SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The work includes demolition work, installation, testing, startup, and commissioning of a third hydroelectric turbine and generator and incidental related work at Tyee Lake Powerhouse. The Tyee Lake powerhouse was designed and constructed in the 1980s. The powerhouse was built with space for three generating units. Two generating units were installed as part of the original construction.

The purpose of this project is to install a third generating unit in the skeleton bay originally constructed for the third unit. Major components of the third unit, including but not limited to the turbine, generator, turbine inlet valve, governor, hydraulic power unit, closed loop cooling water system, excitation system, generator switchgear, and step up transformer will be procured by the OWNER from an equipment SUPPLIER. Major components of the third unit will then be turned over to the CONTRACTOR as OWNER-furnished equipment for installation.

Install the OWNER-furnished equipment under the supervision and direction of the equipment SUPPLIER. Provide additional items and equipment as specified and as shown in order to complete the unit installation. Contractor provided items include, but are not limited to, a pre-cast oil water separator, circuit switcher with support structure, buswork, foundations, wiring, cable, conduit, pumps, motors, valves, and piping as required. Provide assistance to the equipment SUPPLIER during startup, testing, and commissioning activities.

1.1.2 Location

The work is located at the Tyee Lake Powerhouse, approximately 40 miles southeast of Wrangell, Alaska at the head of Bradfield Canal. Practical access is by wheeled charter aircraft for landing on a private airstrip, helicopter, or by shallow draft vessels at high tide.

1.2 OCCUPANCY OF PREMISES

Building(s) will be occupied during performance of work under this Contract.

The Tyee Lake Powerhouse is an operating hydroelectric facility with OWNER personnel living and working on site. Operations and maintenance activities carried out by OWNER personnel will continue throughout the course of this Contract.

Before work is started, arrange with the OWNER, or the OWNER's REPRESENTATIVE, a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

1.3 EXISTING WORK

Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the OWNER. At the completion of operations, existing work must be in a condition equal to or better than that which existed before new work started.

1.4 LOCATION OF UNDERGROUND UTILITIES

Identify and mark all underground utilities within the work area. Verify underground utilities by reviewing the Contract Drawings, facility record drawings, and through consultations with the OWNER. Scan the construction site with Ground Penetrating Radar (GPR), electromagnetic, or sonic equipment, and mark the surface of the ground or paved surface where existing underground utilities are discovered. Verify the elevations of existing piping, utilities,and any type of underground or encased obstruction not indicated, or specified to be removed, that is indicated or discovered during scanning, in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.4.1 Notification Prior to Excavation

Notify the OWNER at least 7 calendar days prior to starting excavation work.

1.5 OWNER-FURNISHED MATERIAL AND EQUIPMENT

The OWNER will furnish the following materials and equipment for installation by the Contractor:

DESIGNATION NO.	Type	Description	QUANTITY
TUR-300	Six (6) Jet Vertical Shaft Pelton Turbine.	Includes turbine housing, runner, nozzle assemblies (needles, beaks, servomotors/actuators), deflector assemblies (deflector plates, linkages, actuators), distributor/manifold piping within the turbine package limits, turbine base/soleplate or support structure furnished with the turbine, turbine drains and vents provided as part of the package, and all turbine-mounted instrumentation and local junction boxes furnished by Supplier. Includes turbine fasteners and installation hardware furnished with the turbine package, and Supplier/OEM installation and commissioning documentation.	1

DESIGNATION NO.	Type	Description	QUANTITY
TIV-301	26-Inch Turbine Inlet Valve with Hydraulic Actuator	Includes valve body and trim, hydraulic actuator, local controls panel, accessories furnished with the valve, valve sole plate and anchorage hardware furnished with the package, dismantling joint, bypass piping assembly with isolation valves and bypass valve as furnished, and any valve-mounted instrumentation provided by Supplier. Includes Supplier/OEM installation documentation.	1
GEN-300	12.5 MVA Synchronous Generator	Includes stator, rotor, shaft/coupling interface components furnished with the generator, bearings and bearing housings furnished with the generator, generator enclosure/covers furnished with the generator, generator-mounted instrumentation furnished by Supplier, and any generator-mounted junction boxes/terminal enclosures furnished with the package. Includes Supplier/OEM installation and commissioning documentation.	1
GSU-300	11.25/15 MVA 13.8/138 kV Generator Step-Up Transformer	Includes transformer tank and core/coil assembly, insulating fluid (as shipped), bushings, grounding provisions, nameplates, lifting lugs, and standard accessories furnished with the transformer (for example, gauges, valves, relief device, and radiators/cooling equipment if part of the unit). Includes Supplier/OEM installation documentation.	1
GOV-300	Turbine Governor	Includes a dedicated governor control cabinet/panel located near the HPU, housing the governor PLC/controller (separate from the Unit Control PLC), required power supplies, I/O modules, and associated internal wiring as furnished with the governor package. Includes operator interface equipment (HMI) provided with the governor package, and governor software/firmware and Supplier/OEM commissioning support documentation.	1

DESIGNATION NO.	Type	Description	QUANTITY
HPU-300	Hydraulic Power Unit	Includes reservoir, pumps, motors/drivers, accumulators, filtration, manifolds, valves, pressure controls, gauges/transducers, and skid/frame as furnished. Includes local electrical panel, disconnects, and instrumentation furnished as part of the HPU package. Includes Supplier/OEM installation, flushing/cleanliness requirements, and commissioning documentation.	1
SWGR-300	15.0 kV Generator Switchgear	Includes metal-clad/metal-enclosed switchgear sections furnished, primary bus, breakers/interrupting devices furnished, protective relays and metering furnished, control power components furnished within the lineup, and internal wiring within the lineup. Includes Supplier/OEM installation and testing documentation.	1
CWS-300	Close Loop Cooling Water System.	Includes pump skid (pumps, motors, base/skid, valves and instrumentation on the skid as furnished), heat exchanger as furnished, and any packaged cooling water piping/hoses within the package limits as furnished. Includes local controls and instrumentation furnished with the cooling water package. Includes Supplier/OEM installation, flushing, and commissioning documentation.	1

Descriptions above identify OWNER-Furnished Equipment (OFE) scope at a package level. Final shipped components, interface points, and termination points are defined by the Supplier submittals and procurement documents. CONTRACTOR shall furnish all field interconnections and incidental materials required beyond OFE package limits unless specifically identified as OFE.

The items listed above are OWNER-Furnished Equipment (OFE) for installation by CONTRACTOR. CONTRACTOR shall not procure, fabricate, or provide substitutions for OFE. CONTRACTOR responsibilities include receiving, offloading, handling, storage, protection, installation, interconnections, and installation support activities as specified.

1.5.1 Delivery Schedule

OWNER-furnished Materials and equipment will be shipped to the site by the SUPPLIER and will be available on or after March 18th, 2027.

1.5.2 Delivery Location

The OWNER-furnished materials and equipment will be delivered to the Tyee

Lake jobsite.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 CONTRACT COST BREAKDOWN

The Contractor must furnish within 30 days after the date of Notice to Proceed, and prior to the submission of its first partial payment estimate, a breakdown of its single job pay item or items which will be reviewed by the OWNER as to propriety of distribution of the total cost to the various accounts. Any unbalanced items as between early and late payment items or other discrepancies will be revised by the OWNER to agree with a reasonable cost of the work included in the various items. This Contract cost breakdown will then be utilized as the basis for progress payments to the Contractor.

1.2 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.2.1 Submission of Invoices

Monthly invoices and supporting forms for work performed through the anniversary award date of the Contract must be submitted to the OWNER within 5 calendar days of the date of invoice. For example, if Contract award date is the 7th of the month, the date of each monthly invoice must be the 7th and the invoice must be submitted by the 12th of the month.

1.2.2 Final Invoice

a. A final invoice must be accompanied by the certification of completion, and the Contractor's Final Release. If the Contractor is incorporated, the Final Release must contain the corporate seal. An officer of the corporation must sign and the corporate secretary must certify the Final Release.

b. Final invoices not accompanied by the Contractor's Final Release and required certification of completion will be considered incomplete and will be returned to the Contractor.

1.3 SINGLE JOB PAYMENT ITEMS

Payment items for the work of this Contract for which Contract job payments will be made are listed in the BID SCHEDULE and are outlined below. All costs for items of work, which are not specifically mentioned to be included in a particular job or unit price payment item, are included in the listed job item most closely associated with the work involved. The job price and payment made for each item listed constitutes full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided.

1.3.1 General Conditions

1.3.1.1 Payment

General Conditions includes bid items 1 though 4. Payment will be made for costs associated with mobilization to and demobilization from the work site, bonds, insurance, permits, project administration, temporary facilities, utilities, access, and environmental controls. Total costs associated with this bid item may not exceed fifteen percent of the total contract amount.

1.3.1.2 Unit of Measure

Unit of measure: job.

1.3.2 Demolition and Site Work

1.3.2.1 Payment

Demolition and Site Work includes bid items 5 through 7. Payment will be made for costs associated with providing all labor, materials, and equipment necessary to perform the demolition work shown in the Contract Documents and to dispose of demolished materials.

1.3.2.2 Unit of Measure

Unit of measure: job.

1.3.3 Civil and Structural Work

1.3.3.1 Payment

Civil and Structural Work includes bid items 9 through 12. Payment will be made for costs associated with providing all plant, labor, materials, and equipment necessary to perform work associated with turbine-generator foundation modifications, equipment pads, housekeeping pads, grouting, structural steel, supports, platforms, handrails, concrete reinforcement, concrete supply, concrete placement, concrete repairs, and miscellaneous concrete work as shown in the Contract Documents.

1.3.3.2 Unit of Measure

Unit of measure: job.

1.3.4 Turbine and Mechanical Installation

1.3.4.1 Payment

Turbine and Mechanical Installation includes bid items 13 through 21. Payment will be made for costs associated with providing all labor, materials, and equipment necessary to complete turbine and distributor piping installation, turbine isolation valve installation, governor and hydraulic power unit installation, and cooling water system installation under the direction of the equipment SUPPLIER. Also included are all costs associated with the supply and installation of the oil-water separator, piping, and appurtenances, miscellaneous insulation, coatings, and pipe identification markings, plant HVAC system modifications, and the design, supply, and installation of the generator fire suppression system as shown in the Contract Documents.

1.3.4.2 Unit of Measure

Unit of measure: job.

1.3.5 Generator and Electrical Installation

1.3.5.1 Payment

Generator and Electrical Installation includes bid items 22 through 29. Payment will be made for costs associated with providing all labor, materials, and equipment necessary to handle, set, assemble and install the complete vertical shaft generator, generator bus and cable, generator breaker and switchgear, step-up transformer, medium voltage cable and terminations, low voltage power distribution and motor control, grounding and bonding, lighting, receptacles, and miscellaneous electrical work as described in the Contract Documents.

1.3.5.2 Unit of Measure

Unit of measure: job.

1.3.6 Controls and Protection

1.3.6.1 Payment

Controls and Protection includes bid items 30 through 34. Payment will be made for costs associated with providing all plant, labor, materials, and equipment necessary to perform unit control panel and PLC installation, governor control panel installation, installation of generator protection, metering, and synchronizing systems, SCADA, communications, and plant control integration, and instrumentation, control cable, and terminations as shown in the Contract Documents.

1.3.6.2 Unit of Measure

Unit of measure: job.

1.3.7 Testing and Closeout

1.3.7.1 Payment

Testing and Closeout includes bid items 35 through 41. Payment will made for costs associated with providing all labor, materials, and equipment necessary to perform all Contractor led test activities described in the Contract Documents, and to support the equipment SUPPLIER led unit startup and commissioning activities as described in the Contract Documents. These activities include, but are not limited to, pre-commissioning and checkout activities, startup and commissioning support, acceptance and performance testing, ten-day operational test support, training support, closeout documentation, and spare parts, special tooling, and maintenance materials.

1.3.7.2 Unit of Measure

Unit of measure: job.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910 Occupational Safety and Health Standards

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

View Location Map

Progress and Completion Pictures

1.3 VIEW LOCATION MAP

Submit, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.4 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color minimum resolution in JPEG file format showing the sequence and progress of work. Take a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten different viewpoints selected by the Contractor unless otherwise directed by the OWNER. Submit the digital photographs taken each month with the monthly invoice. Indicate photographs demonstrating environmental procedures. Provide photographs for each month in a separate monthly directory and name each file to indicate its location on the view location sketch. Include a date designator in file names. Photographs provided are for unrestricted use by the OWNER.

1.5 MINIMUM INSURANCE REQUIREMENTS

Provide the minimum insurance coverage required by the OWNER during the entire period of performance under this contract. Provide other insurance coverage as required by Alaska State law.

1.6 SUPERVISION

1.6.1 Superintendent Qualifications

Provide project superintendent with a minimum of 10 years experience in construction with at least 5 of those years as a superintendent on projects similar in size and complexity. The individual must be familiar with the requirements of 29 CFR 1910 (OSHA) and have experience in the areas of hazard identification and safety compliance. The individual must be capable of interpreting a critical path schedule and construction drawings. The qualification requirements for the alternate superintendent are the same as for the project superintendent. The OWNER may request proof of the superintendent's qualifications at any point in the project if the performance of the superintendent is in question.

For projects where the superintendent is permitted to also serve as the Quality Control (QC) Manager as established in Section 01 45 00 QUALITY CONTROL, the superintendent must have qualifications in accordance with that section.

1.6.2 Minimum Communication Requirements

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of Contract work. In addition, if a Quality Control (QC) representative is required on the Contract, then that individual must also have fluent English communication skills.

1.6.3 Duties

The project superintendent is primarily responsible for managing subcontractors and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend partnering meetings, and quality control meetings. The superintendent or qualified alternative must be on-site at all times during the performance of this contract until the work is completed and accepted.

1.6.4 Non-Compliance Actions

The Project Superintendent is subject to removal by the OWNER for non-compliance with requirements specified in the contract and for failure to manage the project to ensure timely completion. Furthermore, the OWNER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders is acceptable as the subject of claim for extension of time for excess costs or damages by the Contractor.

1.7 PRECONSTRUCTION CONFERENCE

Immediately after award, prior to commencing any work at the site, coordinate with the OWNER a time and place to meet for the Preconstruction Conference. The conference must take place within 35 calendar days after award of the contract, but prior to commencement of any work at the site. The purpose of this conference is to discuss and develop a mutual understanding of the administrative requirements of the Contract including but not limited to: daily reporting, invoicing, safety, base-access, outage requests, hot work permits, schedule requirements, quality control, schedule of prices or earned value report, shop drawings, submittals,

cybersecurity, prosecution of the work, OWNER acceptance, final inspections and contract close-out. Contractor must present and discuss their basic approach to scheduling the construction work and any required phasing.

1.7.1 Attendees

Contractor attendees must include the Project Manager, Superintendent, Site Safety and Health Officer (SSHO), Quality Control Manager and major subcontractors.

1.8 BUILD AMERICA, BUY AMERICA ACT COMPLIANCE

Work under this contract must comply with the Build America, Buy America Act (BABA). Compliance includes, but is not limited to, sourcing domestic steel for all steel used as part of the construction work, and complying with BABA reporting requirements.

1.9 MOBILIZATION

Contractor shall mobilize to the jobsite within 30 calendar days after notice to proceed. Mobilize is defined as having equipment AND having a physical presence of at least one person from the contractor's team on the jobsite.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 32 01

PROJECT SCHEDULE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AACE INTERNATIONAL (AACE)

AACE 29R-03	(2011) Forensic Schedule Analysis
AACE 52R-06	(2006) Time Impact Analysis - As Applied in Construction
AACE 84R-13	(2015) Planning and Accounting for Adverse Weather

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 67-17	(2017) Schedule Delay Analysis

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Project Scheduler Qualifications; O

Preliminary Project Schedule; O

Initial Project Schedule; O

Periodic Schedule Update; O

1.3 PROJECT SCHEDULER QUALIFICATIONS

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating and production of reports. The Designated Project Scheduler must have prepared and maintained at least three previous construction schedules for projects of similar size and complexity to this contract, using Primavera P6. Representative must have a comprehensive knowledge of CPM scheduling principles and application.

PART 2 PRODUCTS

2.1 SOFTWARE

The scheduling software utilized to produce and update the schedules required herein must be capable of meeting all requirements of this specification. Utilize a purpose built scheduling software such as Primavera P6, or Microsoft Project.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein. Show in the schedule the proposed sequence to perform the work and dates contemplated for starting and completing all schedule activities. The scheduling of the entire project is required. The scheduling of construction is the responsibility of the Contractor. Contractor management personnel must actively participate in its development. Subcontractors, and suppliers working on the project must also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool. Use the Critical Path Method (CPM) of network calculation to generate all Project Schedules. Prepare each Project Schedule using the Precedence Diagram Method (PDM).

3.1.1 Scheduling Expectations Kickoff Meeting(SEKO)

In conjunction with the post award conference or pre construction conference the OWNER and the Contractor will hold a separate and distinct Scheduling Expectations Kickoff Meeting(SEKO). The intent of this meeting is for the OWNER to review with the contractor the requirements of the scheduling specification, communicate the OWNER’s expectations regarding schedule development and management, and answer any questions the Contractor may have regarding the schedule requirements.

3.2 BASIS FOR PAYMENT AND COST LOADING

The schedule is the basis for determining contract earnings during each update period and therefore the amount of each progress payment. The aggregate value of all activities coded to a contract bid item must equal the value of the bid item. Match the progress payment "Pay Period Thru" date in RMS to the schedule data date.

3.2.1 Activity Cost Loading

Activity cost loading must be reasonable and without front-end loading. Activities with a negative cost loading is not allowed. Provide additional documentation to demonstrate reasonableness if requested by the OWNER.

3.2.2 Cost Loading of Submittals

No costs are to be assigned to activities for the preparation, review, or approval of submittals, except as described under paragraph COST LOADING OF CLOSEOUT ACTIVITIES, paragraph AS-BUILT DRAWINGS, and paragraph O&M MANUALS.

3.2.3 Withholdings / Payment Rejection

Failure to meet the requirements of this specification may result in the disapproval of the preliminary, initial, or periodic schedule updates and subsequent rejection of payment requests until compliance is met.

In the event that the OWNER directs schedule revisions and those revisions have not been included in subsequent Project Schedule revisions or updates, the OWNER may withhold 10 percent of pay request amount from each payment period until such revisions to the project schedule have been made.

3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

3.3.1 Level of Detail Required

Develop the Project Schedule to the appropriate level of detail to address major milestones and to allow for satisfactory project planning and execution. Failure to develop the Project Schedule to an appropriate level of detail will result in its disapproval. The OWNER will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Non-procurement activities Original Durations (OD) are not to exceed 20 workdays or 30 calendar days.

3.3.3 Procurement Activities

Include in the schedule activities associated with the critical submittals and their approvals, procurement, fabrication, and delivery of long lead materials, equipment, fabricated assemblies, and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days.

3.3.4 Mandatory Activities

Include the following activities in the initial project schedule and all updates.

a. Submission, review and acceptance of SD-01 Preconstruction Submittals (individual activity for each).

b. Submission, review and acceptance of work plans, installation plans, startup and testing plans.

c. Submission of mechanical/electrical/information systems layout drawings.

d. Submission and approval of O & M manuals.

e. Submission and approval of as-built drawings.

f. Submission and approval of installed equipment lists.

g. Submission and approval of testing and air balance (TAB).

h. Submission of TAB specialist design review report.

i. Submission and approval of fire protection specialist.

j. Contractor's pre-final inspection.

k. Correction of punch list from Contractor's pre-final inspection.

l. OWNER's pre-final inspection.

m. Correction of punch list from OWNER's pre-final inspection.

n. Final inspection.

3.3.5 OWNER Activities

Show in schedule, OWNER and other agency activities that could impact progress. These activities include, but are not limited to approvals, environmental permit approvals by State regulators, inspections, utility tie-in, OWNER Furnished Equipment (OFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.6 Contract Milestones and Constraints

Milestone activities are to be used for significant project events including, but not limited to, project phasing, project start and end activities, or interim completion dates. The use of artificial float constraints such as "zero free float" or "zero total float" are prohibited.

Mandatory constraints that ignore or affect network logic are prohibited. No constrained dates are allowed in the schedule other than those specified herein. Submit additional constraints to the OWNER for approval on a case by case basis.

3.3.6.1 Project Start Date Milestone and Constraint

The first activity in the project schedule must be a start milestone titled "NTP Acknowledged," which must have a "Start On" constraint date equal to the date that the NTP is acknowledged.

3.3.6.2 End Project Finish Milestone and Constraint

The last activity in the schedule must be a finish milestone titled "End Project."

Constrain the project schedule to the Contract Completion Date in such a way that if the schedule calculates an early finish, then the float calculation for "End Project" milestone reflects positive float on the longest path. If the project schedule calculates a late finish, then the "End Project" milestone float calculation reflects negative float on the longest path.

3.3.6.3 Interim Completion Dates and Constraints

Constrain contractually specified interim completion dates to show negative float when the calculated late finish date of the last activity in that phase is later than the specified interim completion date.

3.3.6.3.1 Start Phase

Use a start milestone as the first activity for a project phase. Call the start milestone "Start Phase X" where "X" refers to the phase of work.

3.3.6.3.2 End Phase

Use a finish milestone as the last activity for a project phase. Call the finish milestone "End Phase X" where "X" refers to the phase of work.

3.3.7 Adverse Weather

Ensure anticipated adverse weather is accounted for in the Project Schedule. AACE 84R-13 provides methodologies for techniques in planning for adverse weather. The preferred methodology is the use of a weather calendar. If a method other than a weather calendar is proposed, discuss the reason during the SEKO meeting.

3.3.8 Calendars

Schedule activities on a Calendar to which the activity logically belongs. Develop calendars to accommodate any contract defined work period such as a 7-day calendar for OWNER Acceptance activities, concrete cure times, etc. Develop the default Calendar to match the physical work plan with non-work periods identified including weekends and holidays. Develop Seasonal Calendar(s) and assign to seasonally affected activities as applicable.

If a weather calendar is used its implementation and execution is to be in accordance with AACE 84R-13

3.3.9 Open Ended Logic

Only two open ended activities are allowed: the first activity "NTP Acknowledged" is to have no predecessor logic, and the last activity -"End Project" is to have no successor logic. Except as noted above, each activity must have at least a start-to-start or finish-to-start relationship with its predecessor and a finish-to-finish or finish-to-start relationship with its successor.

Predecessor open ended logic may be allowed in a time impact analyses upon the OWNER's approval.

3.3.10 Default Progress Data Disallowed

Actual Start and Finish dates must not automatically update with default mechanisms included in the scheduling software. Updating of the percent complete and the remaining duration of any activity must be independent functions. Disable program features that calculate one of these parameters from the other. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process must match those dates provided in the Contractor Quality Control Reports. Failure to document the AS and AF dates in the Daily Quality Control report will result in disapproval of the Contractor's schedule.

3.3.11 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a

case-by-case basis subject to approval by the OWNER. Propose logic corrections to eliminate out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Address out of sequence progress or logic changes in the Narrative Report and in the periodic schedule update meetings.

3.3.12 Added and Deleted Activities

Do not delete activities from the project schedule or add new activities to the schedule without approval from the OWNER. Activity ID and description changes are considered new activities and cannot be changed without OWNER approval.

3.3.13 Original Durations

Activity Original Durations (OD) must be reasonable to perform the work item. OD changes are prohibited unless justification is provided and approved by the OWNER.

3.3.14 Leads, Lags, and Start to Finish Relationships

Lags must be reasonable as determined by the OWNER and not used in place of realistic original durations, must not be in place to artificially absorb or create float, or to replace proper schedule logic.

a. Leads (negative lags) are prohibited.

b. Start to Finish (SF) relationships are prohibited.

3.3.15 Retained Logic

Schedule calculations must retain the logic between predecessors and successors ("retained logic" mode) even when the successor activity(s) starts and the predecessor activity(s) has not finished (out-of-sequence progress). Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") are not be allowed.

3.3.16 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete to allow for proper schedule management. Budgeted cost of activity is to be reduced by the amount needed to correct deficiency. The activity referenced in paragraph COST LOADING of CLOSEOUT ACTIVITIES must have its budgeted cost increased by this amount.

3.3.17 Remaining Duration

Update the remaining duration for each activity based on the number of estimated workdays it will take to complete the activity. Remaining duration may not mathematically correlate with percentage found under paragraph entitled Percent Complete. The remaining duration for unstarted activities are not to be less than its original duration.

3.3.18 Cost Loading of Closeout Activities

Cost load the "Correction of punch list from OWNER pre-final inspection" activity(ies) not less than 1 percent of the present contract value. Activity(ies) may be declared 100 percent complete upon the OWNER's verification of completion and correction of all punch list work identified during OWNER pre-final inspection(s).

3.3.18.1 As-Built Drawings

If there is no separate contract bid item for as-built drawings, cost load the "Submission and approval of as-built drawings" activity not less than $35,000 or 1 percent of the present contract value, which ever is greater, up to $200,000. Activity will be declared 100 percent complete upon the OWNER's approval.

3.3.18.2 O & M Manuals

Cost load the "Submission and approval of O & M manuals" activity not less than $20,000. Activity will be declared 100 percent complete upon the OWNER's approval of all O & M manuals.

3.3.19 Early Completion Schedule and the Right to Finish Early

An Early Completion Schedule is an Initial Project Schedule (IPS) that indicates all scope of the required contract work will be completed before the contractually required completion date.

a. No IPS indicating an Early Completion will be accepted without being fully resource-loaded (including crew sizes and hours) and the OWNER agreeing that the schedule is reasonable and achievable.

b. The OWNER is under no obligation to accelerate work items it is responsible for to ensure that the early completion is met nor is it responsible to modify incremental funding (if applicable) for the project to meet the contractor's accelerated work.

3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data reports and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS. If the Contractor fails or refuses to furnish the information and schedule updates as set forth herein, the Contractor will be deemed not to have provided an estimate upon which a progress payment can be made.

Review comments made by the OWNER on the schedule(s) do not relieve the Contractor from compliance with requirements of the Contract Documents.

3.4.1 Preliminary Project Schedule Submission

Within 15 calendar days after the NTP is acknowledged, submit the Preliminary Project Schedule defining the planned operations detailed for the first 90 calendar days for approval. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award bid items shown on the Price Schedule. The Preliminary Project Schedule may be summary in nature for the remaining performance period. It must be early start and late finish constrained and

logically tied as specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required plan and program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, Work Plans, Product Data Submittals, etc.) as well as other non-construction activities intended to occur within the first 90 calendar days. OWNER acceptance of all other specified Program and Plan approvals must occur prior to any planned construction activities.

3.4.2 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after notice to proceed is issued. The schedule must demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. No payment will be made for work items not fully detailed in the Project Schedule.

3.4.3 Periodic Schedule Updates

Update the Project Schedule on a regular basis, monthly at a minimum. Provide a draft Periodic Schedule Update for review at the schedule update meetings as prescribed in the paragraph PERIODIC SCHEDULE UPDATE MEETINGS. These updates will enable the OWNER to assess Contractor's progress.

a. Update information including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete. Updated information is subject to the approval of the OWNER at the meeting.

b. AS and AF dates must match the date(s) reported on the Contractor's Quality Control Report for an activity start or finish.

3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

3.5.1 Electronic Scheduling Data

Provide electronic scheduling data containing the current project schedule and all previously submitted schedules in the format of the scheduling software (e.g. .xer). Also include the Narrative Report and all required Schedule Reports. The electronic file is to identify the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and schedule file name. Each schedule must have a unique file name and use project specific settings. The file naming convention is to be determined at SEKO meeting.

3.5.2 Narrative Report

Provide a Narrative Report with each schedule submission. The Schedule Narrative Report is a "stand alone" report in PDF or Word format. Title the report "Schedule Narrative Report". Show the Report date, schedule name, and contract number on the first page. Indicate who is responsible for the schedule update and narrative report. Provide a brief description of the Project Scope. The Narrative Report is expected to communicate to the OWNER the thorough analysis of the schedule output and the plans to compensate for problems, either current or potential, which are revealed through that analysis. Include the following information at a minimum in

the Narrative Report:

a. Identify and discuss the work scheduled to start in the next update period.

b. Describe activities along the critical path in addition to activities on the next float path after the critical path.

c. Describe current and anticipated problem areas, delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. Identify the party responsible for delay, if applicable.

d. Identify and explain why activities, based on their calculated late dates, should have either started or finished during the update period but did not.

e. Identify and discuss all schedule changes by activity ID and activity name including what specifically was changed and why the change was needed. Include at a minimum new and deleted activities, logic changes, duration changes, calendar changes, lag changes, resource changes, and actual start and finish date changes.

f. Identify and discuss out-of-sequence work.

g. If the longest path changes from a monthly update to the next, provide an explanation of the factors driving the change.

h. Respond to OWNER Schedule Review Comments from the previous update(s).

3.5.3 Schedule Reports

The format, filtering, organizing, and sorting for each schedule report will be as directed by the OWNER. Typically, reports contain Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. Provide the reports electronically in .pdf format. The following lists typical reports that will be requested:

3.5.3.1 Activity Report

List of all activities sorted according to activity number.

3.5.3.2 Logic Report

List of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.3.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.3.4 Earnings Report by bid item

A compilation of the Total Earnings on the project from the NTP to the

data date, which reflects the earnings of activities based on the agreements made in the schedule update meeting defined herein. Provided a complete schedule update has been furnished, this report serves as the basis of determining progress payments. Group activities by bid item number and sort by activity number. Provide a total bid item percent earned value, bid item percent complete, and project percent complete. The printed report must contain the following for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Earnings to Date, Earnings this period, Total Quantity, Quantity to Date, and Percent Complete (based on cost).

3.5.3.5 Scheduling and Leveling Report

Provide a Scheduling/Leveling Report generated from the current project schedule being submitted.

3.5.4 Network Diagram

The Network Diagram is required for the Preliminary, Initial and Periodic Updates. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The OWNER will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.4.1 Continuous Flow

Show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.4.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.4.3 Critical Path

Show all activities on the critical path. The critical path is defined as the longest path.

3.5.4.4 Grouping and Sorting

Group and sort activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by major elements of work, category of work, work area and/or responsibility.

3.5.4.5 Cash Flow / Schedule Variance Control (SVC) Diagram

With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates, and 2) Earned Value to-date.

3.6 PERIODIC SCHEDULE UPDATE

Submit the complete Periodic Schedule Update of the Project Schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS.

3.7 WEEKLY PROGRESS MEETINGS

Conduct a weekly meeting with the OWNER (or as otherwise mutually agreed to) between the meetings described in paragraph entitled PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. Use the current approved schedule update for the purposes of this meeting and for the production and review of reports. At the weekly progress meeting, address the status of RFIs, RFPs and Submittals.

3.8 REQUESTS FOR TIME EXTENSIONS

ASCE 67-17 provides delay analysis guidelines. If there is a conflict between the contract and guidance provided in ASCE 67-17, the contract will govern. Provide justification of delay to the OWNER in accordance with the contract provisions and clauses for approval, within 10 days of a delay occurring. Also prepare a time impact analysis for each OWNER request for proposal (RFP).

3.8.1 Justification of Delay

Provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify all schedule activities impacted. Show that the event that caused the delay/impact was the responsibility of the OWNER. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion date, or interim completion date(s). Evaluate multiple impacts chronologically; each with its own justification of delay. With multiple impacts consider any concurrency of delay. A time extension and the schedule fragnet becomes part of the project schedule and all future schedule updates upon approval by the OWNER.

3.8.2 Changes That Do Not Cause Delay

If it is determined that a change does not constitute a schedule time extension, a fragnet as described in paragraph FRAGMENTARY NETWORK, is to be created and inserted into the Project schedule.

3.8.3 Time Impact Analysis (Prospective Analysis)

Submit requests for time extensions based on a prospective analysis if the work involved or the impact identified has not already occurred. Where the impact is ongoing a prospective analysis may be considered. However, the OWNER reserves the right to require a retrospective analysis be prepared after the impact has ended.

Prepare a time impact analysis for approval by the OWNER based on industry recommended practice AACE 52R-06. Utilize a copy of the last approved schedule prior to the first day of the impact or delay for the time impact analysis. If OWNER determines the time frame between the last approved schedule and the first day of impact is too great, prepare an interim updated schedule to perform the time impact analysis. Unless approved by the OWNER, no other changes may be incorporated into the schedule being used to justify the time impact.

3.8.4 Forensic Schedule Analysis (Retrospective Analysis)

Submit requests for time extensions based on a retrospective analysis if

the work involved or the impact identified has already occurred. The analysis must account for the actual performance of both the impacted work and all other contract work in the schedule.

If a methodology is chosen from AACE 29R-03, the method must adhere to the principles identified in ASCE 67-17. If there is a conflict with the methodology chosen from AACE 29R-03 and ASCE 67-17, ASCE 67-17 will govern. Choice of methodology should be discussed prior to submission to OWNER.

3.8.5 Fragmentary Network (Fragnet)

Prepare a proposed fragnet for time impact analysis consisting of a sequence of new activities that are proposed to be added to the project schedule to demonstrate the influence of the delay or impact to the project's contractual dates. Clearly show how the proposed fragnet is to be tied into the project schedule including all predecessors and successors to the fragnet activities. The proposed fragnet must be approved by the OWNER prior to incorporation into the project schedule.

