts as specified herein.

B. Refer to Section 26 00 00 - Electrical, SPARE PARTS for additional spare parts requirements.

3.7 WARRANTY

A. Provide warranty as specified in Section 26 00 00 - Electrical, WARRANTY.

3.8 FINAL ACCEPTANCE

A. Provide final acceptance as specified in Section 26 00 00 - Electrical, FINAL ACCEPTANCE.

B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Supplier shall provide the following to the Owner:

1. A listing of all programming and setup parameters for all instruments for insertion into the O&M manual.

SECTION 40 70 00

APPENDIX "A"

DEVICE INDEX

P&ID DWG	E DWG	TAG	NO.		DESCRIPTION	TYPE	SPECS	MINIMUM NEMA RATING	SIZE	VOLT	SP / RANGE	UNITS	DWG REF DET MOUNTING	NOTES AND ACCESSORIES	40 70 00 TEST FORM
I301	E300	LSHH	351		Level Switch	Float	40 70 00-2.5.B	6P	-	24Vdc	20.75	Elev	E12-G		TF-14
I301	E300	LSLL	351		Level Switch	Float	40 70 00-2.5.B	6P	-	24Vdc	15	Elev	E12-G		TF-14
I301	E300	LT	351		Level Transmitter	Sub	40 70 00-2.5.A	6P	-	24Vdc	0-27	Feet	E12-G		TF-14
I401	E400	FE	471		Flow Element	Mag	40 70 00-2.5.F	4X	2"	-	-	-	E12-E		TF-14
I401	E400	FIT	471		Flow Indicating Xmtr	Mag	40 70 00-2.5.F	4X	-	24Vdc	0-110	GPM	E12-E		TF-14
I401	E400	PIT	461		Pressure Indicating Xmtr	Gauge	40 70 00-2.5.D	4X	-	24Vdc	0-100	PSI	E12-F		TF-14
I401	E400	PIT	462		Pressure Indicating Xmtr	Gauge	40 70 00-2.5.D	4X	-	24Vdc	0-200	PSI	E12-F		TF-14
I401	E400	PSHH	462		Pressure Switch	Gauge	40 70 00-2.5.E	4X	-	24Vdc	160	PSI	E12-G		TF-14
I401	E400	PSLL	461		Pressure Switch	Gauge	40 70 00-2.5.E	4X	-	24Vdc	10	PSI	E12-G		TF-14
I401	E400	PSLL	462		Pressure Switch	Gauge	40 70 00-2.5.E	4X	-	24Vdc	106	PSI	E12-G		TF-14
I401	-	TSH	411		Temperature Switch	N.C.	43 24 16	4X	-	120Vac	-	-	Motor		TF-7
I401	-	TSH	412		Temperature Switch	N.C.	43 24 16	4X	-	120Vac	-	-	Motor		TF-7
I401	E400	ZS	491		Position Switch	-	40 70 00-2.5G	4X	-	-	-	-	Door		TF-7
I501	E510C	FE	571		Flow Element	Mag	40 70 00-2.5.F	4X	4"	-	-	-	E12-E		TF-14
I501	E510C	FIT	571		Flow Indicating Xmtr	Mag	40 70 00-2.5.F	4X	-	24Vdc	0-480	GPM	E12-E		TF-14
I502	E500	LSH	552		Level Switch	-	22 32.13.13	EXPL	-	-	90%	Elev	Per Mnfr		TF-7
I502	E500	LSL	552		Level Switch	-	22 32.13.13	EXPL	-	-	10%	Elev	Per Mnfr		TF-7
I502	E500	LSX	552		Level Switch	-	22 32.13.13	EXPL	-	-	-	-	Per Mnfr		TF-7
I501	E510C	MOV	521		Motor Operated Valve	--	33 14 19	4X	-	120Vac	-	-	Pipe		TF-7
I501	E510C	PIT	561		Pressure Indicating Xmtr	Gauge	40 70 00-2.5.D	4X	-	24Vdc	0-200	PSI	E12-F		TF-14
I501	E510C	PIT	562		Pressure Indicating Xmtr	Gauge	40 70 00-2.5.D	4X	-	24Vdc	0-200	PSI	E12-F		TF-14
I501	E510C	PIT	563		Pressure Indicating Xmtr	Gauge	40 70 00-2.5.D	4X	-	24Vdc	0-200	PSI	E12-F		TF-14
I501	E510C	PSHH	562		Pressure Switch	Gauge	40 70 00-2.5.E	4X	-	24Vdc	165	PSI	E12-G		TF-14
I501	E510C	PSHH	563		Pressure Switch	Gauge	40 70 00-2.5.E	4X	-	24Vdc	70	PSI	E12-G		TF-14
I501	E510C	PSLL	561		Pressure Switch	Gauge	40 70 00-2.5.E	4X	-	24Vdc	10	PSI	E12-G		TF-14
I501	E510C	PSLL	562		Pressure Switch	Gauge	40 70 00-2.5.E	4X	-	24Vdc	110	PSI	E12-G		TF-14
I501	-	TSH	511		Temperature Switch	N.C.	43 24 16	4X	-	120Vac	-	-	Motor		TF-7
I501	-	TSH	512		Temperature Switch	N.C.	43 24 16	4X	-	120Vac	-	-	Motor		TF-7
I502	E510A	ZS	591		Position Switch	-	40 70 00-2.5G	4X	-	-	-	-	Door		TF-7
I502	E500	ZS	592	A,B	Position Switch	-	26 32 13.13	4X	-	-	-	-	Door		TF-7
I501	E510C	ZSC	513		Position Switch	N.O.	DIV 43	4X	-	120Vac	-	-	Valve		TF-7
I501	E510C	ZSC	514		Position Switch	N.O.	DIV 43	4X	-	120Vac	-	-	Valve		TF-7
I501	E510C	ZSO	513		Position Switch	N.O.	DIV 43	4X	-	120Vac	-	-	Valve		TF-7
I501	E510C	ZSO	514		Position Switch	N.O.	DIV 43	4X	-	120Vac	-	-	Valve		TF-7