3.8.6 Time Extension

The OWNER must approve the Justification of Delay including the time impact analysis before a time extension will be granted. No time extension will be granted unless the delay consumes all available Project Float and extends the projected finish date ("End Project" milestone) beyond the Contract Completion Date. The time extension will be in calendar days.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, are not a cause for an extension to the performance period, completion date, or any interim milestone date.

3.8.7 Impact to Early Completion Schedule

No extended overhead will be paid for delay prior to the original Contract Completion Date for an Early Completion IPS unless the Contractor actually performed work in accordance with that Early Completion Schedule. The Contractor must show that an early completion was achievable had it not been for the impact.

3.9 FAILURE TO ACHIEVE PROGRESS

Should the progress fall behind the approved project schedule for reasons other than those that are excusable within the terms of the contract, the OWNER may require provision of a written recovery plan for approval. The plan must detail how progress will be made-up to include which activities will be accelerated by adding additional crews, longer work hours, extra workdays, etc.

3.9.1 Artificially Improving Progress

Artificially improving progress by means such as, but not limited to, revising the schedule logic, modifying, or adding constraints, shortening activity durations, or changing calendars in the project schedule is prohibited. Indicate assumptions made and the basis for any logic, constraint, duration, and calendar changes used in the creation of the recovery plan. Any additional resources, manpower, or daily and weekly

work hour changes proposed in the recovery plan must be evident at the work site and documented in the daily report along with the Schedule Narrative Report.

3.9.2 Failure to Perform

Failure to perform work and maintain progress in accordance with the supplemental recovery plan may result in an interim and final unsatisfactory performance rating and may result in corrective action directed by the OWNER, and other contract provisions.

3.9.3 Recovery Schedule

Should the OWNER find it necessary, submit a recovery schedule detailing how lost time will be made up.

3.10 OWNERSHIP OF FLOAT

Except for the provision given in the paragraph IMPACT TO EARLY COMPLETION SCHEDULE, float available in the schedule, at any time, belongs to the Project and is available for Contractor and OWNER use. This includes activity and project float. Activity float is the number of workdays that an activity can be delayed without causing a delay to the "End Project" finish milestone. Project float (if applicable) is the number of work days between the projected early finish and the "End Project" finish.

3.11 PRIMAVERA P6 MANDATORY REQUIREMENTS

Should the CONTRACTOR use Primavera P6 to develop the project schedule, e nsure Primavera P6 settings provide a schedule capable of fulfilling the requirements of the contract. The following settings are mandatory and required in all schedule submissions to the OWNER:

a. Activity Codes must be Project Level, not Global or EPS level.

b. Calendars must be Project Level, not Global or Resource level.

c. Activity Duration Types must be set to "Fixed Duration & Units".

d. Percent Complete Types must be set to "Physical".

e. Time Period Admin Preferences must remain the default "8.0 hr/day, 40 hr/week, 172 hr/month, 2000 hr/year". Set Calendar Work Hours/Day to 8.0 Hour days.

f. Set Schedule Option for defining Critical Activities to "Longest Path".

g. Set Schedule Option for defining progressed activities to "Retained Logic".

h. Set up cost loading using a single lump sum non-labor resource. The Price/Unit must be $1/hr, Default Units/Time must be "8h/d", and settings "Auto Compute Actuals" and "Calculate costs from units" un-selected.

i. Activity ID's must not exceed 10 characters.

j. Activity Names must have a verb-noun structure and contain the most defining and detailed description within the first 30 characters.

k. The daily ending hour for all work calendars must be the same.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Submittal Information

The OWNER may request submittals in addition to those specified when deemed necessary to adequately describe the Work covered in the respective sections and to verify compliance with the Contract Documents. Such requested submittals are considered incidental to the Work and shall be provided at no additional cost to the OWNER. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with Contract requirements.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

1.1.2 Project Type

The Contractor's Quality Control (CQC) System Manager must check and approve all items before submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

1.1.3 Submission of Submittals

Schedule and provide submittals requiring OWNER approval before acquiring the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Safety Data Sheets (SDS) and in compliance with existing laws and regulations.

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

Submittal requirements are specified in the technical sections. Examples and descriptions of submittals identified by the Submittal Description (SD) numbers and titles follow:

SD-01 Preconstruction Submittals

Submittals that are required prior to or at the start of construction (work) or the next major phase of the construction on a multiphase contract. Preconstruction Submittals include schedules and a tabular list of locations, features, and other pertinent information regarding products, materials, equipment, or components to be used in the work.

Submittal Register

Project Schedule

Mobilization and Remote Logistics Plan

Construction Site Plan

Receiving, Storage, Preservation,and Protection Plan for OFE

Rigging/Lift Plan for major OFE components

Outage and Access Coordination Plan

Temporary Utilities Plan

Certificates Of Insurance

Surety Bonds

List Of Proposed Subcontractors

List Of Proposed Products

Baseline Network Analysis Schedule (NAS)

Submittal Register

Schedule Of Prices Or Earned Value Report

Accident Prevention Plan

Work Plan

Quality Control (QC) plan

Environmental Protection Plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those that will be removed at conclusion of the work.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report that includes findings of a test required to be performed on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report that includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily logs and checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that the product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods, or personnel qualifications.

Confined space entry permits

Text of posted operating instructions

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Safety Data Sheets(SDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data provided by the manufacturer, or the system provider, including manufacturer's help and product line documentation, necessary to maintain and install equipment, for operating and maintenance use by facility personnel.

Data required by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

Data incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Submittals required for Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.2.2 Approving Authority

Approval authority for all submittals is the OWNER or the OWNER's REPRESENTATIVE.

1.2.3 Work

As used in this section, on-site and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction. In exception, excludes work to produce SD-01 submittals.

1.3 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submittal Register; O

Mobilization and Remote Logistics Plan; O

Receiving, Storage, Preservation,, and Protection Plan for OFE; O
Rigging/Lift Plan for Major OFE Components; O
Outage and Access Coordination Plan; O
Temporary Utilities Plan; O

1.4 SUBMITTAL CLASSIFICATION

1.4.1 OWNER Approved (O)

OWNER approval is required for extensions of design, critical materials, calculations, shop drawings, variations, equipment whose compatibility with the entire system must be checked, and other items as designated by the OWNER.

1.4.2 For Information Only

Submittals not requiring OWNER approval will be for information only.

1.5 PREPARATION

1.5.1 Transmittal Form

Develop and use a standard transmittal form for submitting both OWNER -approved and information-only submittals. Include on the form pertinent information such as the date, specification section and paragraph, sheet number, submittal item description, and transmittal number. Also indicate that the submittal has been reviewed and approved by the Quality Control Manager.

1.5.2 Submittal Format

1.5.2.1 Format of SD-01 Preconstruction Submittals

When the submittal includes a document that is to be used in the project, or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.5.2.2 Format for SD-02 Shop Drawings

Provide shop drawings not less than 11 by 17 inches nor more than 22 by 34 inches, except for full-size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless another form is required. Ensure drawings are suitable for reproduction and of a quality to produce

clear, distinct lines and letters, with dark lines on a white background.

a. Include the nameplate data, size, and capacity on drawings. Also include applicable federal, military, industry, and technical society publication references.

b. Dimension drawings, except diagrams and schematic drawings. Prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Submit an electronic copy of drawings in PDF format and native electronic format.

1.5.2.2.1 Drawing Identification

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph IDENTIFYING SUBMITTALS.

Number drawings in a logical sequence. Each drawing is to bear the number of the submittal in a uniform location next to the title block. Place the OWNER contract number in the margin, immediately below the title block, for each drawing.

Reserve a blank space, no smaller than 2 by 2 inches on the right-hand side of each sheet for the OWNER disposition stamp.

1.5.2.3 Format of SD-03 Product Data

Present product data submittals for each section. Include a table of contents, listing the page and catalog item numbers for product data.

Indicate, by prominent notation, each product that is being submitted; indicate the specification section number and paragraph number to which it pertains. Clearly highlight all options or information that applies to each product being submitted. Strike through or cross out all non-applicable options or information.

1.5.2.3.1 Product Information

Supplement product data with material prepared for the project to satisfy the submittal requirements where product data does not exist. Identify this material as developed specifically for the project, with information and format as required for submission of SD-07 Certificates.

Provide product data in units used in the Contract documents. Where product data are included in preprinted catalogs with another unit, submit the dimensions in contract document units, on a separate sheet.

1.5.2.3.2 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the

label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the OWNER. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.2.3.3 Data Submission

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal that is marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will not be accepted for expedition of the construction effort.

Submit the manufacturer's instructions before installation.

1.5.2.4 Format of SD-04 Samples

1.5.2.4.1 Sample Characteristics

Furnish samples in the following sizes, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.

c. Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

e. Sample Volume of Nonsolid Materials: Pint. Examples of nonsolid materials are sand and paint.

f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

g. Sample Panel: 4 by 4 feet.

h. Sample Installation: 100 square feet.

1.5.2.4.2 Sample Incorporation

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at the time of use.

Recording of Sample Installation: Note and preserve the notation of any area constituting a sample installation, but remove the notation at the final clean-up of the project.

1.5.2.4.3 Comparison Sample

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.5.2.5 Format of SD-05 Design Data

Provide design data and certificates in electronic format on 8 1/2 by 11 inch sheet size.

1.5.2.6 Format of SD-06 Test Reports

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.5.2.7 Format of SD-07 Certificates

Provide design data and certificates in electronic format on 8 1/2 by 11 inch sheet size.

1.5.2.8 Format of SD-08 Manufacturer's Instructions

Present manufacturer's instructions submittals for each section. Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry, and technical-society publication references. If supplemental information is needed to clarify the manufacturer's data, submit it as specified for SD-07 Certificates.

Submit the manufacturer's instructions before installation.

1.5.2.8.1 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the OWNER. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.2.9 Format of SD-09 Manufacturer's Field Reports

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report

pertains.

1.5.2.10 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.5.2.11 Format of SD-11 Closeout Submittals

When the submittal includes a document that is to be used in the project or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.5.3 Source Drawings for Shop Drawings

1.5.3.1 Source Drawings

The entire set of source drawing files (DWG) will not be provided to the Contractor. Request the specific Drawing Number for the preparation of shop drawings. Only those drawings requested to prepare shop drawings will be provided. These drawings are provided only after award.

1.5.3.2 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse is at the sole risk of the Contractor and without liability or legal exposure to the OWNER. The Contractor must make no claim, and waives to the fullest extent permitted by law any claim or cause of action of any nature against the OWNER, its agents, or its subconsultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the OWNER harmless against all damages, liabilities, or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic source drawing files are not construction documents. Differences may exist between the source drawing files and the corresponding construction documents. The OWNER makes no representation regarding the accuracy or completeness of the electronic source drawing files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. The Contractor is responsible for determining if any conflict exists. In the event that a conflict arises between the signed and sealed construction documents prepared by the OWNER and the furnished source drawing files, the signed and sealed construction documents govern. Use of these source drawing files does not relieve the Contractor of the duty to fully comply with the contract documents, including and without limitation the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction data related to this contract, remove all previous indication of ownership (seals, logos, signatures, initials and dates).

1.5.4 Electronic File Format

Provide submittals in electronic format, with the exception of material samples required for SD-04 Samples items. In addition to the electronic submittal, provide one hard copy of Record Drawing and Operations and Maintenance Manual submittals. Compile the submittal file as a single, complete document, to include the Transmittal Form described within, and also separately attach the native files which were used to create PDF. The attached files should include the original digital files used to create the submittal. Name the electronic submittal file specifically according to its contents, and coordinate the file naming convention with the OWNER. Electronic files must be of sufficient quality that all information is legible. Use PDF as the electronic format, unless otherwise specified or directed by the OWNER. When electronic files exceed practical e-mail transfer limits, provide submittals through an electronic file sharing system as directed by the OWNER. Generate PDF files from original documents with bookmarks so that the text included in the PDF file is searchable and can be copied. If documents are scanned, optical character resolution (OCR) routines are required. Index and bookmark files exceeding 30 pages to allow efficient navigation of the file. When required, the electronic file must include a valid electronic signature or a scan of a signature.

E-mail electronic submittal documents smaller than 10MB to an e-mail address as directed by the OWNER. Provide electronic documents over 10 MB through an electronic file sharing system such as DropBox as directed by the OWNER.

1.6 QUANTITY OF SUBMITTALS

1.6.1 Number of SD-01 Preconstruction Submittal Copies

Unless otherwise specified, submit one set of administrative submittals.

1.6.2 Number of SD-04 Samples

a. Submit two samples, or two sets of samples showing the range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in the technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of nonsolid materials.

1.7 INFORMATION ONLY SUBMITTALS

Submittals without an "O" designation must be certified by the QC manager and submitted to the OWNER for information-only. Provide information-only submittals to the OWNER a minimum of 14 calendar days prior to the Preparatory Meeting for the associated Definable Feature of Work (DFOW). Approval of the OWNER is not required on information only submittals. The OWNER will mark "receipt acknowledged" on submittals for information and will return only the transmittal cover sheet to the Contractor. Normally, submittals for information only will not be returned. However, the OWNER

reserves the right to return unsatisfactory submittals and require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the OWNER from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the OWNER laboratory or for check testing by the OWNER in those instances where the technical specifications so prescribe.

1.8 PROJECT SUBMITTAL REGISTER

A sample Project Submittal Register showing items of equipment and materials for when submittals are required by the specifications is provided as "Attachment A - Submittal Register."

1.8.1 Submittal Management

Prepare and maintain a submittal register, as the work progresses. Do not change data that is output in columns (c), (d), (e), and (f) as delivered by OWNER; retain data that is output in columns (a), (g), (h), and (i) as approved. As an attachment, provide a submittal register showing items of equipment and materials for which submittals are required by the specifications. This list may not be all-inclusive and additional submittals may be required. The OWNER will provide the initial submittal register in electronic format with the following fields completed.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD Number. and type, e.g., SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in each specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting the project requirements.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns and all dates on which submittals are received by and returned by the OWNER.

1.8.2 Preconstruction Use of Submittal Register

Submit the submittal register. Include the QC plan and the project schedule. Verify that all submittals required for the project are listed and add missing submittals. Coordinate and complete the following fields on the register submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for the approving authority to receive submittals.

Column (h) Contractor Approval Date: Date that Contractor needs

approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.8.3 Contractor Use of Submittal Register

Update the following fields in the OWNER-furnished submittal register program or equivalent fields in the program used by the Contractor with each submittal throughout the contract.

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) Date submittal transmitted.

Column (q) Date approval was received.

1.8.4 Approving Authority Use of Submittal Register

Update the following fields:

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (l) Date submittal was received.

Column (m) through (p) Dates of review actions.

Column (q) Date of return to Contractor.

1.8.5 Action Codes

Submittals reviewed by the OWNER will be given the following action codes upon return to the Contractor:

Approved: The submittal is approved and the Contractor may proceed with the applicable portion of the work.

Approved as Noted: Minor discrepancies have been noted by the OWNER that do not affect overall approval of the submittal. Contractor may proceed with the applicable portion of the work after incorporating the noted corrections.

Revise and Resubmit: Major discrepancies have been noted by the OWNER. Contractor is to revise and resubmit the submittal for approval.

Rejected: The submittal does not meet the contract requirements and must be corrected and resubmitted.

For Record Only: Provides OWNER acknowledgement of For Information Only submittals.

1.8.6 Delivery of Copies

Submit an updated electronic copy of the submittal register to the OWNER with each invoice request. Provide an updated Submittal Register monthly regardless of whether an invoice is submitted.

1.9 VARIATIONS

Variations from contract requirements require OWNER approval, and will be considered where advantageous to the OWNER.

1.9.1 Considering Variations

Discussion of variations with the OWNER before submission of a variation submittal will help ensure that functional and quality requirements are met and minimize rejections and resubmittals. For variations that include design changes or some material or product substitutions, the OWNER may require an evaluation and analysis by a licensed professional engineer hired by the contractor.

Specifically point out variations from contract requirements in a variation submittal. Failure to point out variations may cause the OWNER to require rejection and removal of such work at no additional cost to the OWNER.

1.9.2 Proposing Variations

When proposing variation, deliver a submittal, clearly marked as a "VARIATION" to the OWNER, with documentation illustrating the nature and features of the variation including any necessary technical submittals and why the variation is desirable and beneficial to OWNER. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

The OWNER will indicate an approval or disapproval of the variation request; and if not approved as submitted, will indicate the OWNER's reasons therefore. Any work done before such approval is received is performed at the Contractor's risk.

Specifically point out variations from contract requirements in a variation submittal. Failure to point out variations may cause the OWNER to require rejection and removal of such work at no additional cost to the OWNER.

Clearly indicate variations on the transmittal form for submittals that include variations proposed by the Contractor. Set forth in writing the reason for any variations and note such variations on the submittal. The OWNER reserves the right to rescind inadvertent approval of submittals containing unnoted variations.

1.9.3 Warranting that Variations are Compatible

When delivering a variation for approval, the Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.9.4 Review Schedule Extension

In addition to the normal submittal review period, a period of 14 calendar days will be allowed for the OWNER to consider submittals with variations.

1.10 SCHEDULING

Schedule and submit concurrently product data, design data, and shop drawings covering component items forming a system or items that are interrelated. Submit pertinent certifications at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. The Contractor is responsible for additional time required for OWNER reviews resulting from required resubmittals. The review period for each resubmittal is the same as for the initial submittal.

b. Submittals required by the contract documents are listed on the submittal register. If a submittal is listed in the submittal register but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the OWNER does not relieve the Contractor of supplying submittals required by the contract documents but that have been omitted from the register or marked "N/A."

c. Resubmit the submittal register and annotate it monthly with actual submission and approval dates. When all items on the register have been fully approved, no further resubmittal is required.

OWNER review will be completed within 21 calendar days after receipt of a complete submittal.

1.11 OWNER APPROVING AUTHORITY

When the approving authority is the OWNER, the OWNER will:

a. Note the date on which the submittal was received.

b. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph REVIEW NOTATIONS and with comments and markings appropriate for the action indicated.

Upon completion of review of submittals requiring OWNER approval, stamp and date submittals. One electronic copy of the submittal will be retained by the OWNER and one electronic copy of the submittal will be returned to the Contractor.

1.11.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize proceeding with

the work covered.

b. Submittals marked "approved as noted" or "approved, except as noted, resubmittal not required," authorize proceeding with the work covered provided that the Contractor takes no exception to the corrections.

c. Submittals marked "not approved," "disapproved," or "revise and resubmit" indicate incomplete submittal or noncompliance with the contract requirements or design concept. Resubmit with appropriate changes. Do not proceed with work for this item until the resubmittal is approved.

d. Submittals marked "not reviewed" indicate that the submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

e. Submittals marked "receipt acknowledged" or "for record only" indicate that submittals have been received by the OWNER. This applies only to "information-only submittals" as previously defined.

1.12 DISAPPROVED SUBMITTALS

Make corrections required by the OWNER. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications, give notice to the OWNER. The Contractor is responsible for the dimensions and design of connection details and the construction of work. Failure to point out variations may cause the OWNER to require rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and resubmit in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.13 APPROVED SUBMITTALS

The OWNER's approval of submittals is not to be construed as a complete check, and indicates only that the submittal information appears to conform with the contract requirements.

Approval or acceptance by the OWNER for a submittal does not relieve the Contractor of the responsibility for meeting the contract requirements or for any error that may exist, because under the Quality Control (QC) requirements of this contract, the Contractor is responsible for ensuring information contained with in each submittal accurately conforms with the requirements of the contract documents.

After submittals have been approved or accepted by the OWNER, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, provide assurance that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those that may be damaged in testing, will be returned to the Contractor, at its expense, upon completion of the contract. Unapproved samples will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make as that material. The OWNER reserves the right to disapprove any material or equipment that has previously proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the OWNER for testing. Samples failing to meet contract requirements will automatically void previous approvals. Replace such materials or equipment to meet contract requirements.

1.15 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.16 CERTIFICATION OF SUBMITTAL DATA

Certify the submittal data as follows on transmittal form: "I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

_____NAME OF CONTRACTOR _____ SIGNATURE OF CONTRACTOR

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
TYEE LAKE 3RD UNIT INSTALLATION

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		01 30 00	SD-01 Preconstruction Submittals																
			View Location Map	1.3															
			Progress and Completion	1.4															
			Pictures																
		01 32 01	SD-01 Preconstruction Submittals																
			Project Scheduler Qualifications	1.3	O														
			Preliminary Project Schedule	3.4.1	O														
			Initial Project Schedule	3.4.2	O														
			Periodic Schedule Update	3.6	O														
		01 33 00	SD-01 Preconstruction Submittals																
			Submittal Register	1.8	O														
			Mobilizationand Remote Logistics		O														
			Plan																
			Receiving, Storage,		O														
			Preservation,, and Protection Plan																
			for OFE																
			Rigging/Lift Plan for Major OFE		O														
			Components																
			Outage and Access Coordination		O														
			Plan																
			Temporary Utilities Plan		O														
		01 35 26	SD-01 Preconstruction Submittals																
			Accident Prevention Plan (APP)	1.8	O														
			Indoor Air Quality (IAQ)	1.15	O														
			Management Plan																
			Lift Plans	3.5	O														

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 26	SD-06 Test Reports															
			Accident Reports	1.12.2	O													
			LHE Inspection Reports	1.12.3														
			Monthly Exposure Reports	1.5	O													
			SD-07 Certificates															
			Certified Crane Operators	1.7.3	O													
			Activity Hazard Analysis (AHA)	1.9	O													
			Certificate of Compliance	1.12.4														
			Hot Work Permit	1.13														
			Standard Lift Plan	1.12.4	O													
		01 45 00	SD-01 Preconstruction Submittals															
			Contractor Quality Control (CQC)	1.5.2	O													
			Plan															
			SD-06 Test Reports															
			Verification Statement	1.12.3														
		01 50 00	SD-01 Preconstruction Submittals															
			Construction Site Plan	1.3	O													
		01 74 19	SD-01 Preconstruction Submittals															
			Construction Waste Management	1.7	O													
			Plan															
		01 78 00	SD-03 Product Data															
			Warranty Management Plan	1.7.1														
			Spare Parts Data	1.5														
			SD-08 Manufacturer's Instructions															
			Instructions	1.7.1														

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		01 78 00	SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.4	O													
			Manuals															
			SD-11 Closeout Submittals															
			As-Built Drawings	3.1	O													
			As-Built Record of Equipment	3.3														
			and Materials															
			Warranted Equipment and	1.7.1														
			Materials															
			Final Approved Shop Drawings	3.2	O													
		01 78 23	SD-10 Operation and Maintenance															
			Data															
			Facility Data Workbook	1.4	O													
			Training Plan	3.1.1	O													
			Training Outline	3.1.3	O													
			Training Content	3.1.2	O													
			Operation And Maintenance	3.2.1	O													
			Manual, Progress Submittal															
			Operation And Maintenance	3.2.2	O													
			Manual, Prefinal Submittal															
			Operation And Maintenance	3.2.3	O													
			Manual, Final Submittal															
			SD-11 Closeout Submittals															
			Training Video Recording	3.1.4	O													
			Validation of Training Completion	3.1.6	O													

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		01 78 23	Training Plan	3.1.1	O													
			Record Drawings And Utility	1.6.6.7	O													
			Systems															
		02 41 00	SD-01 Preconstruction Submittals															
			Selective Demolition and		O													
			Removals Plan															
			Penetration and Cutting Plan		O													
			Debris Handling and Disposal		O													
			Plan															
			Existing Conditions	1.10														
			SD-06 Test Reports															
			Notification	1.7														
		03 30 00	SD-01 Preconstruction Submittals															
			Concrete Curing Plan	1.6.3.1	O													
			Quality Control Program	1.6.5	O													
			Quality Control Personnel	1.6.6	O													
			Certifications															
			Quality Control Organizational	1.6.6														
			Chart															
			Laboratory Accreditation	1.6.8	O													
			Form Removal Schedule	1.6.2.1	O													
			Maturity Method Data	3.3.10														
			SD-02 Shop Drawings															
			Formwork	1.6.2.1														
			Reinforcing Steel	1.6.2.2	O													
			SD-03 Product Data															

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		03 30 00	Joint Filler	2.4.2	O														
			Formwork Materials	2.1															
			Cementitious Materials	2.3.1	O														
			Concrete Curing Materials	2.4.1															
			Reinforcement	2.6	S														
			Admixtures	2.3.4															
			Mechanical Reinforcing Bar	2.6.2	O														
			Connectors																
			Waterstops	2.2.2															
			Pumping Concrete	1.6.3.2															
			SD-05 Design Data																
			Concrete Mix Design	1.6.1.2	O														
			Formwork Calculations	1.6.1.1															
			SD-06 Test Reports																
			Concrete Mix Design	1.6.1.2	O														
			Fly Ash	1.6.4.1	O														
			Pozzolan	1.6.4.1	O														
			Slag Cement	1.6.4.2	O														
			Aggregates	1.6.4.3	O														
			Compressive Strength Tests	3.12.3.3	O														
			Unit Weight of Structural	3.12.3.5															
			Concrete																
			Chloride Ion Concentration	3.12.3.6	O														
			Air Content	3.12.3.4	O														
			Slump Tests	3.12.3.1	O														
			Water	2.3.2	O														

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		03 30 00	SD-07 Certificates																
			Reinforcing Bars	2.6.1															
			Field Testing Technician and	1.6.6.2															
			Testing Agency																
			SD-08 Manufacturer’s Instructions																
			Curing Compound	2.4.1															
		03 60 00	SD-01 Preconstruction Submittals																
			Grout Manufacturer's Literature	2.1															
			SD-06 Test Reports																
			Certified Test Reports	1.4.3															
			Field Test Reports	1.4.1															
			SD-07 Certificates																
			Corrosion Certification	2.1.1															
			Expansion Certification	2.1.2															
		05 12 00	SD-01 Preconstruction Submittals																
			Erection and Erection Bracing	1.4.1.1	O														
			Drawings																
			SD-02 Shop Drawings																
			Fabrication Drawings	1.4.2	O														
			SD-03 Product Data																
			Shop Primer	2.6.2															
			Welding Electrodes and Rods	2.4.1															
			SD-05 Design Data																
			Design Calculations for Steel	1.4.3	O														
			Connections																
			Shoring and Temporary Bracing	1.4.2	O														

SUBMITTAL REGISTER

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		05 12 00	SD-06 Test Reports																
			Bolts, Nuts, and Washers	2.3															
			Weld Inspection Reports	3.7.1.2															
			SD-07 Certificates																
			Steel	2.2															
			Bolts, Nuts, and Washers	2.3															
			Galvanizing	2.5															
			AISC Structural Steel Fabricator	1.3															
			Quality Certification																
			AISC Structural Steel Erector	1.3															
			Quality Certification																
			Welding Procedures and	1.4.4.1															
			Qualifications																
			Welding Electrodes and Rods	2.4.1															
			Certified Welding Inspector	3.7.1.1															
			NDT Technician	3.7.1.2															
			Welding Procedure Specifications	3.4															
			(WPS)																
		05 50 13	SD-02 Shop Drawings																
			Cover Plates and Frames	2.3	O														
			Floor Gratings	2.4	O														
			SD-03 Product Data																
			Cover Plates and Frames	2.3	O														
			Floor Gratings	2.4	O														
			SD-07 Certificates																
			Certified Mill	2.1	O														

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		09 90 00	SD-03 Product Data																
			Product Data Sheets	2.1	O														
			SD-04 Samples																
			Color	2.2	O														
			SD-07 Certificates																
			Qualification Testing	1.5.6.2	O														
			Indoor Air Quality for Paints and	1.5.5															
			Primers																
			SD-08 Manufacturer’s Instructions																
			Mixing	2.1															
			Manufacturer's Safety Data	1.7.1															
			Sheets																
			SD-10 Operation and Maintenance																
			Data																
			Coatings	2.1	O														
		13 48 73	SD-02 Shop Drawings																
			Bracing	3.1	O														
			Resilient Vibration Isolation		O														
			Devices																
			Equipment Requirements	2.1	O														
			SD-03 Product Data																
			Bracing	3.1	O														
			Equipment Requirements	2.1	O														
			Anchor Bolts	3.2	O														
			Vibration Isolators		O														
			Snubbers		O														

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		13 48 73	SD-05 Design Data																
			Design Calculations	1.2.3	O														
			SD-06 Test Reports																
			Anchor Bolts	3.2	O														
			SD-07 Certificates																
			ICC ES AC156 Shake Table Test	3.4	O														
		21 21 01	SD-01 Preconstruction Submittals																
			Installer's Qualifications	1.6.3.1	O														
			Supervisor's Qualifications	1.6.3.2	O														
			Designer's Qualifications	1.6.3.3	O														
			SD-02 Shop Drawings																
			Shop Drawings	1.4.2	O														
			Air Sampling Smoke Detectors	3.3.5	O														
			SD-03 Product Data																
			Carbon-Dioxide Supply	2.2	O														
			Pipe and Fittings	2.3	O														
			Piping Accessories	2.4	O														
			Manual Release Stations	2.5.1	O														
			Discharge Pressure Switches	2.5.3	O														
			Alarm Notification Appliances	2.5.4	O														
			Operating Instructions	2.6	O														
			Signs	2.7	O														
			SD-05 Design Data																
			Carbon-Dioxide Supply	2.2	O														
			Calculations																

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		21 21 01	Pipe and Orifice Sizing	2.3.1	O														
			Calculations																
			Seismic Bracing Calculations	2.4.3															
			Air Sampling Smoke Detection	1.4.8	O														
			System Calculations																
			SD-06 Test Reports																
			Test Procedures	3.6.1	O														
			Request for Formal Inspection	3.6.2.2	O														
			and Tests																
			Final Test Report	3.6.2.5	O														
			SD-10 Operation and Maintenance																
			Data																
			Operation And Maintenance	1.4.6	O														
			Instructions																
			Operation And Maintenance	3.6.3	O														
			Instructions																
			SD-11 Closeout Submittals																
			Special Tools	1.5															
			Spare Parts Data	1.5															
			Spare Parts	1.5															
			As-Built Drawings	1.4.7	O														
			As-Built Drawings	3.6.3	O														
			Recordings	3.7.1.2															
		23 05 93	SD-01 Preconstruction Submittals																
			TAB Schematic Drawings And	1.3.2															
			Report Forms																

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		23 05 93	TAB Procedures	1.3.2															
			SD-06 Test Reports																
			TAB Report	1.3															
			SD-07 Certificates																
			Independent TAB Agency And	1.5.1															
			Personnel Qualifications																
			SD-01 Preconstruction Submittals																
			Records Of Existing Conditions	1.3															
		23 30 00	SD-02 Shop Drawings																
			Detail Drawings	1.4.3															
			SD-03 Product Data																
			Diffusers	2.3.2.1															
			Indoor Air Quality For Duct	2.3.1															
			Sealants																
			SD-08 Manufacturer’s Instructions																
			Manufacturer's Installation	3.2															
			Instructions																
			SD-10 Operation and Maintenance																
			Data																
			Operation And Maintenance	3.9.1															
			Manuals																
			SD-11 Closeout Submittals																
			Indoor Air Quality During	3.8															
			Construction																
		26 05 00	SD-03 Product Data																
			Rigid Metal Conduit	2.2.1	O														

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		26 05 00	Liquid-Tight Flexible Metal	2.2.2	O													
			Conduit															
			Non-Metallic Wiring Duct	2.2.3	O													
			(Channel)															
			Rigid Metallic Conduit Fittings	2.2.4	O													
			Flexible Conduit Fittings	2.2.5	O													
			Conduit Hangers	2.2.6	O													
			Wire Ways	2.2.7	O													
			Receptacles	2.4	O													
			Receptacle Boxes and Pull Boxes	2.3.1	O													
			Enclosures	2.3.2	O													
			Terminal Blocks	2.5.1	O													
			Escutcheons and Nameplates	2.6	O													
			SD-08 Manufacturer’s Instructions															
			Spare Parts	2.7	O													
		26 05 13	SD-03 Product Data															
			Medium-Voltage Cable	2.1	O													
			Medium-Voltage Cable	2.4.1														
			Terminations															
			Ground Conductors	2.3.1	O													
			Cable Cleats	3.1.8														
			Cable Identification	3.1.11														
			Cable Pulling Calculations	3.1.4.1														
			Cable Pulling Calculations	3.1.9														
			Splices	3.1.9														
			SD-05 Design Data															

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		26 05 13	Cable Pulling Calculations	3.1.4.1															
			Cable Pulling Calculations	3.1.9															
			SD-06 Test Reports																
			Inspection and Tests	2.5.1															
			Insulation Resistance Test	3.2.1															
			High Potential Test	3.2.1															
			Shield Resistance Test	3.2.1															
		26 05 19	SD-03 Product Data																
			Insulated Wire and Cable	2.1	O														
			Signal and Communications	2.3.3	O														
			Cable																
			Cable Supports	3.1.8	O														
			Control Panel Shop Wiring	2.3.1	O														
			Switchboard Wire	2.3.2	O														
			Ground Conductors	2.3.4															
			Wire Marking	3.1.11															
			Terminations	2.4															
			Metal-Clad Cable	2.3.5															
			Ethernet Cable	2.3.6	O														
			SD-06 Test Reports																
			Factory Inspection and Tests	1.4	O														
			Insulation Resistance Test	3.2.1	O														
			Shield Resistance Test	3.2.1	O														
			Field Acceptance Testing	3.2	O														
		26 05 26	SD-03 Product Data																
			Ground Conductors	2.1	O														

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		26 05 26	Ground Connections	2.2	O													
			Ground Bus	2.3	O													
			Ground Inserts	2.4	O													
			Ground Rods	2.5	O													
			Ground Enhancement Material	2.7	O													
			Switch Operating Platforms	2.8	O													
			Wire Mesh Ground Mat	2.6	O													
			Antioxidant Compounds	2.9	O													
			SD-06 Test Reports															
			Switchyard Ground Resistance	3.8														
			Measurement															
			SD-07 Certificates															
			testing organization's	3.8.1														
			qualifications															
			Grounding Test Technician's	3.8.1														
			qualifications															
		26 05 36	SD-01 Preconstruction Submittals															
			Cable Tray Installation Plan	3.2.1	O													
			SD-02 Shop Drawings															
			Fabrication And Assembly	1.4	O													
			Drawings															
			Installation Drawings	1.4	O													
			SD-03 Product Data															
			Cable Tray Components	2.1	O													
			Hangers and Supports	2.3	O													
			Cable Tray Accessories	2.2														

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		26 05 36	SD-05 Design Data															
			Cable Tray Fill Calculations	3.6														
			Cleat Manufacturer's Spacing	3.5	O													
			Calculations															
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Instructions	3.2.2	O													
		26 05 48	SD-02 Shop Drawings															
			Equipment Requirements	2.1	O													
			Lighting Fixtures	3.4	O													
			SD-03 Product Data															
			Supports and Attachments	1.2.3	O													
			Equipment Requirements	2.1	O													
			Lighting Fixtures	3.4	O													
			Flexible Fittings	2.4	O													
			Anchors	3.5	G													
			SD-05 Design Data															
			Design Calculations	1.2.3	O													
			Design Drawings	1.2.3	O													
			SD-06 Test Reports															
			Anchors	3.5	O													
			SD-07 Certificates															
			ICC ES AC156 Shake Table Test	3.7	O													
		26 08 01	SD-01 Preconstruction Submittals															
			Commissioning Engineer's	1.6.1	O													
			Qualifications															
			SD-05 Design Data															

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		26 08 01	Commissioning Plan	1.7	O													
			SD-06 Test Reports															
			Circuit Functionality Test Report	3.3.1	O													
			Commissioning Report	3.5	O													
		26 12 16	SD-02 Shop Drawings															
			Electrical Equipment Drawings	1.5	O													
			SD-03 Product Data															
			Transformer	2.3	O													
			Nameplates	2.5	O													
			SD-06 Test Reports															
			Field Test Report	3.2.4														
			SD-08 Manufacturer’s Instructions															
			Field Test Procedure	3.2.1														
			Transformer Shipping Plan	3.1														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance Data	2.7														
		26 28 00	SD-02 Shop Drawings															
			Switchboard Drawings	1.4.1														
			Panelboard Drawings	1.4.2														
			SD-03 Product Data															
			Switchboards	2.2														
			Panelboards	2.3														
			Nameplates	2.5														
			Molded Case Circuit Breakers	2.4														
			Terminal Blocks	2.2.11														

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		26 28 00	Indicating Devices	2.2.8															
			Instrument Transformers	2.2.9															
			Spare Parts List	2.6															
			SD-05 Design Data																
			Factory Test Procedures	3.1															
			Field Testing and Commissioning Plan	3.3.1															
			SD-06 Test Reports																
			Field Testing and Commissioning Report	3.3.4															
			SD-09 Manufacturer’s Field Reports																
			Factory Test Reports	3.1															
			SD-10 Operation and Maintenance Data																
			Operation and Maintenance Manuals	3.5															
		26 51 00	SD-02 Shop Drawings																
			Luminaire Drawings	1.4.1															
			SD-03 Product Data																
			Luminaires	2.2															
			Light Sources	2.3															
			LED Drivers	2.4															
			Luminaire Warranty	1.5.1															
			Switches																
			Exit Signs	2.6.1															

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		26 51 00	SD-05 Design Data																
			Luminaire Design Data	1.4.2															
			SD-06 Test Reports																
			ANSI/IES LM-79 Test Report	1.4.3															
			ANSI/IES LM-80 Test Report	1.4.4															
			ANSI/IES TM-21 Test Report	1.4.5															
			ANSI/IES TM-30 Test Report	1.4.6															
			SD-10 Operation and Maintenance																
			Data																
			Lighting System	1.6.1															
			Lighting Control System	1.6.2															
		31 00 00	SD-01 Preconstruction Submittals																
			Excavation and Trenching Plan	3.1.3															
			Dewatering Work Plan	3.1.2															
			Disposition of Surplus Materials	3.8															
			Erosion and Sediment Control	3.1.5															
			Plan																
			SD-06 Test Reports																
			Material Test Reports	3.9															
		40 05 13	SD-02 Shop Drawings																
			Materials and Equipment	2.2															
			Equipment Shop Drawings	2.2.1	O														
			Support System Detail Drawings	2.2.1	O														
			SD-03 Product Data																
			Qualifications	1.4															
			Welders	1.4.2															

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		40 05 13	Waste Water Disposal	3.14															
			Manufacturer's Field Services	3.15															
			Delivery, Storage and Handling	1.5															
			Materials and Equipment	2.2	O														
			Valve Schedule	2.9.2	O														
			Pump	2.8	O														
			SD-06 Test Reports																
			Pipe Leakage Tests	3.12.2															
			Hydrostatic Tests	3.12.1															
			Valve Testing	3.12.3															
			SD-07 Certificates																
			Plastic Piping System	2.6															
			Plastic Pipe Installation	3.3.8															
		40 17 26.00 20	SD-02 Shop Drawings																
			Field Weld Map	1.4.1	O														
			Weld Identifications	1.4.7.1															
			SD-07 Certificates																
			Welding Procedure Specifications	1.4.3	O														
			(WPS) and Procedure																
			Qualification Records (PQR)																
			Welder and Welding Operator	1.4.4	O														
			Performance Qualification																
			Nondestructive Examination	1.4.2	O														
			(NDE) Procedures																
			NDE Personnel Certification	1.4.6.2	O														
			Inspector Certification	1.4.6.1															

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
TYEE LAKE 3RD UNIT INSTALLATION

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		40 17 26.00 20	SD-11 Closeout Submittals															
			Final Weld Log and NDE Reports															
			O															
		46 25 14	SD-02 Shop Drawings															
			Separator	1.2.2	O													
			Accessories	2.6	O													
			SD-05 Design Data															
			Separator	1.2.2	O													
			Accessories	2.6	O													
			SD-06 Test Reports															
			Shop hydrostatic test	2.7.1	O													
			Inspection	3.1														
			Field hydrostatic test	3.3.1														
			Preoperational test	3.3.2														
			In-service test	3.3.3														
			SD-07 Certificates															
			Separator corrosion protection	2.1.1	O													
			SD-08 Manufacturer’s Instructions															
			Separator system	3.2	O													
			SD-10 Operation and Maintenance															
			Data															
			Separator system	3.2	O													
		48 13 01	SD-01 Preconstruction Submittals															
			T/G Installation Plan		O													
			Rigging, Lift, and Handling Plan		O													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION
TYEE LAKE 3RD UNIT INSTALLATION

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		48 13 01	Receiving, Storage, Preservation,		O													
			and Protection Plan															
			Outage and Access Coordination		O													
			Plan															
			SD-02 Shop Drawings															
			Installation and Interconnection		O													
			Drawings															
			Temporary Supports and		O													
			Handling Fixtures															
			SD-03 Product Data															
			Installation Consumables		O													
			SD-06 Test Reports															
			Flushing and Cleanliness Reports		O													
			Pre-Commissioning Check		O													
			Sheets															
			SD-07 Certificates															
			Installation Completion Certificate		O													
			SD-08 Manufacturer’s Instructions															
			SUPPLIER/OEM Installation															
			Instructions															

SECTION 01 35 26

SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ANSI/ASSP A10.34	(2021) Protection of the Public on or Adjacent to Construction Sites
ANSI/ASSP A10.44	(2020) Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations

ASTM INTERNATIONAL (ASTM)

ASTM D6245	(2012) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
ASTM D6345	(2010) Standard Guide for Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air
ASTM F855	(2020) Standard Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1048	(2016) Guide for Protective Grounding of Power Lines
IEEE C2	(2017) National Electrical Safety Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z89.1	(2014; R 2019) American National Standard for Industrial Head Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 51B	(2024) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	(2020) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

NFPA 241	(2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 306	(2024) Standard for the Control of Gas Hazards on Vessels

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

ANSI/SMACNA 008	(2007) IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1915	Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment
29 CFR 1926	Safety and Health Regulations for Construction
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

The following definitions are for the convenience of the reader. If there is a referenced document in the text of this specification section, that is the document that should define terms for that paragraph. If further clarification is needed, contact the OWNER.

1.2.1 Site Safety and Health Officer (SSHO)

A Contractor Employee that is responsible for overseeing and ensuring implementation of the prime Contractor's Safety and Occupational Health (SOH) program according to the Contract, applicable federal, state, and local requirements. The SSHO may perform other duties, but must be the Contractor's lead and primary point of contact for all site safety related matters.

1.2.1.1 Alternate SSHO

An employee that meets the definition of the contract-required level SSHO, but is not the primary SSHO.

1.2.2 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing existing and predictable hazards in the working environment or working conditions that are unsanitary, hazardous, or dangerous to personnel, and who has authorization to take prompt corrective measures to eliminate them.

1.2.3 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.3 SUBMITTALS

OWNER Acceptance or Approval does not remove responsibility from the Contractors for their actions or liability.

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP); O

Indoor Air Quality (IAQ) Management Plan; O

Lift Plans; O

SD-06 Test Reports

Accident Reports; O

LHE Inspection Reports

Monthly Exposure Reports; O

SD-07 Certificates

Certified Crane Operators; O

Activity Hazard Analysis (AHA); O

Certificate of Compliance

Hot Work Permit

Standard Lift Plan; O

1.4 PUBLIC HEALTH EMERGENCIES

In the event of a declared public health emergency, follow safety precautions as required by the Occupational Safety and Health Administration (OSHA) www.osha.gov, the Centers for Disease Control and Prevention (CDC) www.cdc.gov, and as required by federal, state and local requirements.

1.5 MONTHLY EXPOSURE REPORTS

Provide a Monthly Exposure Report by the fifth of each month. This report is a compilation of employee-hours worked each month for all site workers, both Prime and subcontractor. Failure to submit the report may result in

retention of up to 10 percent of the progress payment.

1.6 REGULATORY REQUIREMENTS

In addition to the detailed requirements included in the provisions of this Contract, comply with the most recent edition of the applicable federal, state, and local laws, ordinances, criteria, rules and regulations at the date of the Solicitation for this Contract. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements govern.

1.7 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.7.1 Site Safety and Health Officer (SSHO)

1.7.1.1 Qualifications of SSHO

All SSHOs will have working knowledge of all OSHA regulations, be trained and certified in CPR and first aid, and must have successfully completed an OSHA-30 hour safety training course.

1.7.1.2 Duties of SSHO

All SSHOs will carry out the roles and responsibilities as identified in this Contract. All SSHOs will be designated by the OWNER. Superintendent, QC Manager, and SSHO are subject to dismissal if their required duties are not being effectively carried out. If either the Superintendent, QC Manager, or SSHO are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

1.7.1.3 Safety Meetings

Conduct safety meetings to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent Safety and Occupational Health (SOH) training and motivation. Conduct meetings at least once a month for all supervisors at the project location. The SSHO, supervisors, or foremen must conduct meetings at least once a week for the trade workers. Document meeting minutes to include the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Maintain documentation on-site and furnish copies to the OWNER on request. Notify the OWNER of all scheduled meetings 7 calendar days in advance.

1.7.2 Roles and Responsibilities of Prime Contractor and SSHO

The Prime Contractor and SSHO must ensure that the requirements of all applicable OSHA requirements are met for the project. The Prime Contractor must ensure an SSHO or an equally qualified Alternate SSHO(s) is at the worksite at all times to implement and administer the Contractor's safety program and OWNER accepted Accident Prevention Plan. If the required SSHO has to temporarily (that is, up to 24 hours / 1 day) leave the site of work due to unforeseen or emergency situations, an alternate SSHO may be used in the interim and must be on the site of work at all times when work is being performed.

If the SSHO must be off-site for a period longer than 24 hours / 1 day, a qualified alternate that meets the contract requirements must be onsite.

a. Prime contractor must ensure all SSHOs will:

(1) Are designated in writing on a form submitted to the OWNER.

(2) Meet minimum training and experience requirements identified above.

(3) Execute roles and responsibilities identified in this specification.

1.7.3 Certified Crane Operators

Provide certified crane operators to operate all Contractor-owned cranes and to operate the OWNER's powerhouse bridge crane. Crane operators must be certified in accordance with 29 CFR 1926.1427 and must have met the certification requirements of an accredited testing organization such as the National Commission for the Certification of Crane Operators (NCCCO). Submit crane operator certification documentation for approval.

1.7.4 Competent Person for Confined Space Entry

Provide a CP for Confined Space Entry who meets the requirements of 29 CFR 1926 and herein. The CP for Confined Space Entry must supervise the entry into each confined space in accordance with 29 CFR 1926.

Since this work may involve operations that handle combustible or hazardous materials, this person must have the ability to understand and follow through on the air sampling, Personal Protective Equipment (PPE), and instructions of a Certified Industrial Hygienist. Confined space and enclosed space work must comply with NFPA 306, or as applicable in 29 CFR 1910 for general industry, 29 CFR 1926 for construction.

1.7.5 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must attend the preconstruction conference. This includes the project superintendent, Site Safety and Occupational Health Officer, quality control manager, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the Contract. This list of proposed AHAs will be reviewed and an agreement will be reached between the Contractor and the OWNER as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, and OWNER review of AHAs to preclude project delays. The creation of the APP and Schedule will be created after being given Notice to Proceed.

c. Deficiencies in the submitted APP, identified during the OWNER's review, must be corrected, and the APP re-submitted for review prior to the start of construction. Work is not permitted to begin until an APP is established that is acceptable to the OWNER.

1.8 ACCIDENT PREVENTION PLAN (APP)

1.8.1 Accident Prevention Plan (APP)

Submit the Accident Prevention Plan (APP) for review and acceptance by the OWNER at least 15 calendar days prior to the start, after being given Notice to Proceed. A competent person must prepare the written site-specific APP. The APP must be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP must interface with the Contractor's overall safety and occupational health program referenced in the APP in the applicable APP element, and made site-specific. Describe the methods to evaluate past safety performance of potential subcontractors in the selection process. Also, describe innovative methods used to ensure and monitor safe work practices of subcontractors. The OWNER considers the Prime Contractor to be the "controlling employer" for all worksite safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the Contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP must be signed. The SSHO must provide and maintain the APP and a log of signatures by each subcontractor foreman, attesting that they have read and understand the APP, and make the APP and log available on-site to the OWNER. If English is not the foreman's primary language, the Prime Contractor must provide an interpreter.

Submit the APP to the OWNER within 30 calendar days of Contract award and not less than 10 calendar days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once reviewed and accepted by the OWNER, the APP and attachments will be enforced as part of the Contract. Disregarding the provisions of this Contract or the accepted APP is cause for stopping of work, at the discretion of the OWNER, until the matter has been rectified. Continuously review and amend the APP, as necessary, throughout the life of the Contract. Changes to the accepted APP must be made with the knowledge and concurrence of the OWNER, project superintendent, SSHO and Quality Control Manager. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered. Should any severe hazard exposure (i.e., imminent danger) become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the OWNER within 24 hours of discovery. Eliminate and remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ANSI/ASSP A10.34), and the environment.

1.8.2 Names and Qualifications

Provide the following:

a. Names and qualifications (resumes including education, training, experience and certifications) of site safety and health personnel designated to perform work on this project to include the designated Site Safety and Health Officer and other competent and qualified personnel to be used. Specify the duties of each position.

b. As a minimum, designate and submit qualifications of Competent Persons (CP) for each of the following major areas: excavation; scaffolding; fall protection; hazardous energy; confined space; health hazard recognition, evaluation and control of chemical, physical and biological agents; and personal protective equipment and clothing to include selection, use and maintenance. Designate and submit qualifications for additional CPs as applicable to the work performed under this Contract.

1.8.3 Plans

Provide plans in the APP including the following:

1.8.3.1 Site Demolition Plan

Identify the safety and health aspects, and prepare in accordance with Section 02 41 00 DEMOLITION and referenced sources.

1.8.3.2 Material Handling Plan

Identify the safety and health aspects of rigging, handling, and transporting heavy load to and within the Powerhouse.

1.8.3.3 Hazardous Energy Control Plan

Identify the safety an health aspects of working within an operating Powerhouse. Include discussion of working around energized equipment, as well as working around hydraulic energy in the penstock.

1.9 ACTIVITY HAZARD ANALYSIS (AHA)

Before beginning each activity, task or Definable Feature of Work (DFOW) involving a type of work presenting hazards not experienced in previous project operations, or where a new work crew or subcontractor is to perform the work, the Contractor(s) performing that work activity must prepare an AHA. AHAs must be developed by the Prime Contractor, subcontractor, or supplier performing the work, and provided for Prime Contractor review and approval before submitting to the OWNER. AHAs must be signed by the SSHO, Superintendent, QC Manager and the subcontractor Foreman performing the work. Format the AHA in accordance with the Prime Contractor's standard practices or as directed by the OWNER. Submit the AHA for review at least 15 working days prior to the start of each activity task, or DFOW. The OWNER reserves the right to require the Contractor to revise and resubmit the AHA if it fails to effectively identify the work sequences, specific anticipated hazards, site conditions, equipment, materials, personnel and the control measures to be implemented.

AHAs must identify competent persons required for phases involving high risk activities, including confined entry, crane and rigging, excavations, trenching, electrical work, fall protection, and scaffolding.

1.9.1 AHA Management

Review the AHA list periodically (at least monthly) at the Contractor supervisory safety meeting, and update as necessary when procedures, scheduling, or hazards change. Use the AHA during daily inspections by the SSHO to ensure the implementation and effectiveness of the required safety and health controls for that work activity.

1.9.2 AHA Signature Log

Each employee performing work as part of an activity, task or DFOW must review the AHA for that work and sign a signature log specifically maintained for that AHA prior to starting work on that activity. The SSHO must maintain a signature log on site for every AHA. Provide employees whose primary language is other than English, with an interpreter to ensure a clear understanding of the AHA and its contents.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors must arrange for their own emergency medical treatment. The OWNER has no responsibility to provide emergency medical treatment.

1.12 NOTIFICATIONS AND REPORTS

1.12.1 Accident Notification

Notify the OWNER in accordance with the following Accident Reporting Timeline.

Table
Accident Reporting Required Timeline

Accident Type	Notify OWNER	Complete Final Accident Report and provide to OWNER
Fatality, in-patient hospitalization, amputation, eye loss, or property damage over $600,000.	Immediately, no later than (NLT) 8 Hours	Within 7 Days
All other accidents and near misses	Immediately, no later than (NLT) 24 Hours	Within 7 Days

Within notification include Contractor name; Contract title; type of Contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the OWNER investigation team arrives on-site and OWNER investigation is conducted. Assist and cooperate fully with the OWNER's investigation(s) of any accident or near miss.

1.12.2 Accident Reports

a. Conduct an accident investigation for recordable injuries and

illnesses, property damage, and near misses to establish the root cause(s) of the accident. All accidents are reportable, regardless of whether or not it is recordable. Complete the applicable Accident Report, OSHA Form 301, and provide the report to the OWNER within 7 calendar days of the accident. The OWNER will provide copies of any required or special forms. All accidents are reportable, regardless of whether or not it is recordable.

b. Near Misses: Report all "Near Misses" to the OWNER, using local accident reporting procedures, within 24 hours. Near miss reports are considered positive and proactive Contractor safety management actions.

1.12.3 LHE Inspection Reports

Submit LHE inspection reports required in accordance with 29 CFR 1926 and as specified herein with Daily Reports of Inspections.

1.12.4 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging

Provide a Certificate of Compliance for LHE entering an activity under this Contract and in accordance with 29 CFR 1926. Post certifications on the crane.

Develop a Standard Lift Plan (SLP) in accordance with 29 CFR 1926 and applicable ASME crane safety standards using Standard Pre-Lift Crane Plan/Checklist for each lift planned. Submit SLP to the OWNER for approval within 15 calendar days in advance of planned lift.

1.13 HOT WORK PERMIT

1.13.1 Permit and Personnel Requirements

Submit and obtain a written permit prior to performing "Hot Work" (i.e., welding or cutting) or operating other flame-producing/spark producing devices, from the OWNER. Contractors are required to meet all criteria before a permit is issued. Provide at least two 20 pound 4A:20 BC rated extinguishers for normal "Hot Work". The extinguishers must be current inspection tagged, and contain an approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch must be trained in accordance with NFPA 51B and remain on-site for a minimum of 1 hour after completion of the task or as specified on the hot work permit.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the control room phone number. Report any fire, no matter how small, to the OWNER immediately.

1.13.2 Work Around Flammable Materials

Obtain permit approval from a Certified Industrial Hygienist for "Hot Work" within or around flammable materials (such as fuel systems or welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, or vaults) that have the potential for flammable or explosive atmospheres.

Whenever these materials, except beryllium and chromium (VI), are encountered in indoor operations, local mechanical exhaust ventilation

systems that are sufficient to reduce and maintain personal exposures to within acceptable limits must be used and maintained in accordance with manufacturer's instruction.

1.14 CONFINED SPACE ENTRY REQUIREMENTS

Confined space entry must comply with 29 CFR 1926, 29 CFR 1910, and Directive CPL 2.100. Any potential for a hazard in the confined space requires a permit system to be used.

1.14.1 Rescue Procedures and Coordination with Local Emergency Responders

Develop and implement an on-site rescue and recovery plan and procedures. The rescue plan must not rely on local emergency responders for rescue from a confined space.

1.15 CONSTRUCTION INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN

Submit an IAQ Management Plan not less than 10 calendar days before the preconstruction conference. Revise and resubmit Plan as required by the OWNER. Make copies of the final plan available to all workers on site. Include provisions in the Plan to meet the requirements specified below and to ensure safe, healthy air for construction workers and building occupants.

1.15.1 Requirements During Construction

Provide for evaluation of indoor Carbon Dioxide concentrations in accordance with ASTM D6245. Provide for evaluation of volatile organic compounds (VOCs) in indoor air in accordance with ASTM D6345. Use filters with a Minimum Efficiency Reporting Value (MERV) of 8 in permanently installed air handlers during construction.

1.15.1.1 Control Measures

Meet or exceed the requirements of ANSI/SMACNA 008 to help minimize contamination of the building from construction activities. The five requirements of this manual which must be adhered to are described below:

a. HVAC protection: Isolate return side of HVAC system from surrounding environment to prevent construction dust and debris from entering the duct work and spaces.

b. Source control: Use low emitting paints and other finishes, sealants, adhesives, and other materials as specified. When available, cleaning products must have a low VOC content and be non-toxic to minimize building contamination. Utilize cleaning techniques that minimize dust generation. Cycle equipment off when not needed. Prohibit idling motor vehicles where emissions could be drawn into building. Designate receiving/storage areas for incoming material that minimize IAQ impacts.

c. Pathway interruption: When pollutants are generated use strategies such as 100 percent outside air ventilation or erection of physical barriers between work and non-work areas to prevent contamination.

d. Housekeeping: Clean frequently to remove construction dust and debris. Promptly clean up spills. Remove accumulated water and keep work areas dry to discourage the growth of mold and bacteria. Take

extra measures when hazardous materials are involved.

e. Scheduling: Control the sequence of construction to minimize the absorption of VOCs by other building materials.

1.15.1.2 Moisture Contamination

a. Remove accumulated water and keep work dry.

b. Use dehumidification to remove moist, humid air from a work area.

c. Do not use combustion heaters or generators inside the building.

d. Protect porous materials from exposure to moisture.

e. Remove and replace items which remain damp for more than a few hours.

1.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must comply with the applicable Storm Plan and:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION AND OTHER WORK

Comply with NFPA 70, NFPA 70E, NFPA 241, the APP, the AHA, Federal and State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

PPE is governed in all areas by the nature of the work the employee is performing. Use personal hearing protection at all times in designated noise hazardous areas or when performing noise hazardous tasks. Safety glasses must be worn or carried/available on each person. Mandatory PPE includes:

a. Head Protection that meets ANSI/ISEA Z89.1

b. Long Pants

c. Appropriate Safety Footwear

d. Appropriate Class Reflective Vests

3.1.1 Worksite Communication

Employees working alone in a remote location or away from other workers must be provided an effective means of emergency communications (i.e., cellular phone, two-way radios, land-line telephones or other acceptable means). The selected communication must be readily available (easily within the immediate reach) of the employee and must be tested prior to the start of work to verify that it effectively operates in the area/environment. Develop an employee check-in/check-out communication procedure to ensure employee safety.

3.1.2 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this Contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint, and hexavalent chromium, are prohibited. The OWNER, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. Low mercury lamps used within fluorescent lighting fixtures are allowed as an exception without further OWNER approval. Notify the OWNER prior to excepted items of radioactive material and devices being brought on base.

3.1.3 Unforeseen Hazardous Material

There are not any hazardous materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e., 29 CFR Part 1910.1000) believed to be present in the work area. If material(s) that may be hazardous to human health upon disturbance are encountered during demolition, repair, renovation, or construction operations, stop that portion of work and notify the OWNER immediately. Within 14 calendar days the OWNER will determine if the material is hazardous. If material is not hazardous or poses no danger, the OWNER will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the OWNER will issue a modification.

3.2 UTILITY OUTAGE REQUIREMENTS

Apply for utility outages in sufficient time as to not result in impacts or delays to the project schedule. At a minimum, the written request must include the location of the outage, utilities being affected, duration of outage, any necessary sketches, and a description of the means to fulfill energy isolation requirements in accordance with the Hazardous Energy Control Program. Where outages involve OWNER or Utility personnel, coordinate with the OWNER on all activities involving the control of hazardous energy.

These activities include, but are not limited to, a review of Hazardous Energy Control Program (HECP) and HEC procedures, as well as applicable Activity Hazard Analyses (AHAs). In accordance with NFPA 70E, work on energized electrical circuits must not be performed without prior OWNER authorization. OWNER permission is considered through the permit process and submission of a detailed AHA. Energized work permits are considered only when de-energizing introduces additional or increased hazard or when de-energizing is infeasible.

3.3 OUTAGE COORDINATION MEETING

After the utility outage request is approved and prior to beginning work on the utility system requiring shut-down, conduct a pre-outage coordination meeting. This meeting must include the Prime Contractor, the Prime and subcontractors performing the work, and the OWNER. All parties must fully coordinate HEC activities with one another. During the coordination meeting, all parties must discuss and coordinate on the scope of work, HEC procedures (specifically, the lock-out/tag-out procedures for worker and utility protection), the AHA, assurance of trade personnel qualifications, identification of competent persons, and compliance with HECP training. Clarify when personal protective equipment is required during switching operations, inspection, and verification.

3.4 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Provide and operate a Hazardous Energy Control Program (HECP) in accordance with the OWNER's HECP requirements, 29 CFR 1910, 29 CFR 1915, ANSI/ASSP A10.44, NFPA 70E.

3.4.1 Safety Preparatory Inspection Coordination Meeting with the OWNER or Utility

For electrical distribution equipment that is to be operated by OWNER personnel, the Prime Contractor and the subcontractor performing the work must attend the safety preparatory inspection coordination meeting, which will also be attended by the OWNER's Representative. The meeting will occur immediately preceding the start of work and following the completion of the outage coordination meeting. Both the safety preparatory inspection coordination meeting and the outage coordination meeting must occur prior to conducting the outage and commencing with lockout/tagout procedures.

3.4.2 Lockout/Tagout Isolation

Where the OWNER performs equipment isolation and lockout/tagout, the Contractor must place their own locks and tags on each energy-isolating device and proceed in accordance with the HECP. Before any work begins, both the Contractor and the OWNER must perform energy isolation verification testing while wearing required PPE detailed in the Contractor's AHA and required by the OWNER. Install personal protective grounds, with tags, to eliminate the potential for induced voltage.

3.4.3 Lockout/Tagout Removal

Upon completion of work, conduct lockout/tagout removal procedure in accordance with the HECP. Each lock and tag must be removed from each energy isolating device by the authorized individual or systems operator who applied the device. Provide formal notification to the OWNER (by completing the OWNER form if provided by OWNER's Representative), confirming that steps of de-energization and lockout/tagout removal procedure have been conducted and certified through inspection and verification. OWNER locks and tags used to support the Contractor's work will not be removed until the authorized OWNER employee receives the formal notification.

3.5 CRANE SAFETY

Perform all crane operations in compliance with the requirements of

29 CFR 1926-Subpart CC. Utilize competent personnel to develop lift plans for all critical crane operations, including, but not limited to, offloading of equipment from barges, crane operations in and around the switchyard, lifts involving the generator, turbine isolation valve, step-up transformer, and oil-water separator. Lift plans must clearly identify weights of all below-the-hook items involved in the lift, to include rigging or lifting devices, boom angle, boom height, pick radius, outrigger placement, outrigger cribbing and ground pressures, and crane capacity in the lift configuration. Coordinate with the OWNER for all lifts in and around the switchyard or other overhead power lines, identify if line outages are required during the lift. Submit lift plans for approval a minimum of one week prior to all planned lifts.

3.6 FALL PROTECTION PROGRAM

Establish a fall protection program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify roles and responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.6.1 Fall Protection Equipment and Systems

Enforce use of personal fall protection equipment and systems designated (to include fall arrest, restraint, and positioning) for each specific work activity in the Site Specific Fall Protection and Prevention Plan and AHA at all times when an employee is exposed to a fall hazard..

Provide personal fall protection equipment, systems, subsystems, and components that comply with 29 CFR 1926.

3.6.1.1 Additional Personal Fall Protection Measures

In addition to the required fall protection systems, other protective measures such as safety skiffs, personal floatation devices, and life rings, are required when working above or next to water. Personal fall protection systems and equipment are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall protection systems are required when operating other equipment such as scissor lifts. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, travel, or while performing work.

3.6.1.2 Personal Fall Protection Equipment

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabineers must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 3,600 lbs in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 6 feet, unless the proper energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest

system. Equip all full body harnesses with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance.

3.7 ELECTRICAL

Perform electrical work in accordance with NFPA 70.

3.7.1 Electrical Work

Electrical work is to be conducted in a de-energized state unless there is no alternative method for accomplishing the work. In those cases obtain an energized work permit from the OWNER. The energized work permit application must be accompanied by the AHA and a summary of why the equipment/circuit needs to be worked energized. Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Attach temporary grounds in accordance with ASTM F855 and IEEE 1048. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator is allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method.

When working in energized substations, only qualified electrical workers are permitted to enter. When work requires work near energized circuits as defined by NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety footwear, insulating gloves and electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA. Ensure that each employee is familiar with and complies with these procedures and 29 CFR 1910.

3.7.2 Qualifications

Electrical work must be performed by QP with verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and Local Certifications or Licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and must be identified in the appropriate AHA. Journeyman/Apprentice ratio must be in accordance with State, and Local requirements applicable to where work is being performed.

3.7.3 Arc Flash

Conduct a hazard analysis/arc flash hazard analysis whenever work on or near energized parts greater than 50 volts is necessary, in accordance with NFPA 70E.

All personnel entering the identified arc flash protection boundary must be QPs and properly trained in NFPA 70E requirements and procedures. Unless permitted by NFPA 70E, no Unqualified Person is permitted to approach nearer than the Limited Approach Boundary of energized conductors and circuit parts. Training must be administered by an electrically qualified source and documented.

3.7.4 Grounding

Ground electrical circuits, equipment and enclosures in accordance with NFPA 70 and IEEE C2 to provide a permanent, continuous and effective path to ground.

3.7.5 Testing

Temporary electrical distribution systems and devices must be inspected, tested and found acceptable for Ground-Fault Circuit Interrupter (GFCI) protection, polarity, ground continuity, and ground resistance before initial use, before use after modification and at least monthly. Monthly inspections and tests must be maintained for each temporary electrical distribution system, and signed by the electrical CP or QP.