SECTION 40 70 00

APPENDIX "B"

PLC I/O LIST

Wallan Booster Pump Station

Alderpoint Pump Station

GARBERVILLE SANITARY DISTRICT - REPLACEMENT
PLC I/O LIST
PLC - ANALOG INPUT - WALLAN PUMP STATION

Point	P & ID	Tag Number	Description	Range	Eng Units
1	I401	P 461	Wallan Pump Station Suction Pressure	0-100	PSI
2	I401	P 462	Wallan Pump Station Discharge Pressure	0-200	PSI
3	I401	F 471	Wallan Pump Station Discharge Flow	0-110	GPM
4	-		Spare	0-100	%

GARBERVILLE SANITARY DISTRICT - REPLACEMENT
PLC I/O LIST
PLC - DIGITAL INPUT - WALLAN PUMP STATION

Point	P & ID	Tag Number	Description	0 State	1 State
1	I401	R 400 A	Wallan PS Alarm Acknowledge	Not Ack	Acknowledge
2	I401	R 400 B	Wallan PS Alarm Reset	Null	Reset
3	I401	N 411	Wallan PS Pump 1 Run	Off	Running
4	I401	UST 411	Wallan PS Pump 1 Fail	Normal	Active
5	I401	Y 411	Wallan PS Pump 1 In Auto	Not Auto	Auto
6	I401	N 412	Wallan PS Pump 2 Run	Off	Running
7	I401	UST 412	Wallan PS Pump 2 Fail	Normal	Active
8	I401	Y 412	Wallan PS Pump 2 In Auto	Not Auto	Auto
9	I401	PSHH 461	Wallan PS High High Discharge Pressure	Normal	Active
10	I401	PSLL 461	Wallan PS Lo Lo Discharge Pressure	Normal	Active
11	I401	Y 490	Wallan PS Intrusion Bypass	Normal	Bypass
12	I401	ZA 491	Wallan PS Intrusion	Active	Normal
13	I401	N 498	Wallan PS UPS On	Normal	Active
14	I401	UST 498	Wallan PS UPS Trouble	Normal	Active
15					
16					
17					
18					
19					
20					
21					
22					
23					