-- End of Section --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g., ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AACE INTERNATIONAL (AACE)
726 East Park Avenue #180
Fairmont, WV 26554 USA
Ph: 304-296-8444
Fax: 304-291-5728
Internet: https://web.aacei.org/

AMERICAN CONCRETE INSTITUTE (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3800
Fax: 248-848-3701
Internet: https://www.concrete.org/

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
3640 Park 42 Drive
Cincinnati, OH 45241
Ph: 513-742-2020
Fax: 513-742-3355
Email: customerservice@acgih.org
Internet: https://www.acgih.org/

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 847-934-8800
Fax: 847-934-8803
E-mail: aha@hardboard.org
Internet: http://domensino.com/AHA/

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
130 East Randolph, Suite 2000
Chicago, IL 60601

Ph: 312-670-2400
Fax: 312-670-5403
Steel Solutions Center: 866-275-2472
E-mail: solutions@aisc.org
Internet: https://www.aisc.org/

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1899 L Street, NW,11th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: info@ansi.org
Internet: https://www.ansi.org/

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
1201 Dublin Road Suite G04

Columbus, OH 43215-1045
Ph: 800-222-2768 or 614-274-6003

E-mail: customersupport@asnt.org
Internet: https://www.asnt.org/

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191
Ph: 800-548-2723; 703-295-6300
Email: customercare@asce.org
Internet: https://www.asce.org/

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
180 Technology Parkway NW
Peachtree Corners, GA 30092
Ph: 404-636-8400 or 800-527-4723
Fax: 404-321-5478
E-mail: ashrae@ashrae.org
Internet: https://www.ashrae.org/

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Two Park Avenue
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
E-mail: customercare@asme.org
Internet: https://www.asme.org/

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)
520 N. Northwest Highway
Park Ridge, IL 60068
Ph: 847-699-2929
E-mail: customerservice@assp.org
Internet: https://www.assp.org/

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 W. Quincy Avenue
Denver, CO 80235 USA
Ph: 303-794-7711 or 800-926-7337
Fax: 303-347-0804

Internet: https://www.awwa.org/

AMERICAN WELDING SOCIETY (AWS)
8669 NW 36 Street, #130
Miami, FL 33166-6672
Ph: 800-443-9353
Email: customercare@aws.org
Internet: https://www.aws.org/

ASSOCIATED AIR BALANCE COUNCIL (AABC)
1015 18th St. NW Suite 603
Washington, DC 20036
Ph: 202-737-0202
Fax: 202-315-0285
E-mail: info@aabc.com
Internet: https://www.aabc.com/

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: https://www.astm.org/

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)
PO Box 997377, MS 0500
Sacramento, CA 95899-7377
Ph: 916-558-1784
Internet: https://www.cdph.ca.gov/

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)
1600 Clifton Road
Atlanta, GA 30329-4027
Ph: 800-232-4636
TTY: 888-232-6348
Internet: https://www.cdc.gov

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 North Plum Grove Road
Schaumburg, IL 60173-4758
Ph: 847-517-1200
Email: crsi@crsi.org
Fax: 847-517-1206
Internet: http://www.crsi.org/

FM GLOBAL (FM)
270 Central Avenue
Johnston, RI 02919-4949
Ph: 401-275-3000
Fax: 401-275-3029
Internet: https://www.fmglobal.com/

ICC EVALUATION SERVICE, INC. (ICC-ES)
3060 Saturn Street, Suite 100
Brea, CA 92821
Ph: 800-423-6587
Fax: 562-695-4694

E-mail: es@icc-es.org
Internet: https://icc-es.org/

ILLUMINATING ENGINEERING SOCIETY (IES)
120 Wall Street, Floor 17
New York, NY 10005-4001
Ph: 212-248-5000
Fax: 212-248-5018
E-mail: membership@ies.org
Internet: https://www.ies.org/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333
Fax: 732-981-9667
E-mail: onlinesupport@ieee.org
Internet: https://www.ieee.org/

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 493
Miamitown, OH 45041-9998
E-mail: info@icea.net
Internet: https://www.icea.net/

INTERNATIONAL CODE COUNCIL (ICC)
200 Massachusetts Ave, NW Suite 250
Washington, DC 20001
Ph: 800-786-4452 or 888-422-7233
Fax: 202-783-2348
E-mail: order@iccsafe.org
Internet: https://www.iccsafe.org/

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
3050 Old Centre Ave. Suite 101
Portage, MI 49024
Ph: 269-488-6382 or 1-888-300-6382
Fax: 269-488-6383
Internet: https://www.netaworld.org/

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
3, rue de Varembe, 1st floor
P.O. Box 131
CH-1211 Geneva 20, Switzerland
Ph: 41-22-919-02-11
Fax: 41-22-919-03-00
E-mail: info@iec.ch
Internet: https://www.iec.ch/

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1101 Wilson Blvd, Suite 1425
Arlington, VA 22209-1762
Ph: 703-525-1695
Fax: 703-528-2148
Internet: https://safetyequipment.org/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park Street, NE

Vienna, VA 22180-4602
Ph: 703-281-6613
E-mail: info@msshq.org
Internet: http://msshq.org

MASTER PAINTERS INSTITUTE (MPI)
2800 Ingleton Avenue
Burnaby, BC CANADA V5C 6G7
Ph: 1-888-674-8937
Fax: 1-888-211-8708
E-mail: info@paintinfo.com or techservices@mpi.net
Internet: http://www.mpi.net/

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)
330 N. Wabash Avenue
Chicago, IL 60611
Ph: 312-644-6610
E-mail: MFMAstats@smithbucklin.com
Internet: http://www.metalframingmfg.org/

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)
800 Roosevelt Road, Bldg C, Suite 312
Glen Ellyn, IL 60137
Ph: 630-942-6591
Fax: 630-790-3095
E-mail: info@naamm.org
Internet: http://www.naamm.org

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)
1201 Pennsylvania Ave. NW, Suite 1200
Washington, DC 20004
Ph: 202-991-6300
Fax: 202-217-4171
Internet: https://www.necanet.org/

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 900
Arlington, VA 22209
Ph: 703-841-3200
Email: communications@nema.org
Internet: https://www.nema.org

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)
8575 Grovemont Circle
Gaithersburg, MD 20877
Ph: 301-977-3698
Fax: 301-977-9589
Internet: http://www.nebb.org

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 800-344-3555
Fax: 800-593-6372
Internet: https://www.nfpa.org

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
100 Bureau Drive
Gaithersburg, MD 20899

Ph: 301-975-2000
Internet: https://www.nist.gov/

PLASTICS PIPE INSTITUTE (PPI)
105 Decker Court, Suite 825
Irving, TX 75062
Ph: 469-499-1044
Fax: 469-499-1063
Internet: https://plasticpipe.org/

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1219
Ph: 703-803-2980
Fax: 703-803-3732
Internet: https://www.smacna.org/

SOCIETY FOR PROTECTIVE COATINGS (SSPC)
800 Trumbull Drive
Pittsburgh, PA 15205
Ph: 877-281-7772 or 412-281-2331
Fax: 412-444-3591
E-mail: customerservice@sspc.org
Internet: http://www.sspc.org

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
21865 Copley Drive
Diamond Bar, CA 91765
Ph: 909-396-2000
E-mail: webinquiry@aqmd.gov
Internet: http://www.aqmd.gov

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
http://www.wbdg.org/ffc/army-coe/standards
Order Other Documents from:
Official Publications of the Headquarters, USACE
E-mail: hqpublications@usace.army.mil
Internet: http://www.publications.usace.army.mil/
or
https://www.hnc.usace.army.mil/Missions/Engineering-Directorate/TECHINFO/

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-571-3343
Fax: 215-697-1462
E-mail: customerservice@ntis.gov
Internet: https://www.ntis.gov/
Obtain Military Specifications, Standards and Related Publications from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)

Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: https://assist.dla.mil/online/start/; account registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, DC 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet:
https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-564-4700
Internet: https://www.epa.gov
--- Some EPA documents are available only from:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6060 or 1-800-363-2068
Fax: 703-605-6880
TDD: 703-487-4639
E-mail: info@ntis.gov
Internet: https://www.ntis.gov/

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration
1800 F Street, NW
Washington, DC 20405
Ph: 1-844-472-4111
Internet: https://www.gsaelibrary.gsa.gov/ElibMain/home.do
Obtain documents from:
Acquisition Streamlining and Standardization Information System (ASSIST)
Internet: https://assist.dla.mil/online/start/; account registration required

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Internet: https://www.archives.gov/
Order documents from:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: https://www.gpo.gov/

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road

Camas, WA 98607-8542
Ph: 877-854-3577 or 360-817-5500
E-mail: CustomerExperienceCenter@ul.com
Internet: https://www.ul.com/
UL Directories available through IHS at https://accuristech.com/

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)
994 Old Eagle School Road
Suite 1019
Wayne, PA 19087-1866
Ph: 610-971-4850
E-mail: info@viscma.com
Internet: http://www.viscma.com

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D3740	(2019) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E329	(2023) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program. Include all associated costs in the applicable Bid Schedule item.

1.3 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Contractor Quality Control (CQC) Plan; O

SD-06 Test Reports

Verification Statement

1.4 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system. QC is comprised of plans, procedures, and organization necessary to produce an end product that complies with the Contract requirements. The QC system covers all construction operations, both onsite and offsite, and must be keyed to the proposed construction sequence. The Quality Control Manager, Superintendent, Site Safety and Health Officer (SSHO), and all on-site supervisors are responsible for the quality of work and are subject to removal by the OWNER for non-compliance with the quality requirements specified in the Contract. The Quality Control Manager must maintain a physical presence at the work site at all times and is the primary individual responsible for all quality control.

1.5 QUALITY CONTROL (QC) PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Organization, QC Plan, QC Plan Meeting(s), a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and approval, testing, completion inspections, QC certifications, and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations that comply with the requirements of this Contract. The QC program must cover on-site and off-site work and be keyed to the work sequence. No construction work or testing may be performed unless the QC Manager is on the work site. The QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

1.5.1 Meetings

1.5.1.1 Quality Control Plan Meeting

Prior to submission of the QC Plan, the Contractor may request a meeting with the OWNER to discuss the QC Plan requirements of this Contract.

The purpose of this meeting is to develop a mutual understanding of the QC Plan requirements prior to plan development and submission and to agree on the Contractor's list of Definable Feature of Work (DFOW).

1.5.1.2 Coordination and Mutual Understanding Meeting

After the Preconstruction Conference, before start of construction, and prior to acceptance by the OWNER of the CQC Plan, meet with the OWNER and discuss the Contractor's quality control system. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the OWNER's Quality Assurance. Minutes of the meeting will be prepared by the QC Manager and signed by the Contractor and the OWNER. Provide a copy of the signed minutes to all attendees. At a minimum the Coordination and Mutual Understanding Meeting must be repeated when a new QC Manager is appointed. There can be other occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

1.5.1.2.1 Purpose

The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, design intent, environmental requirements and procedures, coordination of activities to be performed, and the coordination of the Contractor's management, production, and QC personnel. At the meeting, the Contractor must explain in detail how three phases of control will be implemented for each DFOW, as well as how each DFOW will be affected by each management plan or requirement as listed below:

a. Waste Management Plan.

b. Environmental Protection Plan.

c. Environmental regulatory requirements.

d. Indoor Air Quality (IAQ) Management Plan.

1.5.1.2.2 Coordination of Activities

Coordinate activities included in various sections to assure efficient and orderly installation of each component. Coordinate operations included under different sections that are dependent on each other for proper installation and operation. Schedule construction operations with consideration for indoor air quality as specified in the IAQ Management Plan.

1.5.1.2.3 Attendees

As a minimum, the Contractor's personnel required to attend include an officer of the firm, the Project Manager, Project Superintendent, QC Manager, Alternate QC Manager, Environmental Manager, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities must have a principal of the firm at the meeting.

1.5.1.3 Quality Control (QC) Meetings

After the start of construction, conduct weekly QC meetings led by the QC Manager at the work site with the Project Superintendent, and the other personnel as necessary. The QC Manager is to prepare the minutes of the meeting and provide a copy to the OWNER within 2 working days after the meeting. The OWNER may attend these meetings. As a minimum, accomplish the following at each meeting:

a. Review the minutes of the previous meeting.

b. Review the schedule and the status of work and deficiencies/rework. Review the most current approved schedule (in accordance with schedule specification) and the status of work and deficiencies/rework.

c. Review the status of submittals and Request For Information (RFIs).

d. Review the work to be accomplished in the next 3 weeks as defined by the schedule section paragraph WEEKLY PROGRESS MEETINGS in Section 01 32 01 PROJECT SCHEDULE and all documentation required for that work.

e. Review Testing Plan and Log including status of tests performed since last QC Meeting.

f. Resolve QC and production problems. Discuss status of pending change orders.

g. Address items that may require revising the QC Plan.

h. Review Accident Prevention Plan (APP) and effectiveness of the safety program.

i. Review environmental requirements and procedures.

j. Review Environmental Management Plan.

k. Review Waste Management Plan.

l. Review the status of training completion.

m. Review IAQ Management Plan.

1.5.2 Contractor Quality Control (CQC) Plan

Submit no later than 30 days after receipt of notice to proceed, the CQC Plan. The OWNER will consider an interim plan for the first 90 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan and other Contract requirements or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work.

1.5.2.1 Content of Contractor Quality Control (CQC) Plan

Provide a CQC Plan, prior to start of construction that includes a table of contents, with major sections identified, pages numbered sequentially, and that documents the proposed methods and responsibilities for accomplishing quality control during the construction of the project. The CQC Plan must at a minimum include the following sections:

a. A description of the quality control organization and acknowledgment that the CQC staff will implement the three phase control system for all aspects of the work specified.

b. An organizational chart showing the quality control organization with individual names and job titles and lines of authority up to an executive of the company at the home office.

c. NAMES AND QUALIFICATIONS: Names and qualifications, in resume format, (including position titles and durations for qualifying experiences) for each person in the QC organization.

d. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL: Duties, responsibilities, and authorities of each person in the QC organization.

e. OUTSIDE ORGANIZATIONS: A listing of outside organizations, such as architectural and consulting engineering firms, that will be employed by the Contractor and a description of the services these firms will provide.

f. APPOINTMENT LETTERS: Letters signed by an officer of the firm appointing the QC Manager and Alternate QC Manager, and stating that they are responsible for implementing and managing the QC program as described in this Contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of control, and their authority to stop work that is not in compliance with the Contract. Letters of direction are to be issued by the QC Manager to all other QC Specialists or quality control representatives outlining their duties, authorities, and responsibilities. Include copies of the letters in the QC Plan.

g. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER: Procedures for reviewing, approving, scheduling, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in Section 01 33 00 SUBMITTAL PROCEDURES.

h. TESTING LABORATORY INFORMATION: Testing laboratory information required by the paragraph ACCREDITATION REQUIREMENTS, as applicable.

i. TESTING PLAN AND LOG: A Testing Plan and Log that includes the tests required, associated feature of work required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

j. Procedures to complete construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected. This phase is performed prior to beginning work on each definable feature of work, after all required plans, documents, materials are approved, and after copies are at the work site.

k. Reporting procedures, including proposed reporting formats.

l. Procedures for submitting and reviewing design changes/variations prior to submission to the OWNER.

m. LIST OF DEFINABLE FEATURES: A Definable Feature of Work (DFOW) is a task that is separate and distinct from other tasks and has control requirements and work crews unique to that task. A DFOW is identified by different trades or disciplines, or it is work by the same trade in a different environment. A DFOW is by definition any item or activity on the construction schedule, and the schedule specification provides direction regarding how the DFOWs are to be structured. Include in the list of DFOWs for all activities on the Construction Schedule. Although each section of the specifications can generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. Identify the specification section number and schedule activity ID for each DFOW listed. The DFOW list will be reviewed in coordination with the construction schedule and agreed upon during the Coordination of Mutual Understanding Meeting.

n. PROCEDURES FOR PERFORMING AND TRACKING THE THREE PHASES OF CONTROL: Identify procedures used to ensure the three phases of control to manage the quality on this project. For each Definable Feature of Work (DFOW), a Preparatory and Initial phase checklist will be filled out during the Preparatory and Initial phase meetings. Conduct the Preparatory and Initial Phases and meetings with a view towards obtaining quality construction by planning ahead and identifying potential problems for each DFOW.

o. PROCEDURES FOR COMPLETION INSPECTION: Procedures for identifying and documenting the completion inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.

p. ORGANIZATION AND PERSONNEL CERTIFICATIONS LOG: Procedures for

coordinating, tracking and documenting all certifications required for entities such as subcontractors, testing laboratories, suppliers, and personnel. The QC Manager will ensure that certifications are current, appropriate for the work being performed, and will not lapse during any period of the Contract that the work is being performed.

1.5.3 Acceptance of the Quality Control (QC) Plan

The OWNER's acceptance of the Contractor QC Plan, or interim plan applicable to the particular feature of work to be started, is required prior to the start of construction. The OWNER will consider an interim plan for the first 90 days of operation. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work. The OWNER reserves the right to require changes in the QC Plan and operations as necessary, including removal or addition of personnel, to ensure the specified quality of work. The OWNER reserves the right to interview any member of the QC organization at any time to verify the submitted qualifications. All QC organization personnel are subject to acceptance by the OWNER. The OWNER may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

1.5.4 Notification of Changes

Notify the OWNER, in writing, of any proposed changes in the QC Plan or changes to the QC organization personnel. Proposed changes are subject to acceptance by the OWNER.

1.6 QUALITY CONTROL (QC) ORGANIZATION

1.6.1 Personnel Requirements

The requirements for the CQC organization are a Site Safety and Health Officer (SSHO), QC Manager, and enough qualified personnel to ensure safety and Contract compliance. The SSHO reports directly to a senior project (or corporate) official independent from the QC Manager. The SSHO will also serve as a member of the CQC Staff Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The CQC staff always maintains a presence at the site during progress of the work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the OWNER. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawing submittals, schedules, and all other project documentation to the CQC organization. The CQC organization is responsible for always maintaining these documents and records at the site, except as otherwise acceptable to the OWNER.

1.6.2 Quality Control (QC) Manager

1.6.2.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The QC Manager must be employed by the Prime Contractor. In addition to implementing and managing the QC program, the QC Manager may perform the duties of Project Superintendent. The QC Manager must attend the Coordination and Mutual Understanding Meeting, perform the three

phases of control except for those phases of control designated to be performed by QC Specialists, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this Contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by the QC Specialists, testing laboratory personnel and any other inspection and testing personnel required by this Contract. The QC Manager is the manager of all QC activities.

1.6.2.2 Qualifications

The QC Manager must be an individual with a minimum of 10 years combined experience in the following positions: Project Superintendent, QC Manager, Project Manager, Project Engineer or Construction Manager on similar size and type construction Contracts which included the major trades that are part of this Contract. The individual must have at least 2 years experience as a QC Manager. The individual must have experience in the areas of hazard identification, and safety compliance.

The QC Manager and all members of the QC organization must be capable of reading, writing, and conversing fluently in the English language.

1.6.3 Organizational Changes

Maintain the QC staff with personnel as required by the specification section at all times. When it is necessary to make changes to the QC staff, revise the CQC Plan to reflect the changes and submit the changes to the OWNER for acceptance.

1.6.4 Alternate Quality Control (QC) Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The qualification requirements for the Alternate QC Manager must be the same as for the QC Manager.

1.7 SUBMITTAL AND DELIVERABLES REVIEW AND APPROVAL

Procedures for submission, review and approval of submittals are described in Section 01 33 00 SUBMITTAL PROCEDURES. Procedures must include field verification of relevant dimensions and component characteristics by the QC organization prior to submittal being sent to the OWNER. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the Contract.

1.8 THREE PHASES OF CONTROL

CQC enables the Contractor to ensure that the construction, including that of subcontractors and suppliers, complies with the requirements of the Contract. At least three phases of control must be conducted by the QC Manager to adequately cover both on-site and off-site work for each definable feature of the construction work as follows:

1.8.1 Preparatory Phase

Document the results of the preparatory phase actions by separate minutes prepared by the QC Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required to meet Contract specifications.

Notify the OWNER at least 2 business days in advance of each preparatory phase meeting. The meeting will be conducted by the QC Manager and attended by the Project Superintendent, and the foreman responsible for the DFOW. When the DFOW will be accomplished by a subcontractor, that subcontractor's foreman must attend the preparatory phase meeting. This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. Perform the following prior to beginning work on each DFOW:

a. Review each paragraph of the applicable specification sections, reference codes, and standards. Make available during the prepatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by OWNER personnel until final acceptance of the work.

b. Review the Contract drawings.

c. Verify that field measurements are as indicated on construction or shop drawings or both before confirming product orders, to minimize waste due to excessive materials.

d. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.

e. Review the testing plan and ensure that provisions have been made to provide the required QC testing.

f. Examine the work area to ensure that the required preliminary work has been completed and complies with the Contract and ensure any deficiencies/rework items in the preliminary work have been corrected and confirmed by the OWNER.

g. Review coordination of product/material delivery to designated prepared areas to execute the work.

h. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data and are properly stored.

i. Check to assure that all materials and equipment have been tested, submitted, and approved.

j. Discuss specific controls to be used, construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW. Ensure any portion of the plan requiring separate OWNER acceptance has been approved.

k. Review the APP and appropriate Activity Hazard Analysis (AHA) to ensure that applicable safety requirements are met, and that required Safety Data Sheets (SDS) are submitted.

l. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

m. Discuss schedule and execution of the initial control phase and confirmation or construction quality compliance.

1.8.2 Initial Phase

Notify the OWNER at least 2 business days in advance of each initial phase. When construction crews are ready to start work on a DFOW, conduct the initial phase with the Project Superintendent, and the foreman responsible for that DFOW. Observe the initial segment of the DFOW to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily CQC Report and in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site when acceptable levels of specified quality are not being met. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with follow-up phases. Perform the following for each DFOW:

a. Check work to ensure that it is in full compliance with Contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full Contract compliance. Verify required control inspection and testing comply with the Contract.

c. Establish level of workmanship and verify that it meets the minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve any workmanship issues.

e. Ensure that testing is performed by the approved laboratory.

f. Check work procedures for compliance with the APP and the appropriate AHA to ensure that applicable safety requirements are met.

g. Review project specific work plans (i.e., HAZMAT Abatement, Stormwater Management) to ensure all preparatory work items have been completed and documented.

1.8.3 Follow-Up Phase

Perform the following for on-going DFOW daily, or more frequently as necessary, until the completion of each DFOW. The Final Follow-Up for any DFOW will clearly note in the daily report the DFOW is completed, and all deficiencies/rework items have been completed in accordance with the paragraph DEFICIENCY/REWORK ITEMS LIST. Each DFOW that has completed the Initial Phase and has not completed the Final Follow-up must be included on each daily report. If no work was performed on that DFOW for the period of that daily report, it must be so noted. Document all Follow-Up activities for DFOWs in the daily CQC Report:

a. Ensure the work including control testing complies with Contract requirements until completion of that particular work feature. Record checks in the CQC documentation.

b. Maintain the quality of workmanship required.

c. Ensure that testing is performed by the approved laboratory.

d. Ensure that deficiencies/rework items are being corrected. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work.

e. Do not build upon nor conceal non-conforming work.

f. Assure manufacturers' representatives have performed necessary inspections if required and perform safety inspections.

1.8.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same DFOW if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a DFOW has not started within 45 days of the initial preparatory meeting or has resumed after 45 days of inactivity, or if other problems develop.

1.8.5 Notification of Three Phases of Control for Off-Site Work

Notify the OWNER at least 2 weeks prior to the start of the preparatory and initial phases.

1.8.6 Deficiency/Rework Items List

The QC Manager must maintain a list of work that does not comply with the Contract, identifying what items need to be corrected, the activity ID number associated with the item, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected.

The QC Manager reviews the list at each weekly QC Meeting:

a. There is no requirement to report a deficiency/rework item that is corrected the same day it is discovered.

b. No successor task may be advanced beyond the preparatory phase meeting until all deficiencies/rework items have been cleared by the QC Manager and concurred with by the OWNER. This must be confirmed as part of the Preparatory Phase activities.

c. Attach a copy of the "Deficiency/Rework Items List" to the last daily CQC Report of each month.

d. The Contractor is responsible for including those items identified by the OWNER.

e. All deficiencies/rework items must be confirmed as corrected by the QC Manager, and concurred by the OWNER, prior to commencement of any completion inspections per paragraph COMPLETION INSPECTIONS unless specifically exempted by the OWNER.

f. Non-Compliance with these requirements is grounds for removal in accordance with paragraph ACCEPTANCE OF THE QUALITY CONTROL (QC) PLAN.

g. All delays, concurrent or related to failure to manage, monitor, control, and correct deficiencies/rework items are entirely the

responsibility of the Contractor and can not be made the subject, or any component of any request for additional time or compensation.

1.9 TESTING

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to Contract requirements. Upon request, furnish to the OWNER duplicate samples of test specimens for possible testing by the OWNER. Testing includes operation and acceptance tests when specified. Procure the services of an OWNER approved testing laboratory. Perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with Contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all test documentation requirements, have been prepared.

e. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the OWNER, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the OWNER. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

1.9.1 Capability Check

The OWNER retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract. Laboratories utilized for testing soils, concrete, asphalt, and steel must meet criteria detailed in ASTM D3740 and ASTM E329.

1.9.1.1 Onsite Laboratory

The OWNER reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the OWNER.

1.9.2 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the OWNER immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results must be signed by a testing laboratory

representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the OWNER via the QC Manager.

1.10 COMPLETION INSPECTIONS

1.10.1 Punch-Out Inspection

Near the completion of all work or any increment thereof the QC Manager must conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings, specifications, and Contract. Include in the punch list any remaining items on the "Deficiency/Rework Items List", that were not corrected prior to the Punch-Out Inspection as approved by the OWNER in accordance with the paragraph DEFICIENCY/REWORK ITEMS LIST. Include within the punch list the estimated date by which the deficiencies will be corrected. Provide a copy of the punch list to the OWNER.

The QC Manager, or staff, must make follow-on inspections to ascertain that all deficiencies have been corrected. All punch list items must be confirmed as corrected by the QC Manager and concurred by the OWNER. Once this is accomplished, notify the OWNER that the facility is ready for the OWNER "Pre-Final Inspection".

1.10.2 Pre-Final Inspection

The OWNER and QC Manager will perform this inspection to verify that the work is complete and ready to be placed into service. An OWNER "Pre-Final Punch List" will be documented by the QC Manager as a result of this inspection. The QC Manager will ensure that all items on this list are corrected and concurred by the OWNER prior to notifying the OWNER that a "Final" inspection can be scheduled. All items noted on the "Pre-Final" inspection must be corrected and concurred by the OWNER in a timely manner and be accomplished before the Contract completion date for the work, or any increment thereof, if the project is divided into increments by separate completion dates unless exceptions are directed by the OWNER.

1.10.3 Final Acceptance Inspection

Notify the OWNER at least 14 calendar days prior to the date a final acceptance inspection can be held. State within the notice that all items previously identified on the pre-final punch list will be corrected and acceptable, along with any other unfinished Contract work, by the date of the final acceptance inspection. The Contractor must be represented by the QC Manager, the Project Superintendent, and others deemed necessary. Attendees for the OWNER will include the OWNER, other OWNER QA personnel, and personnel representing the equipment SUPPLIER. Failure of the Contractor to have all Contract work acceptably complete for this inspection will be cause for the OWNER to bill the Contractor for the OWNER 's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.11 QUALITY CONTROL (QC) CERTIFICATIONS

1.11.1 Contractor Quality Control (CQC) Report Certification

Contain the following statement within the CQC Report: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used, and work performed during this reporting

period is in compliance with the Contract drawings and specifications to the best of my knowledge, except as noted in this report."

1.11.2 Completion Certification

Upon completion of work under this Contract, the QC Manager must furnish a certificate to the OWNER attesting that "the work has been completed, inspected, tested and is in compliance with the Contract." Provide a copy of this final QC Certification for completion to the preparer of the Operation & Maintenance (O&M) documentation.

1.12 DOCUMENTATION AND INFORMATION FOR THE OWNER

Maintain current and complete records of on-site and off-site QC program operations and activities.

Prior to commencing work on construction, the Contractor must provide a copy set of the proposed report forms. The report forms will consist of the Contractor Quality Control (CQC) Report, CQC Report (Continuation Sheet), Contractor Production Report, Contractor Production Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Testing Plan and Log, and Rework Items List. Contractor may use the forms provided as related material located at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-45-00.

1.12.1 Construction Documentation

Reports are required for each day that work is performed and must be attached to the Contractor Quality Control Report prepared for the same day. Maintain current and complete records of on-site and off-site QC program operations and activities. Reports are required for each day work is performed. Account for each calendar day throughout the life of the Contract.

The Project Superintendent and the QC Manager must prepare and sign the Contractor Production and CQC Reports, respectively. Every space on the forms must be filled in. Use N/A if nothing can be reported in one of the spaces. The reporting of work must be identified by terminology consistent with the construction schedule. In the "Remarks" sections of the reports, enter pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered, a record of visitors to the work site, quality control problem areas, deviations from the QC Plan, construction deficiencies encountered, and meetings held. For each entry in the report(s), identify the Schedule Activity No. that is associated with the entered remark.

1.12.2 Quality Control Activities

CQC and Contractor Production reports will be prepared daily to maintain current records providing factual evidence that required quality control activities and tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:

a. The name and area of responsibility of the Contractors and any

subcontractors.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When a Network Analysis Schedule (NAS) is used, identify each item of work performed each day by NAS activity number.

d. Control phase activities performed. Preparatory, and Initial phase Checklists associated with the DFOW referenced to the construction schedule. Follow-up phase activities identified to the DFOW. If testing or specific QC Specialist activities are associated with the Follow-up phase activities for a specific DFOW note this and include those reports.

e. Test and control activities performed with results and references to specifications and drawings requirements. Identify the control phase (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action in accordance with the paragraph DEFICIENCY/REWORK ITEMS LIST.

f. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications and drawings requirements.

g. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.

h. Offsite surveillance activities, including actions taken.

i. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

j. Instructions given/received and conflicts in plans and specifications.

1.12.3 Verification Statement

Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract.

Furnish the original and one copy of these records in report form to the OWNER by 10:00 AM the next working day after the date covered by the report. As a minimum, prepare and submit one report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the Contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the QC Manager. Include copies of test reports and copies of reports prepared by all subordinate quality control personnel within the QC Manager Report.

1.12.4 Quality Control Validation

Establish and maintain the following in an electronic folder. Divide folder into a series of tabbed sections as shown below. Ensure folder is updated at each required progress meeting.

a. CQC Meeting minutes in accordance with paragraph QUALITY CONTROL (QC) MEETINGS.

b. All completed Preparatory and Initial Phase Checklists, arranged by specification section, further sorted by DFOW referenced to the construction schedule. Submit each individual Phase Checklist the day the phase event occurs as part of the CQC daily report.

c. All milestone inspections, arranged by Activity Number referenced to the construction schedule.

d. An up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section referenced to the DFOW to which individual reports results are associated. Individual field test reports will be submitted within 2 working days after the test is performed in accordance with the paragraph QUALITY CONTROL ACTIVITIES.

e. Copies of all Contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.

f. An up-to-date copy of the paragraph DEFICIENCY/REWORK ITEMS LIST.

g. Upon commencement of Completion Inspections of the entire project or any defined portion, maintain up-to-date copies of all punch lists issued by the QC staff to the Contractor and subcontractors and all punch lists issued by the OWNER in accordance with the paragraph COMPLETION INSPECTIONS.

1.12.5 Testing Plan and Log

As tests are performed, the QC Manager will record on the "Testing Plan and Log" the date the test was performed and the date the test results were forwarded to the OWNER. Attach a copy of the updated "Testing Plan and Log" to the last daily CQC Report of each month. Provide a copy of the final "Testing Plan and Log" to the preparer of the Operation & Maintenance (O&M) documentation.

1.12.6 As-Built Drawings

The QC Manager must ensure the as-built drawings, required by Section 01 78 00 CLOSEOUT SUBMITTALS are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. The as-built drawings document commences with the QC Manager ensuring all amendments, or changes to the Contract prior to Contract award are accurately noted in the initial document set creating the accurate baseline of the Contract prior to any work starting. Ensure each deviation has been identified with the appropriate modifying documentation (e.g., PC No., Modification No., Request for Information No.). The QC Manager must initial each revision. Upon completion of work, the QC Manager will furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the OWNER.

1.13 NOTIFICATION ON NON-COMPLIANCE

The OWNER will notify the Contractor of any detected non-compliance with the Contract. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, is deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the OWNER may issue an order stopping

all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of a claim for extension of time for excess costs or damages by the Contractor.

1.14 DELIVERY, STORAGE, AND HANDLING

Designate receiving/storage areas for incoming material to be delivered according to installation schedule and to be placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. Store and handle materials in a manner as to prevent loss from weather and other damage. Keep materials, products, and accessories covered and off the ground, and store in a dry, secure area. Prevent contact with material that may cause corrosion, discoloration, or staining. Protect all materials and installations from damage by the activities of other trades.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020) National Electrical Code
NFPA 241	(2022) Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.2 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Site Plan; O

1.3 CONSTRUCTION SITE PLAN

Prior to the start of work, submit for OWNER approval a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desired. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

In addition to the items listed above, the Construction Site Plan shall identify and provide details for the following, as applicable:

a. Contractor staging and laydown areas, material receiving areas, and equipment parking.

b. Contractor temporary housing (camp) location, limits, and layout. Temporary housing shall be located only within areas identified on the Contract Drawings as available for contractor use.

c. Temporary sanitary facilities location, screening, servicing approach, and final removal plan (barge transport offsite at completion of the Work).

d. Temporary utility connection points and distribution for (1) electrical power and (2) potable water from OWNER-provided connection points to contractor facilities and work areas.

e. Fuel storage and dispensing locations and details, including secondary containment, spill response equipment, and refueling controls.

f. Mobilization and access plan identifying anticipated delivery and personnel access routes by air and by water, including any tide-dependent access constraints.

Site access is available via wheeled aircraft using the private airstrip, helicopter, and shallow draft watercraft during high tide; barge deliveries may be required for major equipment and materials.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Prior to the commencement of work activities, provide a clear weatherproof covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the Contract, Wage Rate Information poster, Safety and Health Information as required by OSHA and other information approved by the OWNER. Coordinate requirements herein with 01 35 26 SAFETY REQUIREMENTS. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, and in location as approved by the OWNER.

2.1.2 Warning Signs

Post temporary signs, tags, and labels to give workers and the public adequate warning and caution of construction hazards according to OSHA regulations. Attach signs to the perimeter fencing every 150 feet warning the public of the presence of construction hazards. Signs must require unauthorized persons to keep out of the construction site. Correct the data required by safety signs daily. Post signs at all points of entry designating the construction site as a hard hat area.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Barricades

Erect and maintain temporary barricades to limit access to hazardous areas. Barricades are required whenever safe access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.3 FENCING

Provide fencing along the construction site and at all open excavations and tunnels to control access by unauthorized personnel. Safety fencing must be highly visible to be seen by pedestrians and vehicular traffic.

Remove the fence upon completion and acceptance of the work.

2.3.1 Polyethylene Mesh Safety Fencing

Temporary safety fencing must be a high visibility orange colored, high density polyethylene grid, a minimum of 48 inches high and maximum mesh size of 2 inches. Fencing must extend from the grade to a minimum of 48 inches above the grade and be tightly secured to T-posts spaced as necessary to maintain a rigid and taut fence. Fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

2.3.2 Chain Link Panel Fencing

Temporary panel fencing must be galvanized steel chain link panels 6 feet high. Multiple fencing panels may be linked together at the bases to form long spans as needed. Each panel base must be weighted down using sand bags or other suitable materials in order for the fencing to withstand anticipated winds while remaining upright. Fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

2.3.3 Post-Driven Chain Link Fencing

Temporary post-driven fencing must be galvanized chain link fencing 6 feet high supported by an tightly secured to galvanized steel posts driven below grade. Fence posts must be located on minimum 10 foot centers. Posts may be set in various surfaces such as sand, soil, asphalt or concrete as necessary. Chain link fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection. Completely remove fencing and posts at the completion of construction and restore surfaces disturbed or damaged to its original condition. Locate and identify underground utilities prior to setting fence posts. Equip fence with a lockable gate. Gate must remain locked when construction personnel are not present.

2.4 TEMPORARY WIRING

Provide temporary wiring in accordance with, NFPA 241 and NFPA 70. Include monthly inspection and testing of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Construction Contract employees must park privately owned or Contractor owned vehicles in an area designated by the OWNER. Employee parking must not interfere with existing and established parking requirements of the OWNER.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Payment for Utility Services

a. Reasonable amounts of the following utilities will be made available without charge at existing outlets and supplies, at locations coordinated with the OWNER:

(1) Electricity
(2) Potable Water

All other utilities and services required for the Work, including but not limited to fuel supply, sanitary waste handling, communications, and any temporary utility distribution beyond the OWNER's point of connection, shall be provided by the Contractor at no additional expense to the OWNER.

b. The point at which the OWNER will deliver such utilities or services and the quantity available is must be coordinated with the OWNER. Pay all costs incurred in connecting, converting, and transferring the utilities to the work. Make connections including providing transformers and make disconnections.

c. The Contractor shall provide all utilities and services not explicitly identified above as being made available by the OWNER without charge.

3.2.3 Sanitation

Provide and maintain within the construction area field-type, portable sanitary facilities. Locate the facilities behind the construction fence or out of public view. Provide units that are self-contained with sealed holding tanks. Do not discharge sanitary waste to the ground, surface waters, or OWNER systems unless specifically authorized in writing by the OWNER. Service units as required to maintain sanitary conditions, control pests, and eliminate odors. Remove sanitary waste and/or units offsite in accordance with applicable regulations. At completion of the Work, remove all portable sanitary facilities and associated waste from the site by barge transport offsite. OWNER toilet facilities will not be available to Contractor's personnel.

3.2.4 Telephone

Make arrangements and pay all costs for telephone facilities desired.

3.2.5 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 STATION OPERATION AFFECT ON CONTRACTOR OPERATIONS

Work will occur within and adjacent to an operating powerhouse. Contractor shall protect all existing equipment,systems, and finishes from damage during construction. The Contractor shall coordinate with the OWNER for access, security procedures, outage requests, lockout/tagout, tie-ins, switching, and any activity that may affect plant operations. Do not operate, open, isolate, or modify OWNER equipment or systems without prior written authorization and OWNER participation as required. Maintain clear egress, access to operating equipment, and housekeeping suitable for an operating facility at all times.

3.4 CONTRACTOR'S TEMPORARY FACILITIES

Contractor is responsible for security of their property. Provide adequate outside security lighting at the temporary facilities. Trailers must be anchored to resist high winds and meet applicable state or local standards for anchoring mobile trailers.

3.4.1 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site. OWNER office and warehouse facilities will not be available to the Contractor's personnel.

In the event a new building is constructed for the temporary project field office, it must be a minimum 12 feet in width, 16 feet in length and have a minimum of 7 feet headroom. Equip the building with approved electrical wiring, at least one double convenience outlet and the required switches and fuses to provide 110-120 volt power. Provide a work table with stool, desk with chair, two additional chairs, and one legal size file cabinet that can be locked. The building must be waterproof, supplied with a heater, have a minimum of two doors, electric lights, a telephone, a battery-operated smoke detector alarm, a sufficient number of adjustable windows for adequate light and ventilation, and a supply of approved drinking water. Provide approved sanitary facilities. Screen the windows and doors and provide the doors with deadbolt type locking devices or a padlock and heavy-duty hasp bolted to the door. Door hinge pins must be non-removable. Arrange the windows to open and to be securely fastened from the inside. Protect glass panels in windows by bars or heavy mesh screens to prevent easy access. In warm weather, provide air conditioning capable of maintaining the office at 50 percent relative humidity and a room temperature 20 degrees F below the outside temperature when the outside temperature is 95 degrees F. Unless otherwise directed by the OWNER, remove the building from the site upon completion and acceptance of the work.

3.4.2 Quality Control Manager Records and Field Office

Provide on the jobsite an office with approximately 100 square feet of useful floor area for the exclusive use of the QC Manager. Provide a weathertight structure with adequate heating and cooling, toilet facilities, lighting, ventilation, a 4 by 8 foot plan table, a standard size office desk and chair, computer station, and working communications facilities. Provide a door with a cylinder lock and windows with locking hardware. Make utility connections. Locate where indicated. File quality control records in the office and make available at all times to the OWNER. After completion of the work, remove the entire structure from the site.

3.4.3 Storage Area

Construct a temporary 6 foot high chain link fence around trailers and materials. Include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the OWNER away from the vicinity of the construction site but within the installation boundaries. Trailers,

equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on the current day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

Keep fencing in a state of good repair and proper alignment. If the Contractor elects to traverse grassed or unpaved areas which are not established roadways with construction equipment or other vehicles, cover the grassed or unpaved areas with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation must be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, structures, under trailers, and in areas not accessible to mowers must be edged or trimmed neatly.

3.4.4 Supplemental Storage Area

Upon request, and pending availability, the OWNER will designate another or supplemental area for the use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Maintain the area in a clean and orderly fashion and secured if needed to protect supplies and equipment. Utilities will not be provided to this area by the OWNER.

3.4.5 Appearance of Trailers

a. Trailers must be roadworthy and comply with all appropriate state and local vehicle requirements. Trailers which are rusted, have peeling paint or are otherwise in need of repair will not be allowed on Installation property. Trailers must present a clean and neat exterior appearance and be in a state of good repair.

b. Maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal at the Contractor's expense.

3.4.6 Safety Systems

Protect the integrity of all installed safety systems or personnel safety devices. Obtain prior approval from the OWNER if entrance into systems serving safety devices is required. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish Contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the OWNER.

3.4.7 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.4.7.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby OWNER property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby OWNER property.

3.4.8 Temporary Housing (Contractor Camp)

Provide, operate, and maintain temporary housing on site for Contractor personnel for the duration of the Work. Locate temporary housing only within areas identified on the Contract Drawings as available for contractor use. Existing OWNER employee housing and facilities are not available for Contractor use unless specifically authorized in writing by the OWNER. Provide all camp facilities, furnishings, and operations necessary for safe and sanitary occupancy, including heating, lighting, housekeeping, and solid waste management. Upon completion of the Work, remove all temporary housing and appurtenances and restore affected areas to their pre-construction condition.

3.4.9 Fuel Supply, Storage, and Containment

The Contractor shall furnish and transport to the site all fuel required for construction operations, including fuel for equipment, generators (if used), and camp operations. Store fuels and lubricants only in locations approved by the OWNER and shown on the Construction Site Plan. Provide secondary containment for all fuel storage and dispensing areas. Provide spill prevention and response measures, including spill kits, trained personnel, and immediate cleanup of releases. Do not refuel or store fuel where a release could enter waterways. Remove all fuel storage, containment, and related equipment from the site at completion of the Work and restore affected areas.

3.5 PLANT COMMUNICATIONS

Whenever the individual elements of the plant are located so that operation by normal voice between these elements is not satisfactory, install a satisfactory means of communication, such as telephone or other suitable devices and make available for use by OWNER personnel.

3.6 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. Maintain the safety fencing during the life of the Contract and, upon completion and acceptance of the work, remove from the work site.

3.7 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store all salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

3.8 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and all other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence. Restore areas used during the performance of the Contract to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 273	Standards for Universal Waste Management
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.2 DEFINITIONS

1.2.1 Co-mingle

The practice of placing unrelated materials together in a single container, usually for benefits of convenience and speed.

1.2.2 Construction Waste

Waste generated by construction activities, such as scrap materials, damaged or spoiled materials, temporary and expendable construction materials, and other waste generated by the workforce during construction activities.

1.2.3 Demolition Debris/Waste

Waste generated from demolition activities, including minor incidental demolition waste materials generated as a result of Intentional dismantling of all or portions of a building, to include clearing of building contents that have been destroyed or damaged.

1.2.4 Disposal

Depositing waste in a solid waste disposal facility, usually a managed landfill or incinerator, regulated in the US under the Resource Conservation and Recovery Act (RCRA).

1.2.5 Diversion

The practice of diverting waste from disposal in a landfill or incinerator, by means of eliminating or minimizing waste, or reuse of materials.

1.2.6 Final Construction Waste Diversion Report

A written assertion by a material recovery facility operator identifying

constituent materials diverted from disposal, usually including summary tabulations of materials, weight in short-ton.

1.2.7 Recycling

The series of activities, including collection, separation, and processing, by which products or other materials are diverted from the solid waste stream for use in the form of raw materials in the manufacture of new products sold or distributed in commerce, or the reuse of such materials as substitutes for goods made of virgin materials, other than fuel.

1.2.8 Reuse

The use of a product or materials again for the same purpose, in its original form or with little enhancement or change.

1.2.9 Salvage

Usable, salable items derived from buildings undergoing demolition or deconstruction, parts from vehicles, machinery, other equipment, or other components.

1.2.10 Source Separation

The practice of administering and implementing a management strategy to identify and segregate unrelated waste at the first opportunity.

1.3 CONSTRUCTION WASTE (INCLUDES DEMOLITION DEBRIS/WASTE)

Follow applicable industry standards in the management of waste. Apply sound environmental principles in the management of waste. (1) Practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction waste and demolition debris/waste from landfills and incinerators and to facilitate the recycling or reuse of excess construction materials.

1.4 CONSTRUCTION WASTE MANAGEMENT

Implement a Construction Waste Management Program for the project. Take a pro-active, responsible role in the management of construction waste, recycling process, disposal of demolition debris/waste, and require all subcontractors, vendors, and suppliers to participate in the Construction Waste Management Program. Establish a process for clear tracking, and documentation of construction waste and demolition debris/waste.

1.4.1 Implementation of Construction Waste Management Program

Develop and document how the Construction Waste Management Program will be implemented in a Construction Waste Management Plan. Submit a Construction Waste Management Plan to the OWNER for approval. Construction waste and demolition debris/waste materials include un-used construction materials not incorporated in the final work, as well as demolition debris/waste materials from demolition activities or deconstruction activities. In the management of waste, consider the availability of viable markets, the condition of materials, the ability to provide material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates.

1.4.2 Oversight

The Quality Control Manager, as specified in Section 01 45 00 QUALITY CONTROL, is responsible for overseeing and documenting results from executing the Construction Waste Management Plan for the project.

1.4.3 Special Programs

Implement special programs involving rebates or similar incentives related to recycling of construction waste and demolition debris/waste materials. Retain revenue or savings from salvaged or recycling, unless otherwise directed. Ensure firms and facilities used for recycling, reuse, and disposal are permitted for the intended use to the extent required by federal, state, and local regulations.

1.4.4 Special Instructions

Provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the projects. Designation of single source separating or commingling will be clearly marked on the containers.

1.4.5 Waste Streams

Delineate waste streams and characterization, including estimated material types and quantities of waste, in the Construction Waste Management Plan. Manage all waste streams associated with the project. Typical waste streams are listed below. Include additional waste steams not listed:

a. Land Clearing Debris

b. Masonry and CMU

c. Concrete

d. Metals (Includes, but is not limited to, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, bronze.)

e. Wood (nails and staples allowed)

f. Paper

g. Plastics (PET, HDPE,PVC,LDPE,PP,PS, Other)

h. Gypsum

i. Non-hazardous paint and paint cans

j. Ceiling Tiles

1.5 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Waste Management Plan; O

1.6 MEETINGS

Conduct Construction Waste Management meetings. After award of the Contract and prior to commencement of work, schedule and conduct a meeting with the OWNER to discuss the proposed Construction Waste Management Plan and to develop a mutual understanding relative to the management of the Construction Waste Management Program and how waste diversion requirements will be met.

The requirements of this meeting may be fulfilled during the coordination and mutual Understanding meeting outlined in Section 01 45 00 QUALITY CONTROL. At a minimum, discuss and document waste management goals at following meetings:

a. Preconstruction meeting.

b. Regular Quality Control meetings.

c. Work safety meeting (if applicable).

1.7 CONSTRUCTION WASTE MANAGEMENT PLAN

Submit Construction Waste Management Plan within 45 calendar days after notice to proceed. Revise and resubmit Construction Waste Management Plan as necessary, in order for construction to begin. Execute demolition or deconstruction activities in accordance with Section 02 41 00 DEMOLITION. Manage demolition debris/waste or deconstruction materials in accordance with the approved construction waste management plan.

An approved Construction Waste Management Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations. Ensure all subcontractors receive a copy of the approved Construction Waste Management Plan. The plan demonstrates how to meet the project waste diversion requirement. Also, include the following in the plan:

a. Identify the names of individuals responsible for waste management and waste management tracking, along with roles and responsibilities on the project.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of materials.

e. Name of landfill and incinerator to be used.

f. Identification of local and regional re-use programs, including non-profit organizations such as schools, local housing agencies, and organization that accept used materials such as material exchange

networks and resale stores. Include the name, location, phone number for each re-use facility identified, and provide a copy of the permit or license for each facility.

g. List of specific materials, by type and quantity, that will be salvaged or recycled. Identify the recycling facilities by name, address, and phone number.

h. Identification of materials that cannot be recycled or reused with an explanation or justification, to be approved by the OWNER.

i. Description of the means by which materials identified in item (g) above will be protected from contamination.

j. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

k. Copy of training plan for subcontractors and other services to prevent contamination by co-mingling materials identified for diversion and waste materials.

l. Facilities or subcontractors offering construction waste transport on-site or off-site must ensure that proper shipping orders, bill of lading, manifests, or other shipping documents containing waste diversion information meet requirements of 40 CFR 273 Universal Waste Management, 49 CFR 173 Shippers - General Requirements for Shipments and Packagings, and 49 CFR 178 Specifications for Packaging. Individuals signing manifests or other shipping documents should meet the minimum training requirements.

m. Identify local jurisdiction requirements for waste management. Include local requirements and points of contact.

Distribute copies of the waste management plan to each subcontractor, Quality Control Manager , and the OWNER.

1.8 RECORDS (DOCUMENTATION)

1.8.1 General

Maintain records to document the types and quantities of waste generated and diverted though re-use, recycling and sale to third parties; through disposal to a landfill or incinerator facility. Collect and retain manifests, weight tickets, sales receipts, and invoices specifically identifying diverted project waste materials or disposed materials.

1.8.2 Accumulated

Maintain a running record of materials generated and diverted from landfill disposal, including accumulated diversion rates for the project. Make records available to the OWNER during construction or incidental demolition activities. Provide a copy of the diversion records to the OWNER upon completion of the construction, incidental demolitions or minor deconstruction activities.

1.9 COLLECTION

Collect, store, protect, and handle reusable and recyclable materials at the site in a manner which prevents contamination, and provides protection from the elements to preserve their usefulness and monetary value. Provide receptacles and storage areas designated specifically for recyclable and reusable materials and label them clearly and appropriately to prevent contamination from other waste materials. Keep receptacles or storage areas neat and clean.

Train subcontractors and other service providers to either separate waste streams or use the co-mingling method as described in the Construction Waste Management Plan. Separate materials by one of the following methods:

1.9.1 Source Separation Method

Separate waste products and materials that are recyclable from trash and sort as described below into appropriately marked separate containers and then transport to the respective recycling facility for further processing. Deliver materials in accordance with recycling or reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the category types as defined in the Construction Waste Management Plan.

1.9.2 Other Methods

Other methods proposed by the Contractor may be used when approved by the OWNER.

1.10 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the OWNER and in compliance with waste management procedures as described in the waste management plan. Except as otherwise specified in other sections of the specifications, dispose of in accordance with the following:

1.10.1 Reuse

Give first consideration to reusing construction and demolition materials as a disposition strategy. Recover for reuse materials, products, and components as described in the approved Construction Waste Management Plan. Coordinate with the OWNER to identify onsite reuse opportunities or material sales or donation available through resale or donation programs. Consider the use of surplus industrial supply broker services, who match entities with reusable or repurpose industrial materials with entities with need of such materials.

1.10.2 Recycle

Recycle non-hazardous construction and demolition/debris materials that are not suitable for reuse. Recycle all fluorescent lamps, HID lamps, mercury (Hg) -containing thermostats and ampoules, and PCBs-containing ballasts and electrical components as directed by the OWNER. Do not crush lamps on site as this creates a hazardous waste stream with additional handling requirements.

1.10.3 Waste

Dispose by landfill or incineration only those waste materials with no practical use, economic benefit, or recycling opportunity.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 As-Built Drawings

As-built drawings are the marked-up drawings, maintained by the Contractor on-site, that depict actual conditions and deviations from the Contract Documents. These deviations and additions may result from coordination required by, but not limited to: contract modifications; official responses to submitted Requests for Information (RFI's); direction from the OWNER; design that is the responsibility of the Contractor, and differing site conditions. Maintain the as-builts throughout construction as red-lined hard copies on site and/or red-lined PDF files. These files serve as the basis for the creation of the record drawings.

1.1.2 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings and will be completed by the ENGINEER.

1.2 SOURCE DRAWING FILES

Request the full set of electronic drawings, in the source format, as needed for preparation of any Contractor developed shop drawings, after award and at least 30 days prior to required use.

1.2.1 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction drawings and data for the referenced project. Any other use or reuse is at the sole risk of the Contractor and without liability or legal exposure to the OWNER. The Contractor must make no claim and waives to the fullest extent permitted by law, any claim or cause of action of any nature against the OWNER, its agents or sub consultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the OWNER harmless against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic CAD drawing files are not construction documents. Differences may exist between the CAD files and the corresponding construction documents. The OWNER makes no representation regarding the accuracy or completeness of the electronic CAD files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. In the event that a conflict arises between the signed and sealed construction documents prepared by the OWNER and the furnished Source drawing files, the signed and sealed construction documents govern. The Contractor is responsible for determining if any conflict exists. Use of these Source Drawing files does not relieve the Contractor of duty to fully comply with the contract documents, including

and without limitation, the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction drawings and data related to this contract, remove all previous indicia of ownership (seals, logos, signatures, initials and dates).

1.3 RECORD DRAWINGS

The OWNER will provide pdf and or program files at the preconstruction conference that contains one set of "as-designed" electronic CAD files in the specified software and format revised to reflect all amendments and the final contract PDF drawings. The CAD files are provided to enable preparation of as-built drawings. If discrepancies exist between the CAD files and the contract PDF drawings, correct the CAD files to show the contract PDF drawings.

1.3.1 Variation with Contract Drawings

The electronic files provided are not part of the contract documents. If there is any discrepancy between the electronic files and the contract drawings, the contract drawings govern. The OWNER has no responsibility to modify any OWNER furnished model due to changes in the design that occur after award.

Evaluate the content and quality of the OWNER furnished model upon receipt. If major discrepancies or omissions occur in the OWNER furnished model, notify the OWNER and indicate the nature of such variations.

1.3.2 Data Loss, Corruption, and Error

Transfer of OWNER furnished model files may result in corrupted files resulting in data loss and errors. Use of OWNER furnished model files at own risk. Verify data integrity upon receipt and request a replacement if necessary. Make any adjustment in file structure, format, or software version as needed to make OWNER furnished model compatible with computer systems and/or software to meet the requirements of the contract.

1.3.3 Modeling Completeness and Quality

The OWNER makes no guarantee that the OWNER furnished model provide the level of completeness or quality as required by the contract. Further, the OWNER makes no guarantee that identified variations will be corrected upon notification.

1.4 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Warranty Management Plan

Spare Parts Data

SD-08 Manufacturer's Instructions

Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; O

SD-11 Closeout Submittals

As-Built Drawings; O

As-Built Record of Equipment and Materials

Warranted Equipment and Materials

Final Approved Shop Drawings; O

1.5 SPARE PARTS DATA

Submit two copies of the Spare Parts Data list.

a. Indicate manufacturer's name, part number, and stock level required for test and balance, pre-commissioning, maintenance and repair activities. List those items that may be standard to the normal maintenance of the system.

b. At acceptance of commissioning, ensure the required stock level is supplied as indicated in subparagraph a for maintenance and repair activities through the facilities warranty period. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.6 QUALITY CONTROL

Additions and corrections to the contract drawings must be equal in quality and detail to that of the originals. Line colors, line weights, lettering, layering conventions, and symbols must be the same as the original line colors, line weights, lettering, layering conventions, and symbols.

1.7 WARRANTY MANAGEMENT

1.7.1 Warranty Management Plan

At least 30 days before the planned pre-warranty conference, submit one set of the warranty management plan. Include within the warranty management plan all required actions and documents to assure that the OWNER receives all warranties to which it is entitled. The plan narrative must contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below must include due date and whether item has been submitted or was accomplished. Submit warranty information, made available during the construction phase, to the OWNER for approval prior to each monthly pay estimate. Assemble approved information in a binder and turn over to the OWNER upon acceptance of the work. The construction warranty period must begin on the date of project acceptance and continue for the full product warranty period. The warranty management plan must include, but is not limited to, the following:

a. Roles and responsibilities of personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. For each warranty, the name, address, telephone number, and e-mail of each of the guarantor's representatives nearest to the project location.

c. A list and status of delivery of Certificates of Warranty for extended warranty items, including HVAC balancing, pumps, motors, transformers, and for commissioned systems, such as fire protection and alarm systems, and lightning protection systems.

d. Warranted Equipment and Materials list for each warranted equipment, item, feature of construction or system indicating:

(1) Name of item.
(2) Model and serial numbers.
(3) Location where installed.
(4) Name and phone numbers of manufacturers or suppliers.
(5) Names, addresses and telephone numbers of sources of spare parts.
(6) Warranties and terms of warranty. Include one-year overall warranty of construction, including the starting date of warranty of construction. Items which have warranties longer than one year must be indicated with separate warranty expiration dates.
(7) Cross-reference to warranty certificates as applicable.
(8) Starting point and duration of warranty period.
(9) Summary of maintenance procedures required to continue the warranty in force.
(10) Cross-reference to specific pertinent Operation and Maintenance manuals.
(11) Organization, names and phone numbers of persons to call for warranty service.
(12) Typical response time and repair time expected for various warranted equipment.

e. Procedure and status of tagging of equipment covered by warranties longer than one year.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty or safety reasons.

1.7.2 Performance Bond

The Performance Bond must remain effective throughout the construction and warranty period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the OWNER will have the work performed by others, and after completion of the work, will charge the remaining construction warranty funds of expenses incurred by the OWNER while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the OWNER at the Contractor's expense, the OWNER will have the right to recoup expenses from the

bonding company.

c. Following oral or written notification of required construction warranty repair work, respond in a timely manner. Written verification will follow oral instructions. Failure to respond will be cause for the OWNER to proceed against the Contractor.

1.7.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the OWNER, meet with the OWNER to develop a mutual understanding with respect to the requirements of this section. At this meeting, establish and review communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the OWNER for the execution of the construction warranty In connection with these requirements and at the time of the Contractor's quality control completion inspection, furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact must be located within the local service area of the warranted construction, be continuously available, and be responsive to OWNER inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this provision.

PART 2 PRODUCTS

2.1 PDF AS-BUILT FILES

Provide electronic PDF "plots" of all contract drawings sheets associated with the as-built drawing submittal. Compile and organize the PDF set to match the contract drawings. Bookmark and label the pages of the PDF file.

2.2 REDLINES AND MARKUPS

Provide PDFs of the current working redlines and/or markups complying with the as-builts drawing and markup requirements contained in this specification.

2.2.1 Additional Drawings

If additional drawings are required, prepare them using the specified electronic file format applying the same graphic standards specified for original drawings. The title block and drawing border to be used for any new final record drawings must be identical to that used on the contract drawings.

2.2.1.1 Sheet Numbers and File Names

If a sheet needs to be added, follow the OWNER's drawing numbering convention.

2.3 AS-BUILT RE-SUBMISSION REQUIREMENTS

If elements of an as-built submittal are rejected, provide the following for each re-submission, in addition to any information required in Section 01 33 00 SUBMITTAL PROCEDURES:

a. Re-submit all components required under paragraph As-Builts, including updated content in response to OWNER comments.

b. Provide a copy of all OWNER review comments.

c. Provide a disposition/response to each OWNER review comment for a back-check of the re-submission deliverable.

PART 3 EXECUTION

3.1 AS-BUILT DRAWINGS

Provide and maintain two black line print copies of the PDF contract drawings for As-Built Drawings. Maintain the as-builts throughout construction as red-lined hard copies on site and/or red-lined PDF files. Submit As-Built Drawings 30 days prior to Beneficial Occupancy Date (BOD).

3.1.1 Markup Guidelines

Make comments and markup the drawings complete without reference to letters, memos, or materials that are not part of the As-Built drawing. Show what was changed, how it was changed, where item(s) were relocated and change related details. These working as-built markup prints must be neat, legible and accurate as follows:

a. Use base colors of red, green, and blue. Color code for changes as follows:

(1) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.

(2) Deletions (Green) - Over-strike deleted graphic items (lines), lettering in notes and leaders.

(3) Additions (Red) - Added items, lettering in notes and leaders.

b. Provide a legend if colors other than the "base" colors of red, green, and blue are used.

c. Add and denote any additional equipment or material facilities, service lines, incorporated under As-Built Revisions if not already shown in legend.

d. Use frequent written explanations on markup drawings to describe changes. Do not totally rely on graphic means to convey the revision.

e. Use legible lettering and precise and clear digital values when marking prints. Clarify ambiguities concerning the nature and application of change involved.

f. Wherever a revision is made, also make changes to related section views, details, legend, profiles, plans and elevation views, schedules, notes and call out designations, and mark accordingly to avoid conflicting data on all other sheets.

g. For deletions, cross out all features, data and captions that relate to that revision.

h. For changes on small-scale drawings and in restricted areas, provide

large-scale inserts, with leaders to the applicable location.

i. Indicate one of the following when attaching a print or sketch to a markup print:

   1) Add an entire drawing to contract drawings

   2) Change the contract drawing to show changes on the drawing.

   3) Provided for reference only to further detail the initial design.

j. Incorporate all shop and fabrication drawings into the markup drawings.

3.1.2 As-Built Drawings Content

Keep these working as-built markup drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract drawings which are made during construction or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Submit the working as-built markup drawings for approval prior to submission of each monthly pay estimate. For failure to maintain the working and final record drawings as specified herein, the OWNER will withhold 10 percent of the monthly progress payment until approval of updated drawings. Show on the as-built drawings, but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Layout and schematic drawings of electrical circuits and piping.

d. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

e. Changes in details of design or additional information obtained from working drawings specified to be prepared or furnished by the Contractor; including but not limited to shop drawings, fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment, and foundations.

f. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

g. Changes or Revisions which result from the final inspection.

h. Where contract drawings or specifications present options, show only the option selected for construction on the working as-built markup

drawings.

i. If borrow material for this project is from sources on OWNER property, or if OWNER property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

j. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, and fire suppression systems.

k. Changes in location of equipment and architectural features.

l. Modifications.

m. Actual location of anchors, construction and control joints, etc., in concrete.

n. Unusual or uncharted obstructions that are encountered in the contract work area during construction.

o. Location, extent, thickness, and size of stone protection particularly where it will be normally submerged by water.

3.2 FINAL APPROVED SHOP DRAWINGS

Submit final approved project shop drawings 30 prior to final inspection.

3.3 AS-BUILT RECORD OF EQUIPMENT AND MATERIALS

Furnish one copy of preliminary record of equipment and materials used on the project 15 days prior to final inspection. This preliminary submittal will be reviewed and returned 2 days after final inspection with OWNER comments. Submit Two sets of final record of equipment and materials 10 days after final inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA				
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

3.4 OPERATION AND MAINTENANCE MANUALS

Provide project operation and maintenance manuals as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide electronic copies of the Operation and Maintenance Manual files and one hard copy of the Operation and Maintenance Manuals. Submit to the OWNER for approval within 30 calendar days of the Beneficial Occupancy Date (BOD). Update and resubmit files for final approval at BOD.

3.5 CLEANUP

Leave premises "broom clean." Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Replace filters of operating equipment. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

-- End of Section --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE GUIDELINE 1.4	(2019) Preparing Systems Manuals for Facilities

ASTM INTERNATIONAL (ASTM)

ASTM E2166	(2016; R 2023) Standard Practice for Organizing and Managing Building Data

1.2 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Facility Data Workbook; O

Training Plan; O

Training Outline; O

Training Content; O

Operation And Maintenance Manual, Progress Submittal; O

Operation And Maintenance Manual, Prefinal Submittal; O

Operation And Maintenance Manual, Final Submittal; O

SD-11 Closeout Submittals

Training Video Recording; O

Validation of Training Completion; O

Training Plan; O

Record Drawings And Utility Systems; O

1.3 MEETINGS

To assure that Operation and Maintenance Manual and Facility Data Workbook requirements are being met through the duration of the project, organize the following meetings and discuss the subsequent topics:

1.3.1 Pre-Construction Meeting

At a minimum, discuss the following:

a. The requirement for Operation and Maintenance Manuals and Facility Data deliverables under this contract including coordination meetings

b. Processes and method of gathering Facility Data information during construction

c. Primary roles and responsibilities associated with the development and delivery of the Operation and Maintenance Manuals and Facility Data deliverables, and

d. Identify and agree upon a date and attendance list for the meetings described below:

1.3.2 Operation and Maintenance Manual and Facility Data Workbook Coordination Meeting

Facilitate a meeting after the Pre-Construction Meeting prior to the submission of the Operation and Maintenance Manual Progress Submittal. Meeting attendance must include the Contractor's Operation and Maintenance Manual and Facility Data Workbook Preparer, Quality Control Manager, the OWNER's Design Manager (DM), and OWNER's Representative. Include any Mechanical, Electrical, and Fire Protection Sub-Contractors.

The purpose of this meeting is to reach a mutual understanding of the scope of work concerning the contract requirements for Operation and Maintenance Manual and coordinate the efforts necessary by both the OWNER and Contractor to ensure an accurate collection, preparation and timely OWNER review of Operation and Maintenance Manual.

1.3.3 Submittal Coordination Meeting

Facilitate a meeting following submission and OWNER review of each design or progress submittal of the Operation and Maintenance Manual and Facility Data Workbook.

a. Include personnel from the Coordination meeting and any additional personnel identified.

b. The purpose of this meeting is to demonstrate ongoing compliance with the requirements identified in this specification. Discuss OWNER review comments and unresolved items preventing completion and OWNER approval of the Operation and Maintenance Manuals and Facility Data Workbook (FDW).

c. The applicable deliverables, along with OWNER remarks associated with review of these submittals serve as the primary guide and agenda for this meeting.

1.4 FACILITY DATA WORKBOOK

Develop an editable, electronic spreadsheet based on the equipment in the Operation and Maintenance Manuals that contains the information required to start a preventive maintenance program. As a minimum, provide Facility Data Workbook as a list of system equipment, location installed, warranty expiration date, manufacturer, model, and serial number.

1.5 OPERATION AND MAINTENANCE MANUAL MEDIA

Assemble Operation and Maintenance Manual into an electronically bookmarked file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains operation, maintenance and record files, project record documents, and training videos. Include a complete bookmarked operation and maintenance directory.

1.5.1 O&M Manual Tabbed Hard Copy

Provide a hard copy of the O&M manual upon completion of the project. Provide tabs for each section and subsection for ease of navigation by the user.