GARBERVILLE SANITARY DISTRICT - REPLACEMENT
PLC I/O LIST
PLC - DIGITAL OUTPUT - WALLAN PUMP STATION

Point	P & ID	Tag Number	Description	0 State	1 State
1	I401	USF 400	Wallan Pump Station PLC Fault	Normal	Active
2	I401	USY 400	Wallan Pump Station Alarm	Normal	Active
3	I401	X 411	Wallan Pump 1 Call	Stop	Start
4	I401	X 412	Wallan Pump 2 Call	Stop	Start
5			Spare	Off	On
6			Spare	Off	On
7			Spare	Off	On
8			Spare	Off	On

GARBERVILLE SANITARY DISTRICT - REPLACEMENT
PLC I/O LIST
PLC - ANALOG INPUT - ALDERPOINT PUMP STATION

Point	P & ID	Tag Number	Description	Range	Eng Units
1	I501	S 511	Alderpoint Pump Station Pump 1 Speed	0-100	%
2	I501	S 512	Alderpoint Pump Station Pump 2 Speed	0-100	%
3	I501	P 561	Alderpoint Pump Station Inlet Pressure	0-200	PSI
4	I501	P 562	Alderpoint Pump Station Discharge Pressure	0-200	PSI
5	I501	P 563	Alderpoint Pump Station Zone 1A Pressure	0-200	PSI
6	I501	F 571	Alderpoint Pump Station Discharge Flow	0-480	GPM
7	-		Spare	0-100	%

GARBERVILLE SANITARY DISTRICT - REPLACEMENT
PLC I/O LIST
PLC - ANALOG OUTPUT - ALDERPOINT PUMP STATION

Point	P & ID	Tag Number	Description	Range	Eng Units
1	I501	SC 511	Alderpoint Pump Station Pump 1 Speed Control	0-100	%
2	I501	SC 512	Alderpoint Pump Station Pump 2 Speed Control	0-100	%
3	-		Spare	0-100	-

GARBERVILLE SANITARY DISTRICT - REPLACEMENT
PLC I/O LIST
PLC - DIGITAL INPUT - ALDERPOINT PUMP STATION

Point	P & ID	Tag Number	Description	0 State	1 State
1	I502	R 500 A	Alderpoint PS Alarm Acknowledge	Not Ack	Acknowledge
2	I502	R 500 B	Alderpoint PS Alarm Reset	Null	Reset
3	I502	N 501	Alderpoint PS Generator Run	Off	Running
4	I502	NE 501	Alderpoint PS ATS in Standby	Null	Standby
5	I502	NU 501	Alderpoint PS ATS in Utility	Null	Utility
6	I502	UA 501	Alderpoint PS Generator Alarm	Normal	Active
7	I501	N 511	Alderpoint PS Pump 1 Run	Off	Running
8	I501	UST 511	Alderpoint PS Pump 1 Fail	Normal	Active
9	I501	Y 511	Alderpoint PS Pump 1 In Auto	Not Auto	Auto
10	I501	N 512	Alderpoint PS Pump 2 Run	Off	Running
11	I501	UST 512	Alderpoint PS Pump 2 Fail	Normal	Active
12	I501	Y 512	Alderpoint PS Pump 2 In Auto	Not Auto	Auto
13	I501	ZSC 513	Alderpoint PS 6" PRV Close	Null	Closed
14	I501	ZSO 513	Alderpoint PS 6" PRV Open	Null	Opened
15	I501	ZSC 514	Alderpoint PS 4" PRV Close	Null	Closed
16	I501	ZSO 514	Alderpoint PS 4" PRV Open	Null	Opened
17	I501	Y 521	Alderpoint PS Zone 1A MOV Remote	Local	Remote
18	I501	ZSC 521	Alderpoint PS Zone 1A MOV Close	Null	Closed
19	I501	ZSO 521	Alderpoint PS Zone 1A MOV Open	Null	Opened
20	I501	PSLL 561	Alderpoint PS Lo Lo Inlet Pressure	Normal	Active
21	I501	PSHH 562	Alderpoint PS Hi Hi Discharge Pressure	Normal	Active
22	I501	PSLL 562	Alderpoint PS Lo Lo Discharge Pressure	Normal	Active
23	I501	PSHH 563	Alderpoint PS Zone 1A Hi Hi Pressure	Normal	Active
24	I502	Y 590	Alderpoint PS Intrusion Bypass	Normal	Bypass
25	I502	ZA 591	Alderpoint PS Intrusion	Active	Normal
26	I502	ZA 592	Alderpoint PS Generator Intrusion Switch	Active	Normal
27	I502	N 598	Alderpoint PS UPS On	Normal	Active
28	I502	UST 598	Alderpoint PS UPS Trouble	Normal	Active
29					

GARBERVILLE SANITARY DISTRICT - REPLACEMENT
PLC I/O LIST
PLC - DIGITAL OUTPUT - ALDERPOINT PUMP STATION

Point	P & ID	Tag Number	Description	0 State	1 State
1	I502	USF 500	Alderpoint Pump Station PLC Fault	Normal	Active
2	I502	USY 500	Alderpoint Pump Station Alarm	Normal	Active
3	I501	X 511	Alderpoint Pump 1 Call	Stop	Start
4	I501	X 512	Alderpoint Pump 2 Call	Stop	Start
5	I501	ZSO 521	Alderpoint PS Zone 1A MOV Open Control	Null	Open
6	I501	ZSC 521	Alderpoint PS Zone 1A MOV Close Control	Null	Close
7			Spare	Off	On

END OF SECTION

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SECTION 40 97 00

VARIABLE FREQUENCY DRIVE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall supply VFDs along with complete startup and testing services for the variable frequency drive (VFD) as specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a complete operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter at no additional cost to the Owner.

B. Furnish all required labor, materials, safety equipment, transportation, test equipment, incidentals and services to provide a complete and operational system as described in these Specifications, or required for fully operating facility.

C. Work includes that specified in Division 26 and 40.

D. The VFD scope of work includes providing:

1. Providing each modular variable frequency drive as shown on Contract Elementary Drawings. Variable frequency drive shall be provided with fully speed bypass where shown on Contract Drawings. All VFDs shall be of the same manufacturer.
2. Providing cooling system, mounting hardware, associated miscellaneous devices, and field control stations.
3. Installation of the complete VFD systems with components as specified in Section 26 0 00 - Electrical.
4. Submittal data and Drawings.
5. Startup assistance.
6. Testing.
7. Operation and maintenance manuals.
8. Warranty of all components of the VFD system.

1.02 JOB CONDITIONS

A. Rate the equipment to meet the job conditions listed in Section 26 0 00 – Electrical.

B. All the VFDs shall be rated for continuous full load operation when powered from the normal Utility power.

1.03 SUBMITTALS AND DRAWINGS

A. Provide Submittals and Drawings as specified in Section 26 0 00 - Electrical.

B. Include a record of each VFD parameter setup during startup and testing that is not factory default and placed a copy in each O & M manual.

1.04 OPERATION AND MAINTENANCE MANUALS

A. Provide operation and maintenance manuals as specified in Section 26 0 00 - Electrical.

B. Include a record of each VFD parameter setup during startup and testing and place a copy of setting in each O & M manual.

PART 2 - MATERIALS

2.01 QUALITY

A. It is the intent of the Contract specifications and drawings to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.

B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed and braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble free service. Light duty, fragile and competitive grade devices of doubtful durability shall not be used.

C. Products that are specified by manufacturer, trade name or catalog number established a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Owner prior to installation.

D. Underwriters Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

2.02 VARIABLE FREQUENCY DRIVE

A. General:

1. The variable frequency drive shall be Danfoss VLT AQUA FC 202, Allen-Bradley Power Flex, ABB ACS 550 with remote digital controller and display unit or approved equal. Each VFD shall have motor terminator unit supplied and installed near motor.

B. Load - The VFD shall be designed to continuously operate the following motor/pump load.

1. The power section shall consist of six (6) SCRs, rated for a minimum repetitive peak inverse voltage of 1400 V at 480 VAC.

2. Pump, per Mechanical Division Specification.

3. Horsepower, size (minimum) with 1.15 service factor shown on Contract Drawings, at Full speed R.P.M. for supplied pump motor.

4. Continuous current at rated voltage, as shown on Contract single line diagrams, three phase, 60 cycle.

C. The VFD manufacturer shall provide, as a minimum, input line series reactors and motor terminators as shown on Contract One-Line diagrams to prevent VFDs from interacting with the incoming Utility power line or the generator. Harmonics generated by a VFD shall not affect any device on the existing power distribution system; harmonics from any device on the existing power distribution system shall not affect the operation of the VFD. The series reactor shall be as manufactured by TCI, MTE, or approved equal.