1.6 O&M MANUAL CONTENT

Organize the bookmarked Operation and Maintenance Manual into the following Parts in accordance with ASHRAE GUIDELINE 1.4, and as modified and detailed below. Word template for O&M Manual is available at: https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-78-23.

1.6.1 Part 1: Executive Summary

Provide a summary of the information found in the O&M manual including the purpose of the manual and a description of the manual's organization.

1.6.2 Part 2: Facility Design and Construction

1.6.2.1 General Facility and Systems Description

Provide an overview of the intent for design and use of the facility. Provide a PDF of the Record Drawings prepared in accordance with 01 78 00 CLOSEOUT SUBMITTALS and bookmarked using the sheet title and sheet number. Include uncluttered 11 by 17 inches floor plans with room numbers, type or function of space, and overall facility dimensions on the floor plans. Do not include items such as construction instructions, references, or frame numbers.

Detail the overall dimensions of the facility, number of floors, foundation type, expected number of occupants, and facility Category Code list and generally describe all the facility systems and any special building features (for example, HVAC Controls, Sprinkler Systems, Cranes, Elevators, and Generators). Include photographs marked up and labeled to show key operating components and the overall facility appearance.

1.6.2.2 Basis of Design

Provide a copy of the contract Basis of Design.

1.6.2.3 Contract Documents, RFP, Amendments, and Modifications

Provide the contract construction documents complete, to include specifications, drawings, Request for Proposal, amendments, and modifications.

1.6.3 Part 3: Facilities, Systems, and Assemblies Information

1.6.3.1 Organization

Bookmark information in this section using the current version of ASTM E2166 Uniformat II, UFGS numbers, and document type as outlined in the example below. Bookmark/tab each item to the third level for easy navigation of the manual.

Example as shown in Table below:

PARTS AND SUBPART NUMBERING
3.1 B20 EXTERIOR CLOSURE (System)
3.1.1 B2030 EXTERIOR DOORS (Subsystem)
3.1.1.1 B2030110 GLAZED DOORS (Component)
3.1.1.1.1 Applicable specifications List in UFGS Format
3.1.1.1.2 Manufacturer's Operations and Maintenance Data
3.1.1.1.3 Approved Submittal
3.1.1.1.4 Coordination/Shop Drawings
3.1.1.1.5 Sequence of Operation for Operating Equipment
3.1.1.1.6 Testing Equipment Information and Performance Data
3.1.1.1.7 Routine Maintenance Requirements
3.1.1.1.8 Repair Procedures
3.1.1.1.9 Emergency Procedures & Locations of Applicable Controls
3.1.1.1.10 Warranties
3.1.1.1.11 Record Drawings and Utility Systems
3.1.1.1.12 Contractor / Supplies Listing and Contact Information

1.6.3.2 Related Specifications

Reference each specification related to the subsystem in this section, and locate the actual specification section in Part 2 of the O&M Manual. List specifications in table format as shown in the below example.

UFGS Number	Specification Title	Page Spec Begins in Part 2

UFGS Number	Specification Title	Page Spec Begins in Part 2

1.6.3.3 Manufacturer's Operations and Maintenance Data

Provide a copy of all manufacturer specifications and cutsheets. Provide text-searchable, high-quality document files from the manufacturer's online or electronic documentation. Color documents are preferred. Provide documents specific to the product(s) installed under this Contract. Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Provide Uniformat II Level 3 identification for D20, D30, D40 installed equipment. When possible, do not submit document files containing multiple product catalogs from the same manufacturer, or product data from multiple manufacturers in the same files. Provide documents directly from the manufacturer whenever possible. Do not provide scanned copies of hardcopy documents. Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing must show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Group the parts shown in the listings by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master part catalog.

1.6.3.4 Approved Submittals and Certificates

Provide a copy of all submittals documented with the required approval as applicable for each UFGS specification listed in the table outlined in applicable specifications. Include copies of SD-07 Certificates submittals documented with the required approval, SD-08 Manufacturer's Instructions submittals documented with the required approval, and SD-10 Operation and Maintenance Data submittals documents with the required approval.

1.6.3.5 Approved Coordination/Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work. Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

1.6.4 Sequence of Operation for Operating Equipment

Provide record one-line diagrams for each floor, delineating mechanical equipment location within the building. Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.6.4.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard. Specify if any certifications or licenses are required to operate the equipment.

1.6.4.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.6.4.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.6.4.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.6.4.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.6.4.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.6.4.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.6.4.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.6.4.9 Additional Requirements for Equipment Control Systems

Provide Data Package 3 and the following for all control systems:

a. Provide a narrative description on how to perform and apply functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Submit complete controls equipment schedules, full as-built sequence of operations, wiring and logic diagrams, Input/Output Tables, equipment schedules, copies of checkout tests and calibrations performed by the Contractor (not Cx tests), and all associates information.

c. Full print out of all schedules and set points after testing and acceptance of the system.

d. Full as-built print out of software program.

e. Marking of system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.6.4.10 Testing Equipment Information and Performance Data

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms. Provide final set points.

1.6.5 Routine Maintenance Requirements

1.6.5.1 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including requirements by type of activity. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

a. Define the anticipated time required to perform each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.6.5.2 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities. Provide procedural instructions for Oil Sampling for all equipment.

c. A Lubrication Schedule showing service interval frequency.

1.6.6 Repair Procedures

Provide instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards. Provide manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials. Specify if any certifications or licenses are required to repair the equipment.

1.6.6.1 Troubleshooting Guides and Diagnostic Techniques

Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.6.6.2 Wiring Diagrams and Control Diagrams

Provide point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.6.6.3 Removal and Replacement Instructions

Provide step-by-step procedures and a list of required specialty tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Use a combination of text and illustrations.

1.6.6.4 Repair Work-Hours

Provide manufacturer's projection of repair work-hours including

requirements by type of craft. Identify, and tabulate separately, repair that requires the equipment manufacturer to complete or to participate.

1.6.6.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Identify if replacement of a subassembly, attachment or accessory requires the entire assembly to be replaced. Include warranty information for primary components of the system. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.6.6.6 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference the specific operation and maintenance procedures that must be performed to keep the warranty valid. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.6.6.7 Record Drawings and Utility Systems

The record drawings are the final compilation of actual conditions reflected in the as-built drawings. Provide record drawings as outlined in 01 78 00 CLOSEOUT SUBMITTALS.

Using Record Source Drawings, show and document details of the actual installation of the utility systems, annotate and highlight the Operation and Maintenance information. Provide the following drawings at a large enough scale to differentiate designated isolation units from surrounding valves and switches.

1.6.6.8 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.6.6.9 Contractor / Supplier Listing and Contact Information

Provide a list that includes the name, address, telephone number, email and website of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.6.7 Part 4: Facility Operations

1.6.7.1 Completed Facility Operating Plan

Provide a plan that documents that procedures for the operation of systems and assemblies in the facility. The systems that should be included in the Operating Plan include, but are not limited to:

a. Electrical systems and equipment

b. Mechanical systems and equipment

c. Fire Protection systems and equipment

d. Control Systems and equipment

e. Architectural and Structural systems, fixtures, structures, and equipment

f. Vertical transportation such as elevators and escalators

1.6.7.2 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

1.6.7.3 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms. Provide final set points.

1.6.7.4 Approved Field Test Reports and Manufacturer's Field Reports

Compile and provide approved Field Test Reports (SD-06) and Manufacturer's Field Reports (SD-09) submittals.

1.6.7.5 Maintenance Plans, Procedures, Checklists, Records, and Spare Parts Inventory

1.6.7.5.1 Maintenance Schedules

Include recommended maintenance schedules for systems and equipment.

1.6.7.5.2 Ongoing Commissioning Operational and Maintenance Record Keeping

Include ongoing commissioning and optimization procedures and documentation to monitor and improve the performance of facility systems.

1.6.7.6 Utility Record Drawings

1.6.7.6.1 Utility Schematic Diagrams

Provide a one-line schematic diagram for each utility system such as power, water, wastewater, and gas/fuel. Schematic diagram must show from the point where the utility line is connected to the mainline up to the 5 foot connection point to the facility. Indicate location or area designation for route of transmission or distribution lines; locations of duct banks, manholes/handholes or poles; isolation units such as valves and switches; and utility facilities such as pump stations, lift stations, and substations.

1.6.7.6.2 Enlarged Connection and Cutoff Plans

Provide enlarged floor plans and provide information between the 5 foot utilities connection point and where utilities connect to facility

distribution. Enlarge floor plans/elevations of the rooms where the utility enters the building and indicate on these plans the locations of the main interiors and exterior connection and cutoff points for the utilities. Also enlarge floor plans/elevations of the rooms where equipment is located. Include enough information to enable someone unfamiliar with the facility to locate the connection and cutoff points. Indicate designations such as room number, panel number, circuit breaker, or valve number of each utility and equipment connection and cutoff point, and what that connection and cutoff point controls.

1.6.7.6.2.1 One-Line Diagrams and Meter Location of System

Provide one-line diagrams and design drawings that highlight meter locations on the site.

1.6.7.6.3 Spare Parts and Supply Lists

Provide lists of spare parts and supplies required for repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.6.8 Part 5: Training

Provide a copy of training plans used for each type of equipment along with training materials used, arranged in specification sequence. Provide a copy of training records, sign-in sheets, and agendas. Include training and documentation on the updating and continued use of the O&M Manual.

1.6.9 Part 6: Cx Project Report and TAB Report

Provide the final Cx Plan and complete Cx reports with evaluation and testing forms and records for each building system. Include relevant commissioned system assemblies test reports including installers checklists of assemblies. Provide all Cx Progress Reports, issues and resolutions logs with resolution or status of each item, and a list of any open items and seasonal or additional testing required.

1.6.10 Part 7: Regulatory Requirements

Provide information describing regulatory and policies compliance requirements or provide a reference to where it is stored.

1.6.11 Part 8: Permits

Provide information requiring frequently asked questions and associated answers or provide a reference to where it is stored.

1.6.12 Part 9: Operations and Maintenance Manual Approval

Provide a signed document stating that the project O&M Manual has been reviewed and confirming agreement with the approach it presents. Include contact information for the signer for coordination of any future changes.

1.7 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Provide the O&M data packages specified in individual technical sections. O&M Data Packages are one of the components of the O&M Manual. The information required in each type of data package follows:

1.7.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.7.2 Data Package 3

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Operating log

h. Lubrication data

i. Preventive maintenance plan, schedule, and procedures

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Product submittal data

q. O&M submittal data

r. Parts identification

s. Warranty information

t. Extended warranty information

u. Testing equipment and special tool information

v. Testing and performance data

w. Contractor information

x. Field test reports

1.7.3 Changes to Submittals

Provide manufacturer-originated changes or revisions to submitted data if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the OWNER for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 TRAINING

Prior to acceptance of the facility by the OWNER for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address aspects of the Operation and Maintenance Manual submitted in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS. Training must include classroom or field lectures based on the system operating requirements. The location of classroom training requires approval by the OWNER.

3.1.1 Training Plan

Submit a written training plan to the OWNER for approval at least 60 calendar days prior to the scheduled training. Training plan must be approved by the Quality Control Manager (QC)prior to forwarding to the OWNER. Also, coordinate the training schedule with the OWNER and QC. Include within the plan the following elements:

a. Equipment included in training

b. Intended audience

c. Location of training

d. Dates of training

e. Objectives

f. Outline of the information to be presented and subjects covered including description

g. Start and finish times and duration of training on each subject

h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)

i. Instructor names and instructor qualifications for each subject

j. List of texts and other materials to be furnished by the Contractor that are required to support training

k. Description of proposed software to be used for video recording of

training sessions.

3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The QC is responsible for overseeing and approving the content and adequacy of the training. Spend 95 percent of the instruction time during the presentation on the OPERATION AND MAINTENANCE DATA. Include the following for each system training presentation:

a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.

b. Relevant health and safety issues.

c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.

d. Design intent.

e. Use of O&M Manual Files.

f. Review of control drawings and schematics.

g. Interactions with other systems.

h. Special maintenance and replacement sources.

i. Tenant interaction issues.

3.1.3 Training Outline

Provide the Operation and Maintenance Manual Files (Bookmarked PDF) and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.1.4 Training Video Recording

Record classroom training session(s) on video. Provide to the OWNER two copies of the training session(s) in DVD video recording format. Capture within the recording, in video and audio, the instructors' training presentations including question and answer periods with the attendees. The recording camera(s) must be attended by a person during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.1.5 Unresolved Questions from Attendees

If, at the end of the training course, there are questions from attendees that remain unresolved, the instructor must send the answers, in writing, to the OWNER for transmittal to the attendees, and the training video must be modified to include the appropriate clarifications.

3.1.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm OWNER participation in the training. At the completion of training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the OWNER, and one copy to the Operation and Maintenance Manual Preparer for inclusion into the Manual's documentation.

3.1.7 Quality Control Coordination

Coordinate this training with the QC in accordance with Section 01 45 00 QUALITY CONTROL.

3.2 SUBMITTAL SCHEDULING

3.2.1 Operation and Maintenance Manual, Progress Submittal

Submit the Progress submittal when construction is approximately 50 percent complete, to the OWNER for approval. Provide Operation and Maintenance Manual Files (Bookmarked PDF). Include the elements and portions of system construction completed up to this point. The purpose of this submittal is to verify progress is in accordance with contract requirements as discussed during the Operation and Maintenance Manual Coordination Meeting.

3.2.2 Operation and Maintenance Manual, Prefinal Submittal

Submit the 100 percent submittal of the Operation and Maintenance Prefinal Submittal to the OWNER for approval within 60 calendar days of the Beneficial Occupancy Date (BOD). This submittal must provide a complete, working document that can be used to operate and maintain the facility. Any portion of the submittal that is incomplete or inaccurate requires the entire submittal to be returned for correction. Any discrepancies discovered during the OWNER's review of Operation and Maintenance Progress submittal must be corrected prior to the Prefinal submission. The Prefinal Submittal must include Operation and Maintenance Manual Files (Bookmarked PDF).

3.2.3 Operation and Maintenance Manual, Final Submittal

Submit completed Operation and Maintenance Manual Files (Bookmarked PDF) and one hard copy of the Operation and Maintenance Manuals. The Final submittal is due at BOD. Any discrepancies discovered during the OWNER's review of the Prefinal submittal, including the Field Verification, must be corrected prior to the Final submission.

-- End of Section --

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.6	(2006) Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2024) Safety -- Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants

1.2 PROJECT DESCRIPTION

1.2.1 Summary

Perform selective demolition, cutting, removals, and related patching only as required to install Unit 3 Owner-Furnished Equipment (OFE) and associated interconnections at the Tyee Lake Powerhouse. Work occurs within an operating powerhouse. Protect all existing equipment, systems, and finishes from damage and contamination. Coordinate access, outages, tie-ins, lockout/tagout boundaries, and any activities that may affect operations with the OWNER prior to performing work. Do not remove or modify existing structural members, embedded items, or electrical/mechanical systems unless specifically indicated or approved in writing by the OWNER

1.2.2 General Requirements

Do not begin demolition or deconstruction until authorization is received from the OWNER. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. The work includes demolition, and removal of resulting rubbish and debris. Remove rubbish and debris from OWNER property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the OWNER. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 17, Demolition, and other applicable Sections.

Demolition work will be performed in an around an operating hydroelectric

powerhouse. Therefore demolition activities cannot disrupt power generation or the OWNER's maintenance activities. Dust and debris must be kept to a minimum inside the powerhouse in order to not interfere with operations and maintenance activities. Demolition work will be performed around energized electrical circuits and around pipes and isolation valves containing hydraulic potential energy. Exercise care when performing demolition activities around hazardous energy sources.

1.3 ITEMS TO REMAIN IN PLACE

All existing equipment, systems, piping, wiring, finishes, and structures not specifically identified for removal shall remain in place, protected, and fully functional. Provide temporary covers, barriers, and enclosures as required to prevent dust, debris, moisture intrusion, or physical damage. Maintain clear access and egress for OWNER operations and maintenance staff.

1.3.1 Existing Construction Limits and Protection

Limits of demolition are strictly limited to areas indicated and to work necessary for installation of new equipment and interconnections. Prior to cutting, drilling, or removal, field-verify conditions and confirm with OWNER that affected systems are isolated as required. Stop work and notify OWNER if concealed conditions differ from those anticipated.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will be permitted in the OWNER's on site incinerator. Coordinate with the OWNER regarding types of materials that may be incinerated, and the proper use and monitoring of the incinerator. Where burning is permitted, adhere to federal, state, and local regulations.

1.5 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available at contract award.

1.6 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Selective Demolition and Removals Plan; O
Include sequence, proposed methods, temporary barriers/enclosures, dust and debris controls, and protection of existing equipment and finishes.

Penetration and Cutting Plan; O

Identify proposed concrete cutting, core drilling, embedded item avoidance, and patching approach.

Debris Handling and Disposal Plan; O
Identify containerization, staging locations, and barge-out/off-site disposal method.

Existing Conditions

SD-06 Test Reports

Notification

1.7 QUALITY ASSURANCE

It is not anticipated that Asbestos Containing Materials (ACM) will be encountered during demolition activities. However, if ACM are encountered, submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA), the State's environmental protection agency and the OWNER in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition, conform to the safety requirements contained in ASSP A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.7.1 Dust and Debris Control

Control dust and debris at the source. Provide temporary containment (poly sheeting, framed enclosures, negative air machines if needed) to prevent migration into operating areas, equipment, or occupied spaces. Maintain housekeeping daily. Do not use compressed air for cleaning unless contained and approved by OWNER.

1.8 PROTECTION

1.8.1 General

Contractor shall protect all existing equipment, systems, and finishes from damage during construction. Work will occur within an operating powerhouse; coordination with owner is required for access, outages, tie-ins, and activities that may affect operations. Maintain clear egress, maintain fire protection features, and protect instrumentation, controls, and electrical equipment from dust and moisture.

1.8.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the site specific features being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.9 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield surface. Remove all such materials that may appear on operational aircraft surfaces due to the Contractor's operations. If necessary, the OWNER may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. Provide a barricade consisting of a fence covered with a fabric designed to stop the spread of debris. Anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.10 EXISTING CONDITIONS

Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the OWNER or the OWNER 's Representative showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs or electronic images with a minimum resolution of 3072 x 2304 pixels, capable of a print resolution of 300 dpi, will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results to the OWNER or the OWNER's Representative.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Remove only those existing items that conflict with installation of Unit 3 equipment and associated piping, conduit, cable, supports, and penetrations, or as indicated. Protect adjacent items to remain. Do not remove or disturb structural elements, embedded items, or operating systems without OWNER written approval.

Utilities and Related Equipment

3.1.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the OWNER. Do not interrupt existing utilities serving facilities occupied and used by the OWNER except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2 Disconnecting Existing Utilities

Remove existing utilities as indicated and terminate in a manner

conforming to the nationally recognized code covering the specific utility and approved by the OWNER. When utility lines are encountered but are not indicated on the drawings, notify the OWNER prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the OWNER.

3.1.3 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.4 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for reuse structural steel, steel joists, girders, angles, plates, columns and shapes.Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled. Transport structural steel shapes to a designated storage area as directed by the OWNER, stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.5 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal is the Contractor's property. Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.6 Patching

Patch and restore surfaces and assemblies affected by selective demolition. Restore to condition equal to or better than existing. Provide non-shrink grout or appropriate repair mortar for concrete repairs. Repair coatings to match adjacent surfaces. Maintain water, weather, and pest integrity at all penetrations and repaired areas. Provide firestopping where penetrations occur through fire-rated assemblies, as required to maintain ratings.

3.1.7 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit.

3.1.7.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; drain tanks,

piping and fixtures; if previously used to store flammable, explosive, or other dangerous liquids, steam clean interiors. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.7.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, attach end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.7.3 Ducts

Classify removed duct work as scrap metal.

3.1.8 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.8.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.8.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.8.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.8.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and

disposed.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Removed materials are the property of the CONTRACTOR unless specifically identified by OWNER as salvage to remain OWNER property. Do not remove OWNER-identified salvage from the site. Protect salvage materials designated by OWNER and deliver to an OWNER-designated location on site..

3.3.2 Transportation Guidance

Transport cylinders, containers, and other regulated materials removed from the site in accordance with applicable DOT hazardous materials requirements (49 CFR), including packaging, labeling, and shipping paper requirements, and in accordance with disposal facility acceptance requirements. Coordinate with OWNER regarding any OWNER-furnished containers or disposal documentation.

3.3.3 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in accordance with applicable Federal, State, and Local regulations. U nsalvageable and non-recyclable combustible material may be disposed of off site or through the use of the OWNER's on site incinerator.

3.4 CLEANUP

Remove debris and rubbish from project site and similar excavations. Remove and transport the debris in a manner that prevents spillage on roads or adjacent areas. Apply local regulations regarding hauling and disposal.

At the end of each shift, clean work areas to a condition acceptable to OWNER, ensuring no debris remains that could affect plant operations, access, or housekeeping.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations. Storage of removed materials on the project site is prohibited.

Containerize demolition debris and removed materials to prevent release to the environment and migration into operating areas. Stage containers only in OWNER-approved areas. Remove demolition debris from site by barge and dispose of it at an approved off-site facility in accordance with

applicable regulations. Do not bury debris on site. Burning of debris is prohibited unless OWNER provides written authorization.

3.5.2 Burning on OWNER Property

Combustible materials removed from demolished and deconstructed structures may be disposed of through the use of the OWNER's on-site incinerator. Coordinate with the OWNER regarding materials that may be incinerated and proper use instructions for the incinerator. Monitor the incinerator while being used to burn combustible demolished materials, or as otherwise directed by the OWNER.

3.5.3 Removal to Spoil Areas on OWNER Property

Transport noncombustible materials removed from demolition and deconstruction structures to designated spoil areas on OWNER property.

3.5.4 Removal from OWNER Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from OWNER property for legal disposal. Dispose of waste soil as directed.

-- End of Section --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; R 2015) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 301	(2020) Specifications for Structural Concrete
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 304.2R	(2017) Guide to Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305.1	(2014) Specification for Hot Weather Concreting
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 347R	(2014; Errata 1 2017) Guide to Formwork for Concrete
ACI MNL-2	(2019; 11th Edition) ACI Manual of Concrete Inspection
ACI MNL-15	(2020) Field Reference Manual: Specifications for Concrete Construction ACI 301-20 with Selected ACI References

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995; R 2004) Basic Hardboard

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A934/A934M	(2022) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C31/C31M	(2024) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2023) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2023) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C78/C78M	(2022) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2023) Standard Specification for Ready-Mixed Concrete
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138/C138M	(2023) Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2024) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C231/C231M	(2024) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C311/C311M	(2024) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C330/C330M	(2017a) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C494/C494M	(2019; E 2022) Standard Specification for Chemical Admixtures for Concrete
ASTM C567/C567M	(2019) Determining Density of Structural Lightweight Concrete
ASTM C595/C595M	(2023) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2023; E 2023) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C803/C803M	(2023) Standard Test Method for Penetration Resistance of Hardened Concrete
ASTM C845/C845M	(2018) Standard Specification for Expansive Hydraulic Cement
ASTM C873/C873M	(2015) Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
ASTM C900	(2015) Standard Test Method for Pullout Strength of Hardened Concrete
ASTM C989/C989M	(2024) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1012/C1012M	(2018b) Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
ASTM C1074	(2019; E 2021) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C1077	(2024) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157/C1157M	(2023) Standard Performance Specification for Hydraulic Cement

ASTM C1218/C1218M	(2020c) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	(2020) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	(2023) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	(2008; R 2015) Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1567	(2023) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2022) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D412	(2016; R 2021) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D3042	(2017) Standard Test Method for Insoluble Residue in Carbonate Aggregates
ASTM D5759	(2012; R 2020) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM E329	(2023) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E1155	(2020) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2018; Errata 2019) Manual of Standard Practice

CRSI RB4.1	(2016) Supports for Reinforcement Used in Concrete

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2009) DOC Voluntary Product Standard PS 1-07, Structural Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, slag cement, and silica fume.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Supplementary cementing materials" (SCM) include coal fly ash, silica fume, slag cement, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.

e. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.

f. "Mass Concrete" is any concrete system that approaches a maximum temperature of 158 degrees F within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 3 feet or more regardless of temperature.

g. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.

h. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.

i. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds

possessing cementitious properties.

j. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Concrete Curing Plan; O

Quality Control Program; O

Quality Control Personnel Certifications; O

Quality Control Organizational Chart

Laboratory Accreditation; O

Form Removal Schedule; O

Maturity Method Data

SD-02 Shop Drawings

Formwork

Reinforcing Steel; O

SD-03 Product Data

Joint Filler; O

Formwork Materials

Cementitious Materials; O

Concrete Curing Materials

Reinforcement; S

Admixtures

Mechanical Reinforcing Bar Connectors;O

Waterstops

Pumping Concrete

SD-05 Design Data

Concrete Mix Design; O

Formwork Calculations

SD-06 Test Reports

Concrete Mix Design; O

Fly Ash;O

Pozzolan;O

Slag Cement;O

Aggregates;O

Compressive Strength Tests; O

Unit Weight of Structural Concrete

Chloride Ion Concentration;O

Air Content;O

Slump Tests;O

Water;O

SD-07 Certificates

Reinforcing Bars

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Curing Compound

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the OWNER.

1.5 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301, ACI 304R and ASTM A934/A934M requirements. .

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Formwork Calculations

ACI 347R. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Furnish drawings and calculations of shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members. Calculations must indicate concrete pressure with both live and dead loads, along with material types.

1.6.1.2 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit all documentation required in ACI 301 Section 4 and as specified in this section. Submit a complete list of materials including type; brand; source and amount of cement, supplementary cementitious materials, and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, supplementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the OWNER. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. Required average strength can be documented by field experience if field strength test data are available and represent a single group of at least 10 consecutive strength tests for one mixture, using materials and conditions similar to those expected for work, and encompassing a period of not less than 45 days. The average of field strength tests shall equal or exceed fcr'. Changes in materials, conditions, and proportions within the test record shall not have been more closely restricted than those for the proposed work. Test records shall not be more than 24 months old. Obtain mix design approval from the OWNER prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Indicate placement schedule, construction, location and method of forming control joints. Include locations of inserts, conduit, sleeves and other embedded items. Reproductions of contract drawings are unacceptable. Submit form removal schedule indicating element and minimum length of time for form removal.

Design, fabricate, erect, support, brace, and maintain formwork so that it is able to support, without failure, all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

1.6.2.2 Reinforcing Steel

Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

1.6.3 Control Submittals

1.6.3.1 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with ACI 308.1.

1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.6.3.3 Manufacturer's Representative

The site batch manufacturer's representative must be present onsite to ensure proper mix, including high range water reducer, and batching methods during all concrete mix preparation and placement.

1.6.3.4 Safety Data Sheets

Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. SDS must be readily accessible during each work shift to employees when they are at the construction site.

1.6.4 Test Reports

1.6.4.1 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.6.4.2 Slag Cement

Submit test results in accordance with ASTM C989/C989M for slag cement. Submit test results performed within 6 months of submittal date.

1.6.4.3 Aggregates

Submit test results in accordance with ASTM C33/C33M, or ASTM C330/C330M for lightweight aggregate, and ASTM C1293 or ASTM C1567 as required in the paragraph titled ALKALI-AGGREGATE REACTION.

1.6.5 Quality Control Program

Develop and submit for approval a concrete quality control program in accordance with the guidelines of ACI 121R and as specified herein. The plan must include approved laboratories. Provide direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the OWNER,

Quality Manager and Concrete Supplier. Maintain a copy of ACI MNL-15 and CRSI 10MSP at project site.

1.6.6 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the various positions. Quality control personnel must be employed by the Contractor.

Submit American Concrete Institute certification for the following:

a. CQC personnel responsible for inspection of concrete operations.

b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.

c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

1.6.6.1 Quality/Plant Manager Qualifications

The quality manager must hold a current license as a professional engineer in a U.S. state or territory or hold a NRMCA Plant Manager Certification with experience on at least five similar projects. Evidence of extraordinary proven experience may be considered by the OWNER as sufficient to act as the Quality/Plant Manager.

1.6.6.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the OWNER prior to performing testing on concrete.

a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI MNL-2 or equivalent. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI MNL-2.

b. Testing agencies that perform testing services on reinforcing steel must meet the requirements of ASTM E329.

c. Testing agencies that perform testing services on concrete materials must meet the requirements of ASTM C1077.

1.6.7 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of ASTM C1077 and be Cement and Concrete Reference Laboratory (CCRL) inspected.

1.6.8 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and

ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a registered professional engineer in a U.S. state or territory competent in concrete materials who is competent in concrete materials and must sign all reports and designs.

b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.

c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

a. Form-facing material in contact with concrete must be lumber,plywood, tempered concrete-form-grade hardboard, or metal. Submit product information on proposed form-facing materials if different from that specified herein.

b. Design formwork, shores, reshores, and backshores to support loads transmitted to them and to comply with applicable building code requirements.

c. Design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.

d. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.

e. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.

f. Design formwork joints to inhibit leakage of mortar.

g. Limit deflection of facing materials for concrete surfaces exposed to view to 1/240 of center-to-center spacing of facing supports.

h. Do not use earth cuts as forms for vertical or sloping surfaces.

i. Submit product information on proposed form-facing materials if different from that specified herein.

j. Submit shop drawings for formwork, shoring, reshoring, and backshoring. Shop drawings must be signed and sealed by a design engineer licensed by the state of Alaska.

k. Submit design calculations for formwork, shoring, reshoring, and backshoring. Design calculations must be signed and sealed by a design engineer licensed by the state of Alaska.

2.1.1 Wood Forms

Provide lumber that is square edged or tongue-and-groove boards, 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 AHA A135.4, hardboard for smooth form lining.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORMWORK ACCESSORIES

a. Use commercially manufactured formwork accessories, including ties and hangers.

b. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Form Ties

a. Use form ties with ends or end fasteners that can be removed without damage to concrete.

b. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in walls.

c. The breakback distance for ferrous ties must be at least 2 in. for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.

d. If the breakback distance is less than 3/4 in., use coated or corrosion-resistant ties.

e. Submit manufacturer's data sheet on form ties.

2.2.2 Waterstops

Submit manufacturer's data sheet on waterstop materials and splices.

2.2.2.1 PVC Waterstop

Polyvinylchloride waterstops must conform to COE CRD-C 572.

2.2.2.2 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that

swells upon contact with water must conform to the following requirements when tested in accordance to ASTM D412: Tensile strength 350 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

2.2.3 Chamfer Materials

Use lumber materials with dimensions of 3/4 x 3/4 in.

2.2.4 Construction and movement joints

a. Submit details and locations of construction joints in accordance with the requirements herein.

b. Locate construction joints within middle one-third of spans of slabs, beams, and girders. If a beam intersects a girder within the middle one-third of girder span, the distance between the construction joint in the girder and the edge of the beam must be at least twice the width of the larger member.

c. Locate construction joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.

d. Make construction joints perpendicular to main reinforcement.

2.2.5 Other Embedded items

Use sleeves, inserts, anchors, and other embedded items of material and design indicated in Contract Documents.

2.3 CONCRETE MATERIALS

2.3.1 Cementitious Materials

2.3.1.1 Portland Cement

a. Unless otherwise specified, provide cement that conforms to ASTM C150/C150M Type I or II .

b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

c. Submit information along with evidence demonstrating compliance with referenced standards. Submittals must include types of cementitious materials, manufacturing locations, shipping locations, and certificates showing compliance.

d. Cementitious materials must be stored and kept dry and free from contaminants.

2.3.1.2 Blended Cements

a. Blended cements must conform to ASTM C595/C595M Type IP or IS.

b. Slag cement added to the Type IS blended cements must meet ASTM C989/C989M.

c. The pozzolan added to the Type IP blended cements must meet ASTM C618

Class F and must be interground with the cement clinker. The manufacturer must state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. The percentage and type of pozzolan used in the blend must not change from that submitted for the aggregate evaluation and mixture proportioning.

2.3.1.3 Fly Ash

a. ASTM C618, Class F or Class C, except that the maximum allowable loss on ignition must not exceed 6 percent.

b. If fly ash is used it shall range from 15 to 225 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level,it shall not be used. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

2.3.1.4 Slag Cement

ASTM C989/C989M, Grade 100 or 120.

2.3.1.5 Silica Fume

Silica fume must conform to ASTM C1240, including the optional limits on reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as slurry. Proper mixing is essential to accomplish proper distribution of the silica fume and avoid agglomerated silica fume which can react with the alkali in the cement resulting in premature and extensive concrete damage. Supervision at the batch plant, finishing, and curing is essential. A High Range Water Reducing admixture (HRWRA) must be used when silica fume is the only pozzolan used.

2.3.1.6 Other Supplementary Cementitious Materials

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirement for uniformity.

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.

b. The average particle size must not exceed 6 microns.

c. The sum of SiO_2 plus Al_2O_3 plus Fe_2O_3 must be greater than 77 percent.

2.3.2 Water

a. Water or ice must comply with the requirements of ASTM C1602/C1602M.

b. Minimize the amount of water in the mix. Improve workability by adjusting the grading of the aggregate and using admixture rather than by adding water.

c. Water must be potable; free from injurious amounts of oils, acids,

alkalis, salts, organic materials, or other substances deleterious to concrete.

d. Protect mixing water and ice from contamination during storage and delivery.

e. Submit test report showing water complies with ASTM C1602/C1602M.

2.3.3 Aggregate

2.3.3.1 Normal-Weight Aggregate

a. Aggregates must conform to ASTM C33/C33M.

b. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in concrete represented by submitted field test records or used in trial mixtures.

c. Provide sand that is at least 50 percent acid insoluble based on ASTM D3042.Provide sand that is at least 50 percent natural sand.

d. Store and handle aggregate in a manner that will avoid segregation and prevents contamination by other materials or other sizes of aggregates. Store aggregates in locations that will permit them to drain freely. Do not use aggregates that contain frozen lumps.

e. Submit types, pit or quarry locations, producers' names, aggregate supplier statement of compliance with ASTM C33/C33M, and ASTM C1293 expansion data not more than 18 months old.

2.3.4 Admixtures

a. Chemical admixtures must conform to ASTM C494/C494M.

b. Air-entraining admixtures must conform to ASTM C260/C260M.

c. Do not use calcium chloride admixtures.

d. Admixtures used in concrete must be the same as those used in the concrete represented by submitted field test records or used in trial mixtures.

e. Protect stored admixtures against contamination, evaporation, or damage.

f. To ensure uniform distribution of constituents, provide agitating equipment for admixtures used in the form of suspensions or unstable solutions. Protect liquid admixtures from freezing and from temperature changes that would adversely affect their characteristics.

g. Submit types, brand names, producers' names, manufacturer's technical data sheets, and certificates showing compliance with standards required herein.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete Curing Materials

Provide concrete curing material in accordance with ACI 301 Section 5 and ACI 308.1 Section 2. Submit product data for concrete curing compounds. Submit manufactures instructions for placement of curing compound.

2.4.2 Premolded Joint Filler

ASTM D1751 or ASTM D1752 Type I or Type II. Material must be 1/2 inch thick, unless otherwise indicated.

2.5 CONCRETE MIX DESIGN

2.5.1 Properties and Requirements

a. Use materials and material combinations listed in this section and the contract documents.

b. Cementitious material content must be adequate for concrete to satisfy the specified requirements for strength, w/cm, durability, and finishability described in this section and the contract documents.

The minimum cementitious material content for concrete used in floors must meet the following requirements:

Nominal maximum size of aggregate, in.	**Minimum cementitious material content, pounds per cubic yard**
1-1/2	470
1	520
3/4	540
3/8	610

c. Selected target slump must meet the requirements this section, the contract documents, and must not exceed 8 in at point of delivery . Concrete must not show visible signs of segregation.

d. The target slump must be enforced for the duration of the project. Determine the slump by ASTM C143/C143M. Slump tolerances must meet the requirements of ACI 117.

e. The nominal maximum size of coarse aggregate for a mixture must not exceed three-fourths of the minimum clear spacing between reinforcement, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

f. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must be in accordance with the requirements of the paragraph titled DURABILITY.

g. Measure air content at the point of delivery in accordance with ASTM C173/C173M or ASTM C231/C231M.

h. Concrete for slabs to receive a hard-troweled finish must not contain an air-entraining admixture or have a total air content greater than 3 percent.

i. Concrete properties and requirements for each portion of the structure are specified in the table below. Refer to the paragraph titled DURABILITY for more details on exposure categories and their requirements.

	Minimum $f'c$ psi	Exposure Categories^	Miscellaneous Requirements
Footings and Slabs on Ground	4500 28 days	S1; C1; W1; F2	Max. slump: 6 in. Nominal maximum aggregate size must be 3/4 in.
Turbine Generator Foundation	4500 28 days	S1; C1; W1; F2	Max. slump: 6 in. Nominal maximum aggregate size must be 3/4 in.
Interior Slab, Beam, and Columns	4500 28 days	S0; C0; W0; F0	Max. W/C: 0.45 Nominal maximum aggregate size must be 3/4 in.

2.5.2 Durability

2.5.2.1 Alkali-Aggregate Reaction

Do not use any aggregate susceptible to alkali-carbonate reaction (ACR). Use one of the two options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction (ASR):

a. For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 must not exceed 0.04 percent at one year.

b. For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 must not exceed 0.10 percent at an age of 16 days.

2.5.2.2 Freezing and Thawing Resistance

a. Provide concrete meeting the following minimum requirements based on exposure class assigned to members for freezing-and-thawing exposure

in Contract Documents:

Exposure class	Maximum *w/cm**	Minimum *f'c*, psi	Air content	Additional Requirements
F0	N/A	2500	N/A	
F1	0.55	3500	Depends on aggregate size	N/A
F2	0.42	4500	Depends on aggregate size	See limits on maximum cementitious material by mass
F3	0.40	5000	Depends on aggregate size	See limits on maximum cementitious material by mass
F3 plain concrete	0.45	4500	Depends on aggregate size	See limits on maximum cementitious material by mass

*The maximum *w/cm* limits do not apply to lightweight concrete.

b. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must meet the requirements of the following table:

Nominal maximum aggregate size, in.	Total air content, percent*^	
	Exposure Class F2 and F3	Exposure Class F1
3/8	7.5	6.0
1/2	7.0	5.5
3/4	6.0	5.0
1	6.0	4.5
1-1/2	5.5	4.5
2	5.0	4.0
3	5.5	3.5

*Tolerance on air content as delivered must be plus/minus 1.5 percent.

^For f'c greater than 5000 psi, reducing air content by 1.0 percentage point is acceptable.

c. Submit documentation verifying compliance with specified requirements.

d. For sections of the structure that are assigned Exposure Class F3, submit certification on cement composition verifying that concrete mixture meets the requirements of the following table:

Cementitious material	**Maximum percent of total cementitious material by mass***
Fly ash or other pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989/C989M	50
Silica fume conforming to ASTM C1240	10
Total of fly ash or other pozzolans, slag cement, and silica fume	50^
Total of fly ash or other pozzolans and silica fume	35^

*Total cementitious material also includes ASTM C150/C150M, ASTM C595/C595M, ASTM C845/C845M, and ASTM C1157/C1157M cement. The maximum percentages above must include:

i. Fly ash or other pozzolans present in ASTM C1157/C1157M or ASTM C595/C595M Type IP blended cement.

ii. Slag cement present in ASTM C1157/C1157M or ASTM C595/C595M Type IS blended cement.

iii. Silica fume conforming to ASTM C1240 present in ASTM C1157/C1157M or ASTM C595/C595M Type IP blended cement.

^Fly ash or other pozzolans and silica fume must constitute no more than 25 percent and 10 percent, respectively, of the total mass of the cementitious materials.

2.5.2.3 Corrosion and Chloride Content

a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members requiring protection against reinforcement corrosion in Contract Documents.

b. Submit documentation verifying compliance with specified requirements.

c. Water-soluble chloride ion content contributed from constituents including water, aggregates, cementitious materials, and admixtures must be determined for the concrete mixture by ASTM C1218/C1218M at age between 28 and 42 days.

d. The maximum water-soluble chloride ion (Cl-) content in concrete, percent by mass of cement is as follows:

Exposure class	Maximum *w/cm**	Minimum f'c, psi	Maximum water-soluble chloride ion (CL-) content in concrete, percent by mass of cement
Reinforced concrete			
C0	N/A	2500	1.00
C1	N/A	2500	0.30
C2	0.4	5000	0.15
C0	N/A	2500	0.06
C1	N/A	2500	0.06
C2	0.4	5000	0.06

*The maximum w/cm limits do not apply to lightweight concrete.

2.5.2.4 Sulfate Resistance

a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members for sulfate exposure.

Exposure class	Maximum w/cm	Minimum f'c, psi	Required cementitious materials-types			Calcium chloride admixture
			ASTM C150/C150M	ASTM C595/C595M	ASTM C1157/C1157M	
S0	N/A	2500	N/A	N/A	N/A	No restrictions
S1	0.50	4000	II*^	Types with (MS) designation	MS	No restrictions
S2	0.45	4500	V^	Types with (HS) designation	HS	Not permitted
S3	0.45	4500	V + pozzolan or slag cement**	Types with (HS) designation plus pozzolan or slag cement**	HS + pozzolan or slag cement**	Not permitted
S3	0.40	5000	V***	Types with (HS) designation	HS	Not permitted

* For seawater exposure, other types of portland cements with tricalcium aluminate (C3A) contents up to 10 percent are acceptable if the w/cm does not exceed 0.40.

** The amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slag used shall not be less than the amount tested in

accordance with ASTM C1012/C1012M and meeting the requirements maximum expansion requirements listed herein.

*** If Type V cement is used as the sole cementitious material, the optional sulfate requirement of 0.040 percent maximum expansion in ASTM C150/C150M shall be required.

^ Other available types of cement, such as Type III or Type I, are acceptable in exposure classes S1 or S2 if the C3A contents are less than 8 or 5 percent, respectively.

b. The maximum w/cm limits for sulfate exposure do not apply to lightweight concrete.

c. Alternative combinations of cementitious materials of those listed in this paragraph are acceptable if they meet the maximum expansion requirements listed in the following table:

Exposure class	**Maximum expansion when tested using ASTM C1012/C1012M**		
	At 6 months	**At 12 months**	**At 18 months**
S1	0.10 percent	N/A	N/A
S2	0.05 percent	0.10 percent^	N/A
S3	N/A	N/A	0.10 percent

^The 12-month expansion limit applies only when the measured expansion exceeds the 6-month maximum expansion limit.

2.5.2.5 Concrete Temperature

The temperature of concrete as delivered must not exceed 95°F.

2.5.2.6 Concrete Permeability

a. Provide concrete meeting the requirements of the following table based on exposure class assigned to members requiring low permeability in the Contract Documents.

Exposure class	**Maximum *w/cm****	**Minimum f'c, psi**	**Additional minimum requirements**
W0	N/A	2500	None
W1	0.5	4000	None
W2	0.50	4000	None

*The maximum w/cm limits do not apply to lightweight concrete.

b. Submit documentation verifying compliance with specified requirements.

2.5.3 Trial Mixtures

Trial mixtures must be in accordance to ACI 301.

2.5.4 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

a. Type and brand cement

b. Cement and supplementary cementitious materials content in 94-pound bags per cubic yard of concrete

c. Maximum size of aggregate

d. Amount and brand name of admixtures

e. Total water content expressed by water cementitious material ratio

2.6 REINFORCEMENT

Shop Fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

a. Bend reinforcement cold. Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not permitted. Bending must be in accordance with the standard approved practice and by approved machine methods. Provide hooks and bends that are in accordance with the Contract Documents. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117.

b. Submit manufacturer's certified test report for reinforcement.

c. Submit placing drawings showing fabrication dimensions and placement locations of reinforcement and reinforcement supports. Placing drawings must indicate locations of splices, lengths of lap splices, and details of mechanical and welded splices.

d. Submit request with locations and details of splices not indicated in Contract Documents.

e. Submit request to place column dowels without using templates.

f. Submit request and procedure to field-bend or straighten reinforcing bars partially embedded in concrete at locations not indicated in Contract Documents. Field bending or straightening of reinforcing bars is permitted where existing reinforcing must be adjusted to conform to new concrete placement and lap with new reinforcing.

g. Submit request for field cutting, including location and type of bar to be cut and reason field cutting is required.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine.

Marks must correspond with those used on the placing drawings.

2.6.1 Reinforcing Bars

a. Reinforcing bars must be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.

b. ASTM A615/A615M with the bars marked S, Grade 60; or ASTM A996/A996M with the bars marked R, Grade 60, or marked A, Grade 60.

Submit mill certificates for reinforcing bars.

2.6.2 Mechanical Reinforcing Bar Connectors

a. Provide 125 percent minimum yield strength of the reinforcement bar.

b. Mechanical splices for galvanized reinforcing bars must be galvanized or coated with dielectric material.

c. Mechanical splices used with epoxy-coated or dual-coated reinforcing bars must be coated with dielectric material.

d. Submit data on mechanical splices demonstrating compliance with this paragraph.

2.6.3 Reinforcing Bar Supports

a. Provide reinforcement support types within structure as required by Contract Documents. Reinforcement supports must conform to CRSI RB4.1. Submit description of reinforcement supports and materials for fastening coated reinforcement if not in conformance with CRSI RB4.1.
b. Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

PART 3 EXECUTION

3.1 EXAMINATION

a. Do not begin installation until substrates have been properly constructed; verify that substrates are level.

b. If substrate preparation is the responsibility of another installer, notify OWNER of unsatisfactory preparation before processing.

c. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify OWNER and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

a. Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

b. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Edge Forms and Screed Strips for Slabs

a. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment.

b. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.3 Reinforcement and Other Embedded Items

a. Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

b. When concrete is placed, reinforcement must be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimensions, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.

3.3 FORMS

a. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade.

b. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch. Place chamfer strips in corners of formwork to produce beveled edges on permanently exposed surfaces. Do not bevel reentrant corners or edges of formed joints of concrete.

c. Provide formwork with clean-out openings to permit inspection and removal of debris.

d. Inspect formwork and remove foreign material before concrete is placed.

e. At construction joints, lap form-facing materials over the concrete of previous placement. Ensure formwork is placed against hardened concrete so offsets at construction joints conform to specified tolerances.

f. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in formwork after concrete has reached initial setting. Brace formwork to resist lateral deflection and lateral instability.

g. Fasten form wedges in place after final adjustment of forms and before concrete placement.

h. Provide anchoring and bracing to control upward and lateral movement of formwork system.

i. Construct formwork for openings to facilitate removal and to produce

opening dimensions as specified and within tolerances.

j. Provide runways for moving equipment. Support runways directly on formwork or structural members. Do not support runways on reinforcement. Loading applied by runways must not exceed capacity of formwork or structural members.

k. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with removable material to prevent concrete entry into voids.

l. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete placement.

3.3.1 Coating

a. Cover formwork surfaces with an acceptable material that inhibits bond with concrete.

b. If formwork release agent is used, apply to formwork surfaces in accordance with manufacturer's recommendations before placing reinforcement. Remove excess release agent on formwork prior to concrete placement.

c. Do not allow formwork release agent to contact reinforcement or hardened concrete against which fresh concrete is to be placed.

3.3.2 Reshoring

a. Do not allow structural members to be loaded with combined dead and construction loads in excess of loads indicated in the accepted procedure.

b. Install and remove reshores or backshores in accordance with accepted procedure.

c. For floors supporting shores under newly placed concrete, either leave original supporting shores in place, or install reshores or backshores. Shoring system and supporting slabs must resist anticipated loads. Locate reshores and backshores directly under a shore position or as indicated on formwork shop drawings.

d. In multistory buildings, place reshoring or backshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads.

3.3.3 Reuse

a. Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

b. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.

c. Remove leaked mortar from formwork joints before reuse.

3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-1.0, for formed surfaces that are to be concealed by other construction.

3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view.

3.3.6 Form Ties

a. For post-tensioned structures, do not remove formwork supports until stressing records have been accepted by the OWNER.

b. After ends or end fasteners of form ties have been removed, repair tie holes in accordance with ACI 301 Section 5 requirements.

3.3.7 Forms for Concrete Pan Joist Construction

Pan-form units for one-way or two-way concrete joist and slab construction must be factory-fabricated units of the approximate section indicated. Units must consist of steel or molded fiberglass concrete form pans. Closure units must be furnished as required.

3.3.8 Tolerances for Form Construction

a. Construct formwork so concrete surfaces conform to tolerances in ACI 117.

b. Position and secure sleeves, inserts, anchors, and other embedded items such that embedded items are positioned within ACI 117 tolerances.

c. To maintain specified elevation and thickness within tolerances, install formwork to compensate for deflection and anticipated settlement in formwork during concrete placement. Set formwork and intermediate screed strips for slabs to produce designated elevation, camber, and contour of finished surface before formwork removal. If specified finish requires use of vibrating screeds or roller pipe screeds, ensure that edge forms and screed strips are strong enough to support such equipment.

3.3.9 Removal of Forms and Supports

a. If vertical formed surfaces require finishing, remove forms as soon as removal operations will not damage concrete.

b. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform repairs and finishing operations required. If forms are removed before end of specified curing period, provide curing and protection.

c. Do not damage concrete during removal of vertical formwork for columns, walls, and sides of beams. Perform needed repair and finishing operations required on vertical surfaces. If forms are removed before end of specified curing period, provide curing and protection.

d. Leave formwork and shoring in place to support construction loads and weight of concrete in beams, slabs, and other structural members until in-place required strength of concrete is reached.

e. Form-facing material and horizontal facing support members may be removed before in-place concrete reaches specified compressive strength if shores and other supports are designed to allow facing removal without deflection of supported slab or member.

3.3.10 Strength of Concrete Required for Removal of Formwork

If removal of formwork, reshoring, or backshoring is based on concrete reaching a specified in-place strength, mold and field-cure cylinders in accordance with ASTM C31/C31M. Test cylinders in accordance with ASTM C39/C39M. Alternatively, use one or more of the methods listed herein to evaluate in-place concrete strength for formwork removal.

a. Tests of cast-in-place cylinders in accordance with ASTM C873/C873M. This option is limited to slabs with concrete depths from 5 to 12 in.

b. Penetration resistance in accordance with ASTM C803/C803M.

c. Pullout strength in accordance with ASTM C900.

d. Maturity method in accordance with ASTM C1074. Submit maturity method data using project materials and concrete mix proportions used on the project to demonstrate the correlation between maturity and compressive strength of laboratory cured test specimens to the OWNER.

3.4 WATERSTOP INSTALLATION AND SPLICES

a. Provide waterstops in construction joints as indicated.

b. Install formwork to accommodate waterstop materials. Locate waterstops in joints where indicated in Contract Documents. Minimize number of splices in waterstop. Splice waterstops in accordance with manufacturer's written instructions. Install factory-manufactured premolded mitered corners.

c. Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.4.2 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

a. Unless otherwise specified, placing reinforcement and miscellaneous materials must be in accordance to ACI 301. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement.

b. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

c. Nonprestressed cast-in-place concrete members must have concrete cover for reinforcement given in the following table:

Concrete Exposure	**Member**	**Reinforcement**	**Specified cover, in.**
Cast against and permanently in contact with ground	All	All	3
Exposed to weather or water	All	All	2
Not exposed to weather or in contact with ground	Slabs, joists, and walls	All	1-1/2
	Beams, columns, pedestals, and tension ties	Primary reinforcement, stirrups, ties, spirals, and hoops	1-1/2

3.5.1 General

Provide details of reinforcement that are in accordance with the Contract Documents.

3.5.2 Reinforcement Supports

Provide reinforcement support in accordance with CRSI RB4.1 and ACI 301 Section 3 requirements. Supports for coated or galvanized bars must also

be coated with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bars.

3.5.3 Splicing

As indicated in the Contract Documents. For splices not indicated follow ACI 301. Do not splice at points of maximum stress.

3.5.4 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.5.5 Inspection of Reinforcement

Inspect and verify proper reinforcement grade, shape, cross section and condition. Do not use reinforcement with the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances.

b. Bends or kinks not indicated on drawings or approved shop drawings.

c. Bars with reduced cross section due to rusting or other cause.

3.5.6 Placing Reinforcement

Place reinforcement in accordance with ACI 301.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 301 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

b. Equip supports on ground and similar surfaces with sand-plates.

c. Support welded wire reinforcement as required for reinforcing bars.

d. Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

e. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Contract Documents.

f. Bending of reinforcing bars partially embedded in concrete is permitted only as specified in the Contract Documents.

3.5.7 Spacing of Reinforcing Bars

a. Spacing must be as indicated in the Contract Documents.

b. Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the OWNER.

3.5.8 Concrete Protection for Reinforcement

Additional concrete protection must be in accordance with the Contract Documents.

3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

In accordance with ASTM C94/C94M, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

3.6.2 Mixing

a. Mix concrete in accordance with ASTM C94/C94M, ACI 301 and ACI 304R.

b. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates. A retarder shall be used to facilitate placing and finishing when concrete temperature is 85 degrees F or greater.

c. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture, within the manufacturer's recommended dosage, to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.7 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5. Concrete shall be placed within 15 minutes of discharge into non-agitating equipment.

3.7.1 Pumping

ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well-rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.7.2 Cold Weather

Cold weather concrete must meet the requirements of ACI 306.1 unless otherwise specified. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 5 degrees F in any one hour and 18 degrees F per 24 hours after heat application.

3.7.3 Hot Weather

Hot weather concrete must meet the requirements of ACI 305.1 unless otherwise specified. Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.4 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of

laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

3.8 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.8.1 Defects

Repair surface defects in accordance with ACI 301 Section 5.

3.8.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.8.3 Formed Surfaces

3.8.3.1 Tolerances

Tolerances in accordance with ACI 117 and as indicated.

3.8.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301.

3.8.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301.

3.9 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

In accordance with ACI 301 and ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Where straightedge measurements are specified, Contractor must provide straightedge.

3.9.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater. Grate tampers ("jitterbugs") shall not be used.

3.9.1.1 Concrete Containing Silica Fume

Finish using magnesium floats or darbies.

3.9.1.2 Steel Troweled

Use for floors intended as walking surfaces. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

3.9.1.3 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.9.2 Flat Floor Finishes

ACI 302.1R. Construct in accordance with one of the methods recommended in Table 10.15.3a, "Slab-on-ground flatness/levelness construction guide" or Table 10.15.3b, "Suspended slab flatness/levelness construction guide" appropriate for the type of construction. ACI 117 for tolerance tested by ASTM E1155.

a. Specified Conventional Value:

Floor Flatness (Ff) 25 minimum

Floor Levelness (FL) 20 minimum

3.9.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to OWNER within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E1155.

3.9.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

3.10 JOINTS

3.10.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

3.10.1.1 Construction Joints for Constructability Purposes

a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

3.10.2 Isolation Joints in Slabs on Ground

a. Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

b. Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.10.3 Contraction Joints in Slabs on Ground

a. Provide joints to form panels as indicated.

b. Under and on exact line of each control joint, cut 50 percent of welded wire reinforcement before placing concrete.

c. Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.

3.11 CURING AND PROTECTION

Curing and protection in accordance with ACI 301 Section 5, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing

water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer, hardener, or epoxy coating.

3.11.1 Curing Periods

ACI 301 Section 5, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the OWNER.

3.11.2 Curing Formed Surfaces

a. Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

b. Formed exterior concrete surface may be membrane cured.

3.11.3 Curing Unformed Surfaces

a. Accomplish all curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by water curing.

b. Accomplish final curing of concrete surfaces to receive liquid floor hardener or paint finish by moisture-retaining cover curing.

3.11.4 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 5 degrees F in any one hour nor 49 degrees F in any 24-hour period.

3.11.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.6 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Aggregate Testing

3.12.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C136/C136M and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall be immediately reported to the OWNER, concreting shall be stopped, and immediate steps taken to correct the grading.

3.12.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C136/C136M for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the OWNER. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and reported to the OWNER. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.12.2 Concrete Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

3.12.3 Concrete Testing

3.12.3.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made.

3.12.3.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.3.3 Compressive Strength Tests

ASTM C39/C39M. Make six 6 inch by 12 inch or nine 4 inch by 8 inch test cylinders for each set of tests in accordance with ASTM C31/C31M, ASTM C172/C172M and applicable requirements of ACI 305R and ACI 306R. Take precautions to prevent evaporation and loss of water from the specimen. Test two 6 inch by 12 inch or three 4 inch by 8 inch cylinders at 7 days, two 6 inch by 12 inch or three 4 inch by 8 inch cylinders at 28 days, and hold two 6 inch by 12 inch or three 4 inch by 8 inch cylinders in reserve. Take samples for strength tests for each concrete mixture placed each day not less than once a day, nor less than once for each 150 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two 6 inch by 12 inch or three 4 inch by 8 inch cylinders from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of this section, the Contract Document, and ACI 301.

3.12.3.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete . Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.3.5 Unit Weight of Structural Concrete

ASTM C567/C567M and ASTM C138/C138M. Determine unit weight of lightweight and normal weight concrete. Perform test for every 20 cubic yards maximum.

3.12.3.6 Chloride Ion Concentration

Chloride ion concentration must meet the requirements of the paragraph titled CORROSION AND CHLORIDE CONTENT. Determine water soluble ion concentration in accordance with ASTM C1218/C1218M. Perform test once for each mix design.

3.12.3.7 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

a. Failure to meet compressive strength tests as evaluated.

b. Reinforcement not conforming to requirements specified.

c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.

d. Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified.

e. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

f. Poor workmanship likely to result in deficient strength.

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the OWNER.

3.12.3.8 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the OWNER to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The OWNER may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

3.12.3.9 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

a. Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the OWNER.

b. Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.

c. Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

d. Strength of cores from each member or area are considered satisfactory if their average compressive strength is equal to or greater than 85

percent of the design compressive strength, and if no single core strength is less than 75 percent of the design compressive strength. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted only when approved by the OWNER.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the OWNER.

3.13 REPAIR, REHABILITATION AND REMOVAL

Before the OWNER accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the OWNER for approval before any corrective work is accomplished.

3.13.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.02 inches wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the OWNER for approval. The proposal must address the amount of movement expected in the crack due to temperature changes and loading.

3.13.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 1/4 inch thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick must be removed and replaced or mitigated in a manner acceptable to the OWNER.

3.13.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the OWNER prior to proceeding.

-- End of Section --

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.1 SUMMARY

Provide grout, complete and in place, in accordance with the Contract Documents. The following types of grout are covered in this Section:

a. Cement Repair Mortars

b. Non-Shrink Grout - Class I (cement-based)

c. Non-Shrink Grout - Class II (cement based)

d. Non-Shrink Epoxy Grout

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C109/C109M	(2024) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C157/C157M	(2024; E 2024) Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
ASTM C307	(2023) Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C348	(2021) Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars
ASTM C496/C496M	(2017) Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C531	(2018; R 2023) Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings, and Polymer Concretes
ASTM C579	(2023) Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

ASTM C580	(2018; R 2023) Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C779/C779M	(2019) Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces
ASTM C827/C827M	(2023) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C882/C882M	(2024) Standard Test Method for Bond Strength of Bonding Systems Used With Concrete by Slant Shear
ASTM C939/C939M	(2022) Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1202	(2025) Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

1.3 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Furnish submittals in accordance with the requirements of Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Grout Manufacturer's Literature; O

SD-06 Test Reports

Certified Test Reports

Field Test Reports

SD-07 Certificates

Corrosion Certification

Expansion Certification

1.4 QUALITY CONTROL

1.4.1 Field Tests

Submit Field Test Reports including test results and service report from the field tests indicated herein.

Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the Engineer. The specimens will be made by the Engineer or its representative.

Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C1107/C1107M, at intervals during construction selected by the Engineer. A set of three specimens will be made for testing at seven Days, 28 Days, and each additional time period as appropriate.

Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 30 00 - Cast-in-Place Concrete, at intervals during construction selected by the Engineer.

The cost of laboratory tests on grout will be paid by the Owner except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the Work.

Assist the Engineer in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

1.4.2 Construction Tolerances

Construction tolerances shall be as indicated in Section 03 30 00 - Cast-in-Place Concrete, unless indicated otherwise.

1.4.3 Certified Test Reports

Submit certified testing lab reports for tests indicated herein.

1.5 SPECIAL CORRECTION OF DEFECTS PROVISIONS

Furnish a one-year manufacturer's warranty for Work provided under this Section. Manaufacturer's warranty must not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 PRODUCTS

2.1 GROUT MANUFACTURER'S LITERATURE

Submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the Work, and location of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.

2.1.1 Corrosion Certification

Submit grout manufacturer's certification that grouts used on the project contain no chlorides or other chemicals that cause corrosion.

2.1.2 Expansion Certification

Submit manufacturer's certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.

2.2 APPLICATION

Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Beam and column (1- or 2-story) base plates less than 16 inches in the least dimension.	Non-Shrink - Class I
Column base plates (greater than 2-story or larger than 16 inches in the least dimension)	Non-Shrink - Class II
Storage tanks and other non-motorized equipment and machinery under 30 horsepower	Non-Shrink - Class I
Pumps over 1,000 horsepower, unless indicated otherwise	Non-Shrink Epoxy Resin
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink - Class I (Class II where placement time exceeds 20 min.)
Surface repairs	Cement repair mortar
Repair of holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material	Non-Shrink - Class I
Repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials	Non-Shrink - Class II
Any application not listed above, where grout is indicated	Non-Shrink Class I, unless specifically indicated otherwise

2.3 CEMENT REPAIR MORTARS

a. One or two-component, fast-setting, polymer modified cementitious based repair mortar system.

b. Compressive Strength, ASTM C109/C109M:

1. 1 day: 2,500 psi minimum.

2. 7 days: 4,000 psi minimum

3. 28 days: 6,000 psi minimum.

c. Flexural Strength at 28 days, ASTM C348: 1,300 psi minimum.

d. Slant Shear Bond Strength at 28 Days, ASTM C882/C882M: 2,000 psi minimum.

e. Splitting Tensile Strength at 28 Days, ASTM C496/C496M: 600 psi minimum.

f. Abrasion Resistance Depth of Wear at 60 Minutes, ASTM C779/C779M, Procedure A: 0.033 inch maximum.

g. Drying Shrinkage at 28 Days, ASTM C157/C157M Modified: 0.09 percent maximum.

h. Rapid Chloride Ion Permeability Based on Charge Passed at 28 Days, ASTM C1202: Under 850 coulombs maximum.

i. Horizontal concrete repair mortars shall be SikaTop-111 or SikaTop-122 by Sika, Duraltop by Euclid Chemical, or equal.

j. Vertical and overhead repair mortars shall be SikaTop-123 by Sika, Verticoat by Euclid Chemical, or equal.

2.4 NON-SHRINK GROUTS (CEMENT BASED)

2.4.1 General

a. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.

b. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.

c. Grout shall not contain chlorides or additives that may contribute to corrosion.

d. Grout shall be formulated to be used at any consistency from fluid to plastic.

e. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:

1. Minimum tensile splitting strength of 500 psi per ASTM C496/C496M.

2. Minimum flexural strength of 1,000 psi per ASTM C580.

3. Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C882/C882M.

4. Grout shall be certified for use in freeze/thaw environments for exterior applications.

2.4.2 Class I Non-Shrink Grout

a. Class I non-shrink grout shall have a minimum 28-Day compressive strength of 5,000 psi when mixed at a fluid consistency.

b. Class I non-shrink grout shall meet the requirements of ASTM C1107/C1107M, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.

c. Grout shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M. The grout when tested shall not bleed or segregate at maximum allowed water.

d. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090.

e. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.

f. Class I Non-Shrink Grout shall be , Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, Premier by L&M Construction Chemicals; High-Flow Grout by Euclid Chemical Company, or equal.

2.4.3 Class II Non-Shrink Grout

a. Class II non-shrink grout shall be a high precision, fluid, extended working time grout. The minimum 28-Day compressive strength shall be 7,500 psi when mixed at a fluid consistency.

b. Grout shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M.

c. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090.

d. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827/C827M at temperature extremes of 45 to 90° F in accordance with ASTM C1107/C1107M.

e. Class II non-shrink grout shall meet the requirements of ASTM C1107/C1107M, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939/C939M.

f. The grout when tested shall not bleed or segregate at maximum allowed water content.

g. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.

h. Class II non-shrink grout shall be SikaGrout 928 by Sika Corporation, Five Star Fluid Grout 100 by Five Star Products, Crystex by L&M Construction Chemicals, or equal.

2.5 NON-SHRINK EPOXY GROUT

a. Non-shrink epoxy adhesives shall be a flowable, non-shrink, 100 percent solids system. The epoxy resin system shall have three components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

b. Epoxy resin shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M, (modified for epoxy resins by using an indicator ball with a specific gravity between 0.9 and 1.1).

c. Epoxy resin shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested according to ASTM C531.

d. The epoxy resin shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, method B.

e. The mixed epoxy resin shall have a minimum working life of 90 to 120 minutes at 70°F.

f. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C 1339 - Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts, for bearing area and flow.

g. The chemical formulation of the epoxy resin shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.

h. Non-shrink epoxy resin shall have the following minimum properties when tested at seven Days:

1. minimum bond strength to concrete of 3000 psi per ASTM C882/C882M modified;

2. minimum bond strength to steel of 1700 psi per ASTM C882/C882M modified;

3. minimum flexural strength of 2500 psi per ASTM C580; and

4. minimum tensile strength of 2000 psi per ASTM C307.

i. Non-shrink epoxy resin shall be Five Star DP Epoxy Grout by Five Star Products, Inc., SikaGrout 648 by Sika Corporation, or equal.

2.6 CURING MATERIALS

Curing materials shall be as recommended by the manufacturer of prepackaged products.

2.7 CONSISTENCY

The consistency of grouts shall be that necessary to completely fill the space needed for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

2.8 MEASUREMENT OF INGREDIENTS

Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed. Prepackaged grouts and resins shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

Grouts shall be stored in accordance with manufacturer's recommendations.

3.2 GENERAL

a. Grout shall not be placed until base concrete has attained its design strength, unless authorized otherwise by the Engineer.

b. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

c. Surface preparation, curing, and protection of cement grout shall be as recommended by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.

d. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

e. Shade the Work from sunlight for at least 24 hours before and 48 hours after grouting.

f. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

3.3.1 General

Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

3.3.2 Equipment, Tank, and Pipe Supports

Structural, equipment, tank, and piping support bases shall be grouted,

unless indicated otherwise.

a. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum 1-inch thickness of grout or other thickness if indicated.

b. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Where anchors are grouted into blockouts, grout tubes shall be used to fill anchor blockouts from the bottom to the underside of the grout pad prior to filling the remaining space between the concrete and base plate. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the Engineer, alternate grouting methods shall be submitted for acceptance by the Engineer.