D. The harmonic distortion shall meet the requirements of IEEE519. Provide additional filtering equipment as required at no additional cost to Owner.

E. The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

F. The VFD shall not be affected by or generate excessive electro-magnetic interference (EMI). The VFD shall be provided with a radio interference filter (RIF) to meet the following requirements:

G. The use of a 4 Watt hand-held VHF/UHF transceiver within three feet of the VFD with its doors closed shall not cause erratic operation, loss of configuration, or any other deviation from normal operation.

H. Provide RFI/EMI filter on line side of VFD. Filter shall attenuate conducted radio frequencies or EMI to meet FCC standards for conducted emissions.

I. The worst case conducted and radiated EMI generated by the VFD shall not be enough to prevent the use of hand held VHF-UHF transceivers within three feet of the VFD with its doors closed.

J. Digital programmer/controller –The VFD shall be provided with a door mounted alpha-numeric human interface module (HIM) digital display with keypad to view and adjust the diagnostic and status indicators. Provide manual single turn potentiometer for manual speed control.

K. Each controller shall automatically restart upon reapplication of power after a loss of line power without requiring a manual reset. Momentary or sustained power failures shall not fault trip out the controller or blow any fuses.

L. Input and Output Terminations - The VFD assembly shall have functional conduit entry provisions and termination points at terminal blocks as shown on the Contract "E"-Series and Elementary Drawings.

M. Panel Mounted Ethernet port – Provide panel mounted Ethernet port connected directly to each VFD drive Ethernet port. Ethernet port shall be UL recognized, Category 6, RJ45- Bulkhead with cast aluminum base housing, 304 stainless steel latch, and polycarbonate UV rated gasketed cover. Ethernet port shall be Grace Engineered Products or approved equal.

N. Provide Ethernet port for future PLC communication.

O. Enclosure - The enclosure shall be as shown on Contract Drawings. All components shall be accessible from the front of the enclosure. Rear or side access shall not be required in order to remove or service any component. The enclosure shall include the following in its construction:

1. Copper lugs sized for wires listed in the Conduit & Wire Routing Schedule and provisions for connecting the motor power leads to output of the SSS shall be provided at the bottom of the enclosure.

2. The VFD shall incorporate fans for cooling. The air flow through the VFD compartment shall provide proper cooling of the operating VFD at an ambient temperature of 110° Fahrenheit. The thermostat shall be designed to regulate and monitor air temperature in the VFD enclosure. Thermostat shall have bi-metallic adjustable set point range of 30 to 140° F. Thermostat shall have a switching capacity of 10A at 120 VAC.

3. The complete VFD unit, including the enclosure assembly, shall be U.L. listed for a minimum of 65,000 RMS symmetrical ampere fault withstand capability. VFD assemblies consisting of the VFD, enclosure and all accessories that are not U.L. listed will not be approved.

4. Provide all vents and louvers with removable metal filters.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Electrical Section 26 0 00.

B. The Supplier shall employ personnel that are skilled and experienced in the startup and testing of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had VFD experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Electrical Section 26 0 00 - subsections labeled General Construction Methods and General Equipment Fabrication applies to the construction and assembly of VFDs.

E. Perform any required work to correct improper installations at no additional expense to the Owner.

F. All equipment installed by the Contractor shall be in accordance with the Drawings and the manufacturer's recommendations and instructions and shall operate to the Owner's satisfaction. Follow all manufacturer's instructions for handling, receiving, installation, and pre-check requirements prior to energization. After energization, follow manufacturer's instructions for programming, set-up and calibration of equipment. The Contractor shall be responsible for, and shall correct by repair or replacement, at his own expense, equipment that, in the opinion of the Owner has been caused by faulty mechanical or electrical assembly by the Contractor. Necessary tests to demonstrate that the electrical and mechanical operation of the equipment is satisfactory and meets the requirements of these Specifications shall be made by the Contractor at no additional cost to the Owner.

3.02 MAINTAINABILITY

A. The following minimum provisions shall be included for the VFD assembly maintainability:

1. All control circuit voltages (12 VDC, 24 VDC and 120 VAC) shall be physically and electrically isolated from power circuit voltages (380 to 600 VACS) to ensure safety to maintenance personnel.

2. A control compartment for all low voltage signals and circuit boards shall be provided which is physically separated from the power compartment and power wiring.

3. All printed circuit boards shall utilize quick disconnect plugs and/or pull apart terminal blocks to facilitate maintenance by providing quick change out without disconnecting terminal strip connections thereby reducing wiring errors.

4. The VFD assembly shall be modular in construction to provide for ease and speed of maintenance. The modules shall be designed to allow for their removal by one maintenance technician.

5. The VFD shall be capable of starting and operating without a motor connected in order to run tests of only the VFD assembly.

6. The supplier of the VFD shall have a factory trained service representative in domestic residence within 150 miles of the jobsite. This factory representative shall be trained in the maintenance and troubleshooting of the equipment specified herein.

7. The complete VFD assembly shall be manufactured in the U.S.A.

3.03 RELIABILITY

A. The quality assurance and testing program shall at a minimum consist of the following:

1. Component testing - All power semiconductors and integrated circuits shall be 100% tested.

2. Computerized ATE testing - Computerized automated test equipment (ATE) shall be used to evaluate the functional performance of printed circuit boards. Printed circuit boards shall receive a thermal stress test with temperatures cycled between 0° C and 65° C and receive electrical power-on and power-off cycle tests.

3. System testing - The complete VFD assembly mounted in MCC for this project shall be tested at the systems house prior to shipment. All modes of operations shall be tested with a small motor load to check functionality in compliance with the specifications.

4. Failures - The manufacturer shall repeat each entire test upon any component failure, modification, or replacement. All component failures, modifications, or replacements shall be listed on the test documentation.

5. A complete description of suppliers' quality assurance and testing program shall be included in this submittal.

3.04 FIELD ASSISTANCE

A. Field testing, checkout and start-up of the VFD equipment shall be performed under the technical direction of the VFD manufacturer's field service engineer. Submit resume for approval of field service engineer proposed to do VFD startup one (1) week prior to energizing any VFD in field. Under no circumstances are any portions of the drive system to be energized to run motor loads without authorization from the manufacturer's field service engineer.

1. The setup and programming of each VFD shall be provided by a factory-trained representative who is authorized by the VFD manufacturer to perform the startup. This setup and programming shall be done prior to and during the first application of power to the pump motor. Each VFD electronic motor overload protection shall be set to meet the NEC Code requirements.

2. Provide operating testing as specified in Section 26 0 00 - Electrical.

B. Provide 2 hours of "VFD Setup" Training on operating and maintenance procedure.

3.05 WARRANTY

A. Provide warranty as specified in Electrical Section 26 0 00 - subsection Warranty.

END OF SECTION

Process Gas and Liquid Handling, Purification, and Storage

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SECTION 43 21 14

VERTICAL INLINE MULTI-STAGE PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes vertical inline multi-stage pumps complete with pump, motor, and mounting base for potable water service. The Contractor shall provide all items, and operations, including all labor, materials, equipment, and incidentals necessary for completion of work.

B. Contractor shall provide one complete and factory-tested shelf spare complete pump and motor for each unique pump size.

1.2 RELATED WORK

A. Section 01 78 23—Operations and Maintenance Data

B. Section 33 01 10—Disinfection of Water Utility Piping Systems

C. Section 33 14 11—Water Utility Piping

D. Section 40 68 00—Process Control Software

E. Section 40 07 00—Instrumentation for Process Systems

F. Section 40 97 00—Variable Frequency Drive

G. Section 43 14 19—Valves and Hydrants for Water Utility Service

1.3 REFERENCES

A. American Water Works Association (AWWA)

B. Hydraulic Institute (HI)

C. American Society for Testing and Materials (ASTM)

D. American National Standards Institute (ANSI)

E. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

A. Submit shop drawings in accordance with General Provisions.

B. As specified in “Section 01 33 00 Submittal Procedures“

C. Submit dimensional drawings.

D. Submit manufacturer's catalog data and detail drawings showing all pump parts and described

by material of construction, specification (such as AISI, ASTM, etc.), and grade or type. Show linings and coatings. Include total pump weight.

E. Submit pump manufacturer ISO-9001 certification.

F. Submit pump curves on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show required NPSH.

G. Submit manufacturer's sample form for reporting performance test results at least two weeks before the tests.

H. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, brake horsepower, pump efficiency, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.

I. Submit motor data.

J. Submit manufacturer's installation instructions, including anchorage requirements.

K. Submit an Operations and Maintenance Manual for the entirety of each pump station including pumps, motors, controls, and instrumentation in accordance with Section 01 78 23.

1. Provide two (2) hard copies and one digital copy for each pump station

1.5 QUALITY ASSURANCE

A. All components must be supplied by the pump manufacturer as an integrated and compatible system. The pump manufacturer shall have complete unit responsibility for meeting the requirements of this specification.

B. Pump manufacturer shall have ISO-9001 certification. As an alternative, provide a letter from the pump manufacturer accepting warranty responsibility for the entire pump, motor, and baseplate unit.

C. Except as modified or supplemented herein, all pumps shall conform to the applicable requirements of all ANSI-Hydraulic Institute Standards.

D. All materials and coatings in contact with potable water shall be ANSI/NSF-61 certified.

E. All materials of construction shall comply with California “Lead Free” regulations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Pumps and appurtenances shall be manufactured by Xylem (Goulds).

B. Alternate manufacturers may be considered provided that the pumps are produced domestically and can be serviced by a manufacturer-approved representative located within 150 miles of the project site. Submit evidence of meeting this requirement if requesting a substitution in accordance with 01 25 13 - Substitutions.

2.2 DESIGN REQUIREMENTS

A. The pump curve shall be continuously rising and free from dips and valleys from 70 percent of the design flow to the shutoff head.

B. For design and rating purposes, the temperature of the water to be pumped is anticipated to range between 50 and 78 degrees Fahrenheit.

C. Pump performance shall be stable and free from damaging cavitation, vibration, and noise within the operating range.

D. The pump and motor shall each be supported on a common base.

E. Contractor shall design pump anchorage according to site specific criteria.

2.3 SERVICE CONDITIONS

A. Alderpoint Pump Station

1. Tags: P511 & P512
2. Location: Indoors
3. Elevation: 700 ft
4. Design Flow (gpm): 200
5. Design Total Dynamic Head (TDH, ft): 312
6. Minimum Efficiency at Design: 73%
7. Maximum Motor HP: 30
8. Variable Speed: Yes
9. Minimum NPSH (Available, ft): 60
10. Basis of Design: 46SV42GN4F20

B. Wallan Pump Station

1. Tags: P411 & P412
2. Location: Indoors
3. Elevation: 870 ft
4. Design Flow (gpm): 55
5. Design Total Dynamic Head (TDH): 276 ft
6. Minimum Efficiency at Design: 69%
7. Maximum Motor HP: 7.5
8. Variable Speed: No
9. Minimum NPSH (Available): 38 ft

10. Basis of Design: 10SV7GH4F20

2.4 MATERIALS OF CONSTRUCTION

A. Materials of construction shall be as follows:

1. Pump Body: Cast Iron 35/40B
2. Impeller: Stainless Steel (304)
3. Diffuser: Stainless Steel (304)
4. Casing: Stainless Steel (316L)
5. Shaft: Stainless Steel (316)
6. Adapter: Cast Iron 35/40B
7. Coupling: Aluminum (A384.0-F)
8. Seal Plate: Stainless Steel (316L)
9. Mechanical Seal:
    a. Rotating Face: Carbon
    b. Stationary Face: Silicon Carbide Graphite Filled
    c. Elastomers: Viton
    d. Spring: Stainless Steel (316)
    e. Metal Components: Stainless Steel (316)
10. Coupling Guard: Stainless Steel (304)
11. Shaft Sleeve and Bushing: Tungsten Carbide
12. Fill/Drain Plugs: Stainless Steel (316)
13. Tie Rods: Carbon Steel/Zinc Plated
14. Case Wear Rings: PPS
15. Seal Gland: Stainless Steel (316)

2.5 CASING

A. Suction and discharge connections shall be flanged.

1. Contractor shall coordinate connections (bolt circle, quantity, rating) for compatibility of attachment to piping system and valves.

B. The casing shall be equipped with feet for easy back pullout without disturbing the suction and discharge piping connections.

2.6 IMPELLER

A. The impellers shall be statically and dynamically balanced.

2.7 SHAFT

A. The pump shaft shall be one-piece, finished, and polished along its entire length.

B. The maximum allowable deflection of the shaft shall be 0.002 inches at any point of operation on the pump curve.

C. The shaft journal and chamber bearings shall be Tungsten Carbide and Bronze

2.8 SEAL

A. Pump shall be equipped with a mechanical seal.

B. Mechanical seal shall be constructed with all metal parts to be 316 stainless steel, Buna-N elastomers, ceramic seat, and carbon washer.

C. The mechanical seal box shall be equipped with a heavy, cast, one piece O-ring sealed gland.

2.9 BASE

A. The pump shall include a baseplate with integral anchorage points.

B. The base shall be sufficiently rigid to support the pump and motor without the use of additional supports or members.

2.10 MOTOR

A. Electric motors shall be NEMA Design B, squirrel-cage induction motors designed for normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value indicated in ANSI/NEMA MG 1.

B. Motors shall be fabricated, assembled, and tested in accordance with the most current applicable standards as defined by ANSI, IEEE, NEMA, and AFBMA. Motors shall comply with ANSI/NEMA MG 1. Motors shall be labeled as being approved by the Underwriters Laboratories (UL).

C. Motor Voltage Ratings: Motors shall be rated in accordance with the following unless indicated otherwise on the drawings:

1. Motors below 10 HP shall be rated 230V volts, 3-phase, 60-Hz.

2. Motors 10 HP and larger shall be rated 460 volts, 3-phase, 60 Hz.

D. Each motor shall have sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor. Motors shall have a service factor of at least 1.15.

E. Motors shall include Class F insulation, rated to operate at an ambient temperature of 40 degrees C without exceeding Class B temperature rise limits at the motors nominal rating.

F. Motors for variable frequency drives (VFD) shall be specifically rated for inverter duty and shall be severe duty NEMA MG 1 design A or B, high efficiency, with NEMA MG 1 Class F insulation. Winding temperature rise shall be limited to Class B rise when operating over the specified

speed range. Motor insulation shall be designed to meet NEMA MG 1, Part 31 (1600-volt peak at a minimum of 0.1 microsecond rise time). Motors shall conform to IEEE 841. All internal surfaces shall be coated with epoxy paint.

G. Inverter duty motors shall be equipped with shaft-grounding with stub shaft extended from the motor shaft. Grounding unit shall be equipped with two brushes, totally enclosed and sealed against environmental contamination.

H. Motors shall include bearings with a minimum L-10 life of 50,000 hours. Motors larger than 2 HP shall include relubricatable bearings.

I. Motors over 25 HP shall have short commercial tests performed which include: no load current, locked rotor current, winding resistance, high potential, and vibration and bearing inspection.

2.11 FACTORY PERFORMANCE TESTING

A. Each pump shall be non-witness tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, shutoff head or point of discontinuity, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. If the pump fails to operate properly or fails to meet the specified conditions or requirements during shop testing, the pump manufacturer shall modify the pumping unit and perform additional tests. The pump manufacturer shall submit complete pump test reports, including test arrangement, instrumentation calibration data, test procedures, & test data in curve format.

B. Each pump shall be subjected to a non-witnessed factory hydrostatic test per ANSI/HI 1.6.

PART 3 EXECUTION

3.1 SHIPMENT

A. All equipment shall include a stainless steel nameplate including the equipment tag number.

B. The interior of the equipment shall be clean and free from debris.

C. Provide and label lifting points for all pump components.

3.2 INSTALLATION

A. Provide all manufacturer recommended lubricants for the pump and motor.

B. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and Inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of ENGINEER.

C. Install the pump per ANSI/HI 1.4. Ensure that pump flanges are properly aligned prior to installing bolts. Do not allow any piping strain to be transmitted to the pump.

D. The manufacturer's representative shall furnish a written report certifying that the equipment

has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

E. All costs of these services shall be included in the contract price for the number of days and round trips to the site as required.

3.3 FIELD QUALITY CONTROL

A. Bump motor to ensure proper rotational direction.

B. Perform field vibration measurements during normal operation. Vibration levels shall be within HI limits. Repair or replace pumps not meeting the HI vibration limits.

C. Collect flow and discharge pressure data from at least three different flow rates, including the design flow rate. Compare the data with the factory performance curve and notify the Engineer if the data varies by more than 5%.

END OF SECTION

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