3.4 CONSOLIDATION

Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

3.5 CURING

Cement-based grouts shall be cured per the manufacturer's recommendations.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 207	(2016; R 2017) Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components
AISC 303	(2016) Code of Standard Practice for Steel Buildings and Bridges
AISC 325	(2017) Steel Construction Manual
AISC 326	(2009) Detailing for Steel Construction
AISC 341	(2016) Seismic Provisions for Structural Steel Buildings
AISC 360	(2016) Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B46.1	(2020) Surface Texture, Surface Roughness, Waviness and Lay

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel
AWS D1.8/D1.8M	(2016) Structural Welding Code—Seismic Supplement
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M	(2024) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A29/A29M	(2023) Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	(2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500/A500M	(2023) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2022) Standard Specification for Structural Steel Shapes
ASTM B695	(2021) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F844	(2019) Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1136/F1136M	(2011) Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

ASTM F2329/F2329M	(2015; R 2023) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F2833	(2011; R 2017) Standard Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC Paint 20	(2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	(2002; E 2004) Zinc Dust Sacrificial Primer, Performance-Based
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2023; with Change 1, 2023) Structural Engineering

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR Part 1926, Subpart R	Steel Erection

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Erection and Erection Bracing Drawings; O

SD-02 Shop Drawings

Fabrication Drawings; O

SD-03 Product Data

Shop Primer

Welding Electrodes and Rods

SD-05 Design Data

Design Calculations for Steel Connections; O

Shoring and Temporary Bracing; O

SD-06 Test Reports

Bolts, Nuts, and Washers

Weld Inspection Reports

SD-07 Certificates

Steel

Bolts, Nuts, and Washers

Galvanizing

AISC Structural Steel Fabricator Quality Certification

AISC Structural Steel Erector Quality Certification

Welding Procedures and Qualifications

Welding Electrodes and Rods

Certified Welding Inspector

NDT Technician

Welding Procedure Specifications (WPS)

1.3 AISC QUALITY CERTIFICATION

Work must be fabricated by an AISC Certified Structural Steel Fabricator, in accordance with AISC 207, Category BU. Submit AISC Structural Steel Fabricator quality certification.

Work must be erected by an AISC Structural Steel Certified Erector, in accordance with AISC 207, Category CSE. Submit AISC Structural Steel erector quality certification.

1.4 QUALITY ASSURANCE

1.4.1 Preconstruction Submittals

1.4.1.1 Erection and Erection Bracing Drawings

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing. The erection drawings must conform to AISC 303. Erection drawings must be reviewed, stamped and sealed by a registered professional engineer.

1.4.2 Fabrication Drawing Requirements

Submit fabrication drawings, including details of connections, for approval prior to fabrication. Prepare in accordance with AISC 303, AISC 326 and AISC 325. Fabrication drawings must not be reproductions of contract drawings. Sign and seal fabrication drawings by a registered professional engineer. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing must be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Clearly highlight any deviations from the details shown on the contract drawings highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.4.3 Delegated Connection Design

Design structural steel connection indicated in the contract documents per AISC 303, Option 3, using the connection loads indicated. Submit design calculations for steel connections signed and sealed by a registered professional engineer.

1.4.4 Certifications

1.4.4.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welder or welding operator is more than 6 months old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M and AWS D1.8/D1.8M.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide the structural steel system, including galvanizing, complete and ready for use. Provide structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing in accordance with AISC 303, AISC 360, AISC 341, and UFC 3-301-01 except as modified in this contract.

2.2 STEEL

2.2.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M.

2.2.2 Structural Steel Tubing

ASTM A500/A500M, Grade C 50 ksi.

2.2.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard) or as indicated.

2.3 BOLTS, NUTS, AND WASHERS

Submit the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

2.3.1 Common Grade Bolts

2.3.1.1 Bolts

ASTM A307, Grade A, plain finish hot dipped zinc coating. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.3.1.2 Nuts

ASTM A563, Grade A, heavy hex style.

2.3.1.3 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin must slide along the bolt threads, and by reversing the direction of the locking pin, the nut can be removed without damaging the nut or bolt. Provide stainless steel locking pins.

2.3.1.4 Washers

ASTM F844.

2.3.2 High-Strength Bolts

High strength bolts and nuts must be shipped together in the same shipping container. Fasteners indicated to be galvanized shall be tested by the supplier to show that the galvanized nut with the supplied lubricant provided may be rotated from the snug tight condition well in excess of the rotation required for pretensioned installation without stripping. The supplier shall supply nuts that have been lubricated and tested with the supplied bolts.

2.3.2.1 Bolts

ASTM F3125/F3125M, Grade A325M A325 , Type 1 Heavy Hex Head Style, plain finish hot dipped zinc coating.

2.3.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.3.2.3 Washers

ASTM F436/F436M, plain carbon steel.

2.3.3 Foundation Anchorage

2.3.3.1 Anchor Rods

ASTM F1554 Gr 55, or as required by the equipment manufacturers, Class 1A.

2.3.3.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.3.3.3 Anchor Washers

ASTM F844.

2.3.3.4 Anchor Plate Washers

ASTM A36/A36M.

2.4 STRUCTURAL STEEL ACCESSORIES

2.4.1 Welding Electrodes and Rods

AWS D1.1/D1.1M. Submit product data for welding electrodes and rods.

2.4.2 Welded Shear Stud Connectors

ASTM A29/A29M, Grades 1010 through 1020. AWS D1.1/D1.1M, Table 7.1, Type B.

2.5 GALVANIZING

ASTM F2329/F2329M, ASTM F1136/F1136M, ASTM F2833 or ASTM B695 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt and pin holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the OWNER.

2.6.1 Markings

Prior to erection, identify members by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field

connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

SSPC Paint 20 or SSPC Paint 29, (zinc rich primer). Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking and shear studs are to be welded). If flash rusting occurs, re-clean the surface prior to application of primer. Submit shop primer product data.

Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the OWNER. Repair damaged primed surfaces with an additional coat of primer.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

PART 3 EXECUTION

3.1 ERECTION

a. Erection of structural steel must be in accordance with the applicable provisions of AISC 325, AISC 303 and 29 CFR Part 1926, Subpart R.

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.1.1 STORAGE

Store the material out of contact with the ground in such manner and location as to minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, design connections indicated in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

Tighten ASTM A307 bolts to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact

wrench, or the full effort of a man using a spud wrench, contact the OWNER for further instructions.

3.3 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors is not permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the OWNER.

3.4 WELDING

Welding must be in accordance with AWS D1.1/D1.1M.. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Submit for approval all WPS, whether prequalified or qualified by testing.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Field prime steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. Notify the OWNER in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1.

3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M. All personnel performing NDT must be certified in accordance with ANSI/ASNT CP-189 in the method of testing being performed. Submit certificates showing compliance with ANSI/ASNT CP-189 for all NDT technicians. If more than 20 percent of welds made by a welder contain defects identified by testing, then all groove welds made by that welder must be tested by ultrasonic testing, and all fillet welds made by that welder must be inspected by magnetic particle testing (MT) or dye penetrant testing (PT) as approved by the OWNER. When groove welds made by an individual welder are required to be tested, magnetic particle or dye penetrant testing may be used only in areas inaccessible to ultrasonic testing. Retest all repaired areas. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Dye Penetrant	50 percent of PJP and Fillet Welds

3.7.2 High-Strength Bolts

3.7.2.1 Inspection

Inspection procedures must be in accordance with AISC 360. Confirm and report to the OWNER that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.7.3 Inspection and Testing of Steel Stud Welding

Perform verification inspection and testing of steel stud welding conforming to the requirements of AWS D1.1/D1.1M, Stud Welding Clause. The OWNER will serve as the verification inspector. Bend test studs that do not show a full 360 degree weld flash or have been repaired by welding as required by AWS D1.1/D1.1M, Stud Welding Clause. Studs that crack under testing in the weld, base metal or shank will be rejected and replaced by the Contractor at no additional cost.

-- End of Section --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2016) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.2	(2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.21.2M	(1999; R 2014) Lock Washers (Metric Series)
ASME B18.22M	(1981; R 2017) Metric Plain Washers

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A108	(2024) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2023) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500/A500M	(2023) Standard Specification for Cold-Formed Welded and Seamless Carbon

	Steel Structural Tubing in Rounds and Shapes
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	(2015; R 2021) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A924/A924M	(2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D1187/D1187M	(1997; R 2018) Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2017) Metal Bar Grating Manual
NAAMM MBG 532	(2019) Heavy Duty Metal Bar Grating Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2024) Safety -- Safety and Health Requirements Manual

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cover Plates and Frames, Installation Drawings; O

Floor Gratings, Installation Drawings; O

Steel Railings, Installation Drawings; O

SD-03 Product Data

Cover Plates and Frames; O

Floor Gratings; O

SD-07 Certificates

Certified Mill Test Reports for Chemistry and Mechanical Properties; O

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

1.5 MISCELLANEOUS REQUIREMENTS

1.5.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

1.5.2 Installation Drawings

Submit templates, erection, and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation in relation to the building construction.

PART 2 PRODUCTS

2.1 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied. Submit the manufacturer's certified mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.

2.1.1 Structural Carbon Steel

Provide in accordance with ASTM A36/A36M, unless otherwise indicated.

2.1.2 Steel Pipe Railings

a. Painted carbon steel, ASTM A500/A500M, Gr B.

b. Outside Diameter: 1.900 inch.
c. Wall Thickness:
1. Rail: 0.145 inch, minimum.
2. Post: 0.200 inch, minimum.
d. Accessories, including railing components, flanges, wall brackets, anchor plates, shall conform to the following:
1. Post Bolted Baseplate: Carbon steel ASTM A36/A36M, painted.
2. Wall Brackets:
a. Malleable iron, round top, and painted.
b. Manufacturers and Products:
1) The Wagner Companies; No. 1765.
2) Julius Blum & Co., Inc.; No. 1382.
e. Rail Terminals (including Wall Returns):
1. Round, painted steel, welded to rail, with two 5/16 inch holes for 1/4 inch fasteners.
2. Manufacturer: The Wagner Companies.
f. Toeboards and Accessories:
1. ASTM A36/A36M steel painted.
2. Toeboards: Provide slotted holes for expansion and contraction where required.
3. Fasteners: stainless steel.

2.1.3 Gratings

c. Provide galvanized metal bar type grating in accordance with NAAMM MBG 531 and NAAMM MBG 532.

2.1.4 Floor Plates, Patterned

Provide floor plate in accordance with ASTM A786/A786M. Provide steel plate, hot-dip galvanized, thickness as shown on drawings

2.1.5 Anchor Bolts

Provide in accordance with ASTM F1554. Where exposed, provide anchor bolts of the same material, color, and finish as the metal to which they are applied.

2.1.5.1 Adhesive Anchors

Provide diameter indicated on the drawings. Minimum concrete embedment of 3 in, or as shown on drawings.

a. All adhesive anchors shall be HIT-RE 500 V3 by Hilti.

2.1.5.2 Bolts, Nuts, Studs and Rivets

Provide in accordance with ASME B18.2.2 or ASTM A307.

2.1.5.3 Washers

Provide plain washers in accordance with ASME B18.22M, ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers in accordance with ASME B18.21.2M, ASME B18.21.1.

2.1.5.4 Welded Headed Shear Studs

Provide in accordance with ASTM A108.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by OWNER. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

2.2.4.2 Pretreatment, Priming and Painting

Apply pre-treatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3 COVER PLATES AND FRAMES

Fabricate cover plates of 3/8 inch thick rolled steel weighing not more than 100 pounds per plate with a raised pattern nonslip top surface. Provide galvanized plate. Provide structural steel shapes and plates for frames, with bent steel bars or headed anchors welded to frame for anchoring to concrete. Miter and weld all corners. Butt joint straight runs.

2.4 FLOOR GRATINGS AND

Design steel grating in accordance with NAAMM MBG 531 and NAAMM MBG 532 for bar type gratings, or in accordance with manufacturer's charts for plank grating. Galvanize steel floor gratings.

a. Design floor gratings to support a stress live load of 300_ pounds per square foot for the spans indicated, with maximum deflection of L/240.

b. In accordance with NAAMM MBG 531, NAAMM MBG 532, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and to match grating finish.

c. Anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Include materials and parts necessary to complete each assembly, whether indicated or not. Miss-alignment and miss-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved, provide a smooth finish on exposed surfaces. Provide countersunk rivets where exposed. Provide coped and mitered corner joints aligned flush and without gaps.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts, expansion shields, powder-driven fasteners, toggle bolts (when approved for concrete), through bolts for masonry, headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous metal. Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise.

3.4 BUILT-IN WORK

Where necessary and not otherwise indicated, form built-in metal work for anchorage with concrete. Provide built-in metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with AWS D1.1/D1.1M, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect in accordance with ASTM D1187/D1187M, asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

3.7 PREPARATION

3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.7.2 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the OWNER. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

-- End of Section --

SECTION 09 90 00

PAINTS AND COATINGS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.1.1.1 Interior Painting

Includes new concrete surfaces and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, slabs, walls, ceilings, and metal deck; and

b. Other contiguous surfaces.

1.1.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, anodized aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100	(2017; Suppl 2020) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)

ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
ASTM D4263	(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM F1869	(2023) Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)

Intelligence Bulletin 65	(2013) Occupational Exposure to Carbon Nanotubes and Nanofibers

MASTER PAINTERS INSTITUTE (MPI)

MPI 47	(2016) Alkyd, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 76	(2016) Primer, Alkyd, Quick Dry, for Metal
MPI 77	(2015) Epoxy, Gloss
MPI 101	(2016) Primer, Epoxy, Anti-Corrosive, for Metal
MPI ASM	(2019) Architectural Painting Specification Manual
MPI GPS-1-14	(2014) Green Performance Standard GPS-1-14
MPI GPS-2-14	(2014) Green Performance Standard GPS-2-14
MPI MRM	(2015) Maintenance Repainting Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4	(2007) Brush-Off Blast Cleaning
SSPC Glossary	(2011) SSPC Protective Coatings Glossary
SSPC Guide 6	(2021) Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC Guide 7	(2015) Guide to the Disposal of Lead-Contaminated Surface Preparation Debris

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC QP 1	(2019) Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors (Field Application to Complex Industrial Steel Structures and Other Metal Components)
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 2	(2018) Hand Tool Cleaning
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning
SSPC SP 10/NACE No. 2	(2015) Near-White Blast Cleaning
SSPC VIS 1	(2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning
SSPC VIS 4/NACE VIS 7	(1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC-SP WJ-1/NACE WJ-1	(2012) Clean to Bare Substrate, Waterjet Cleaning of Metals
SSPC-SP WJ-2/NACE WJ-2	(2012) Very Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-3/NACE WJ-3	(2012) Thorough Cleaning, Waterjet Cleaning of Metals
SSPC-SP WJ-4/NACE WJ-4	(2012) Light Cleaning, Waterjet Cleaning of Metals

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	(2018) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1001	Asbestos
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead

1.3 DEFINITIONS

1.3.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third-party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.3.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing must be accomplished by an MPI testing lab.

1.3.3 Coating

SSPC Glossary; (1) A liquid, liquefiable, or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer; (2) Generic term for paint, lacquer, enamel.

1.3.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.3.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five levels are generically defined under the Assessment sections in the MPI MRM, MPI Maintenance Repainting Manual.

1.3.6 EXT

MPI short term designation for an exterior coating system.

1.3.7 INT

MPI short term designation for an interior coating system.

1.3.8 Loose Paint

Paint or coating that can be removed with a dull putty knife.

1.3.9 mil / mils

The English measurement for 0.001 in or one one-thousandth of an inch.

1.3.10 MPI Gloss Levels

MPI system of defining gloss. Seven gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degree angle	Units at 80 degree angle
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the OWNER has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.3.11 MPI System Number

The MPI coating system number in each MPI Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).

1.3.12 Paint

SSPC Glossary; (1) Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer that is converted to an opaque solid film after application. Used for protection, decoration, identification, or to serve some other functional purposes; (2) Application of a coating material.

1.3.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.3.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

1.4 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

SD-03 Product Data

Product Data Sheets; O

SD-04 Samples

Color; OSD-07 Certificates

Qualification Testing laboratory for coatings; O

Indoor Air Quality for Paints and Primers

SD-08 Manufacturer's Instructions

Mixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Coatings, Data Package 1; O

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

1.5.1.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify OWNER of any paint specified herein which fails to conform.

1.5.1.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.1.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.1.4 Asbestos Content

Provide asbestos-free materials.

1.5.1.5 Mercury Content

Provide materials free of mercury or mercury compounds.

1.5.1.6 Silica

Provide abrasive blast media containing no free crystalline silica.

1.5.1.7 Human Carcinogens

Provide materials that do not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.5.1.8 Carbon Based Fibers / Tubes

Materials must not contain carbon based fibers such as carbon nanotubes or

carbon nanofibers. Intelligence Bulletin 65 ranks toxicity of carbon nanotubes on a par with asbestos.

1.5.2 Coating Contractor's Qualification

Submit the name, address, telephone number, and e-mail address of the Contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address and telephone number of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.5.3 SSPC QP 1 Certification

Contractors that perform surface preparation or coating application on steel substrates must be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to Contract award, and must remain certified while accomplishing any surface preparation or coating application. If a Contractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered. Notify the OWNER of any change in Contractor certification status. Notify the OWNER of all scheduled and unannounced on-site audits from SSPC and furnish a copy of all audit reports.

1.5.4 Approved Products List

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of Contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire Contract and each coating system is to be from a single manufacturer. Provide all coats on a particular substrate from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

1.5.5 Paints and Coatings Indoor Air Quality Certifications

Provide paint and coating products certified to meet indoor air quality requirements by MPI GPS-1-14, MPI GPS-2-14 or provide certification by other third-party programs. Provide current product certification documentation from certification body.

Provide certification of Indoor Air Quality for Paints and Primers. Submit required indoor air quality certifications in one submittal package.

1.5.6 Field Samples and Tests

The OWNER may choose up to two coatings that have been delivered to the site to be tested at no cost to the OWNER. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURE. Test each chosen product as specified in the paragraph TESTING PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing as specified in the paragraph TESTING PROCEDURE at no cost to the OWNER.

Another required testing is Batch Quality Conformance Testing to prove conformance of the manufacturer's paint to the specified MPI standard. This testing is accomplished before the materials are delivered to the job site. Provide testing for paint products. Test paint products as specified in the paragraph TESTING PROCEDURE.

1.5.6.1 Sampling Procedure

Select paint at random from the products that have been delivered to the job site for sample testing. The Contractor must provide one quart samples of the selected paint materials. Take samples in the presence of the OWNER, and label, and identify each sample. Provide labels in accordance with the paragraph PACKAGING, LABELING, AND STORAGE.

1.5.6.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph QUALIFICATION TESTING laboratory for coatings. Include the backup data and summary of the test results within the qualification testing lab report. Provide a summary listing of all the reference specification requirements and the result of each test. Clearly indicate in the summary whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If MPI is chosen to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.6 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the Contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 5 gallons. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

Comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 SAFETY REQUIREMENTS. Include in the Activity Hazard Analysis the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100, threshold limit values.

d. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Additional guidance is given in SSPC Guide 6 and SSPC Guide 7.

e. The appropriate OSHA standards in 29 CFR 1910.1001 for surface preparation of painted surfaces containing asbestos.

Submit manufacturer's Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.8 ENVIRONMENTAL REQUIREMENTS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the OWNER and the product manufacturer. Do not, under any circumstances, violate the manufacturer's application

recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit Product Data Sheets for specified coatings and solvents. Provide preprinted cleaning and maintenance instructions for all coating systems. Submit Manufacturer's Instructions on Mixing: Detailed mixing instructions, minimum and maximum application temperature and humidity, pot life, and curing and drying times between coats.

2.2 COLOR SELECTION OF FINISH COATS

Provide colors of finish coats to match existing. Allow Owner to select colors not indicated or specified. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors are approximately the colors indicated and the product conforms to specified requirements.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, reinstall removed items by workmen skilled in the trades. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals in contact with surfaces to be painted with water-thinned paints, with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas. Refer to MPI ASM and MPI MRM for additional more specific substrate preparation requirements.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 3. Protect shop-coated ferrous surfaces from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3 / SSPC-SP WJ-3/NACE WJ-3.

c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with SSPC SP 10/NACE No. 2.

3.3.2 Final Ferrous Surface Condition:

3.3.2.1 Tool Cleaned Surfaces

Comply with SSPC SP 2 and SSPC SP 3. Use as a visual reference, photographs in SSPC VIS 3 for the appearance of cleaned surfaces.

3.3.2.2 Abrasive Blast Cleaned Surfaces

Comply with SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. Use as a visual reference, photographs in SSPC VIS 1 for the appearance of cleaned surfaces.

3.3.2.3 Waterjet Cleaned Surfaces

Comply with SSPC-SP WJ-1/NACE WJ-1, SSPC-SP WJ-2/NACE WJ-2, SSPC-SP WJ-3/NACE WJ-3 or SSPC-SP WJ-4/NACE WJ-4. Use as a visual reference, photographs in SSPC VIS 4/NACE VIS 7 for the appearance of cleaned surfaces.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete

a. Curing: Allow concrete surfaces to cure at least 30 days before painting, and concrete slab on grade to cure at least 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Paint and Loose Particles: Remove by wire brushing.

(3) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Do not apply epoxies to damp surfaces as

determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturer's recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.5 APPLICATION

3.5.1 Coating Application

a. Comply with applicable federal, state and local laws enacted to ensure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

b. At the time of application, paint must show no signs of deterioration. Maintain uniform suspension of pigments during application.

c. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Use rollers for applying paints and enamels of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

d. Only apply paints, except water-thinned types, to surfaces that are completely free of moisture as determined by sight or touch.

e. Thoroughly work coating materials into joints, crevices, and open spaces. Pay special attention to ensure that all edges, corners, crevices, and welds receive a film thickness equal to that of adjacent painted surfaces.

f. Apply each coat of paint so that dry film is of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Completely hide all blemishes.

g. Touch up damaged coatings before applying subsequent coats. Broom clean and clear dust from interior areas before and during the application of coating material.

h. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

i. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Cover each preceding coat or surface completely by ensuring visually perceptible difference in shades of successive coats.

j. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

3.5.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the OWNER to use thinners. Verify that the written permission includes quantities and types of thinners to use.

When thinning is allowed, thin paints immediately prior to application with not more than one pint of suitable thinner per gallon. The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

3.5.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

3.5.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table for Interior Applications	
MPI Division	Substrate Application
MPI Division 3	Interior Concrete Paint Table
MPI Division 5	Interior Metal, Ferrous and Non-Ferrous Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness, where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat unspecified surfaces the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

3.6 COATING SYSTEMS FOR METAL

Apply coatings of Tables in MPI Division 5 for Interior.

a. Apply specified ferrous metal primer to steel surfaces on the same day that surface is cleaned, to surfaces that meet all specified surface

preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat. Overcoat these items with the specified ferrous-metal primer prior to application of finish coats.

3.7 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in MPI Division 3 for Interior.

3.8 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components for inspection by the OWNER. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.9 PAINT TABLES

All DFT's are minimum values. Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.9.1 Interior Paint Tables

3.9.1.1 MPI Division 3: Interior Concrete Paint Table

A. New concrete surfaces, not specified otherwise.

Epoxy					
New	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 3.1F-G6 (Gloss)	MPI RIN 3.1E-G6 (Gloss)	MPI 77	MPI 77	MPI 77	4 mils
Note: 1. Primer may be reduced for penetration per manufacturer's instructions. 2. Match existing epoxy system and colors. 3. Existing system is BAR-Rust 235 by Devoe, a discontinued two-part epoxy.					

B. New concrete floors.

Epoxy

New surfaces	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 3.2C-G6 (Gloss)	MPI RIN 3.2C-G6 (Gloss)	MPI 77	MPI 77	MPI 77	5 mils
Note: 1. Primer may be reduced for penetration per manufacturer's instructions. 2. Match existing epoxy system and colors. 3. Existing system is BAR-Rust 235 by Devoe, a discontinued two-part epoxy.					

3.9.1.2 MPI Division 5: Interior Metal, Ferrous and Non-Ferrous Paint Table

A. Interior Steel / Ferrous Surfaces

(1) New metal guardrail system.
(2) New turbine air vent piping above Elevation 33.00 ft.

Alkyd				
New surfaces	Primer	Intermediate	Topcoat	System DFT
MPI INT 5.1E-G5 (Semigloss)	MPI 76	MPI 47	MPI 47	5.25 mils
Topcoat: Coating to be safety yellow color to match existing.				

-- End of Section --

SECTION 13 48 73

SEISMIC CONTROL FOR MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 355.2	(2007) Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
ACI 355.4	(2011) Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4) and Commentary

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A490	(2014a) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A500/A500M	(2023) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A603	(2019) Standard Specification for Zinc-Coated Steel Structural Wire Rope

ASTM E488/E488M	(2022) Standard Test Methods for Strength of Anchors in Concrete Elements
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC156	(2012) Acceptable Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components
ICC-ES AC23	(2012; R 2016) Acceptance Criteria for Sprayed Fire-resistant Materials (SFRMs), Intumescent Fire-resistant Coatings and Mastic Fire-resistant Coatings Used to Protect Structural Steel Members

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2024) International Building Code

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

MFMA-4	(2004) Metal Framing Standards Publication

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2023; with Change 1, 2023) Structural Engineering
UFC 4-010-01	(2018; with Change 3, 2024) DoD Minimum Antiterrorism Standards for Buildings

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)

VISCMA 412	(2014) Installing Seismic Restraints for Mechanical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for seismic protection measures, described in this section and on the drawings, of the miscellaneous equipment and systems listed below, in accordance with UFC 3-301-01 and additional data furnished by the OWNER. Provide seismic protection measures in addition to any other requirements called for in other sections of these specifications. Where there is a conflict between the specifications and the drawings, the specifications will take precedence. Accomplish resistance to lateral forces induced by earthquakes without consideration of friction resulting from gravity loads
.

1.2.2 Miscellaneous Equipment and Systems

Equipment/Components with Ip = 1.5 (Designated Seismic Systems)
Turbine Generator
Transformer
Insert edited list here similar to one above for Ip = 1.0

1.2.3 Contractor Designed Bracing

Submit copies of the design calculations with the drawings. Calculations must be approved, certified, stamped and signed by a registered Professional Structural Engineer. Calculations must verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-301-01, UFC 4-010-01 and additional data furnished by the OWNER. Resistance to lateral forces induced by earthquakes must be accomplished without consideration of friction resulting from gravity loads. UFC 3-301-01 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas must be required. Loadings determined using UFC 3-301-01 are based on strength design; therefore, AISC 325 Specifications must be used for the design. The bracing for the equipment designated in paragraph 1.2.2 must be developed by the Contractor.

1.3 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing; O

Resilient Vibration Isolation Devices; O

Equipment Requirements; O

SD-03 Product Data

Bracing; O

Equipment Requirements; O

Anchor Bolts; O

Vibration Isolators; O

Snubbers; O

SD-05 Design Data

Design Calculations; O

SD-06 Test Reports

Anchor Bolts; O

SD-07 Certificates

ICC ES AC156 Shake Table Test; O

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Submit detail drawings of bracing along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed in Paragraph 1.2.2. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. Provide calculations and drawings that are stamped by a registered structural engineer, and that verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design must be based on actual equipment and system layout. Design must include calculated dead loads, static seismic loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods.

Include drawing for Designated Seismic System Equipment indicating the equipment location in the facility sufficient to be used for the installation. Equipment must be rigidly or flexibly mounted as indicated in the specifications and/or drawings depending on vibration isolation requirements as follows below. Roof mounted equipment both vibration isolated and nonisolated, must have support members designed and anchored to building structural steel or concrete as required for seismic restraint and wind loads.

2.1.1 Rigidly (Base and Suspended) Mounted Equipment

Equipment furnished under this contract must be rigidly mounted using cast-in-place anchor bolts to anchor them or post-installed anchors that are qualified for earthquake loading in accordance with ACI 355.2 and ACI 355.4. Anchor bolts must conform to ASTM F1554-07ae1. For any rigid equipment which is rigidly anchored, provide flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions. Suspended equipment bracing attachments should be located just above the center of gravity to minimize swinging. Designated Seismic Systems (DSS) RC IV buildings assigned to Seismic Design Category Coefficient (SDC) C, D, E, or F and Risk Category IV components needed for continued operation after an earthquake must have two nuts provided on each anchor bolt.

2.2 BOLTS AND NUTS

Hex head bolts, and heavy hexagon nuts must be ASTM A325 or ASTM A490 bolts and ASTM A563 nuts. Provide bolts and nuts galvanized in accordance with ASTM A153/A153M when used underground or exposed to weather.

2.3 SWAY BRACING

Material used for members listed in this section and on the drawings, must be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A36/A36M.

b. Wire rope, ASTM A603.

c. Tubes, ASTM A500/A500M, Grade B.

d. Pipes, ASTM A53/A53M, Grade B.

e. Angles, ASTM A36/A36M.

f. Channels (Struts) with in-turned lips and associated hardware for fastening to channels at random points conforming to MFMA-4.

PART 3 EXECUTION

3.1 BRACING

Provide bracing conforming to the arrangements shown. Install cables at a 45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 412.

3.2 ANCHOR BOLTS

3.2.1 General

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified.

Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices allowing adequate edge distance and embedment depth for restraint anchor bolts. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Install neoprene grommet washers or till the gap with epoxy on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 0.125 inches.

3.2.2 Cast-In-Place

Use templates to locate cast-in-place bolts accurately and securely in formwork. Provide anchor bolts with an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads must either extend into concrete floor or the foundation or be increased in depth to accommodate bolt lengths. Use templates to locate cast-in-place bolts accurately and securely in formwork.

3.2.3 Drilled-In Anchor Bolts

Drill holes with rotary impact hammer drills. Drill bits must be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the drawings, all holes must be drilled perpendicular to the concrete surface. Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the COR if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons,

electrical and telecommunications conduit, and gas lines. Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Perform anchor installation in accordance with manufacturer instructions. For Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10 percent of the specified torque, 100 percent of the specified torque must be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor must be removed and replaced unless otherwise directed by the Engineer.

For Cartridge Injection Adhesive Anchors where approved for seismic application, clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive must be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed. For Capsule Anchors where approved for seismic application, perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors must be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.2.4 Anchor Bolt Testing

Test in place expansion and chemically bonded anchors not more than 24 hours after installation of the anchor, conducted by an independent testing agency, or qualified Contractor personnel; testing must be performed on random anchor bolts as described below.

3.2.4.1 Torque Wrench Testing

Perform torque wrench testing on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque must equal the minimum required installation torque as required by the bolt manufacturer. Calibrate torque wrenches at the beginning of each day the torque tests are performed. Recalibrate torque wrenches for each bolt diameter whenever tests are run on bolts of various diameters. Apply torque between 20 and 100 percent of wrench capacity. Reach the test torque within one half turn of the nut, except for 3/8 inch sleeve anchors which must reach their torque by one quarter turn of the nut. If any anchor fails the test, test similar anchors not previously tested until 10 consecutive anchors pass. Failed anchors must be retightened and retested to the specified torque; if the anchor still fails the test it must be replaced.

3.2.4.2 Pullout Testing

Test expansion and chemically bonded anchors by applying a pullout load using a hydraulic ram attached to the anchor bolt. Testing must be done in accordance with ASTM E488/E488M or ICC-ES AC23. At least 10 percent of the anchors must be tested. Apply the load to the anchor without removing the nut; when that is not possible, the nut must be removed and a threaded coupler must be installed of the same tightness as the original nut. Check the test setup to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus must be at least 1.5 times the embedment length away from the bolt being tested. Load each tested anchor to 1 times the design tension value for the anchor. The anchor must have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested must be tested until 10 consecutive anchors pass. Failed anchors must be retightened and retested to the specified load; if the anchor still fails the test it must be replaced.

3.3 EQUIPMENT SWAY BRACING

3.3.1 Floor or Pad Mounted Equipment

3.3.1.1 Shear Resistance

Bolt to the floor, floor mounted equipment. Provide the number and installation of bolts to resist shear forces in accordance with paragraph ANCHOR BOLTS.

3.3.1.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and overturning.

3.4 SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT

Equipment and components designated as Designated Seismic Systems required to remain operational after an earthquake will be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing agency for the specific equipment and/or components. Prequalified certifications are acceptable unless noted otherwise.

Miscellaneous components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates must be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate must not be less than 5 inches x 7 inches with red letters 1 inch in height on a white background stating "Certified Equipment." The following statement must be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file." The nameplate must also contain the component identification number in accordance with the drawings/specifications and the O&M manuals.

3.5 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS AND EQUIPMENT

Perform special inspections for seismic-resisting systems, equipment and components designated seismic systems and equipment per ICC IBC 1705.12.4; and storage racks per ICC IBC 1705.12.7. Periodic special inspections will be conducted on miscellaneous equipment as required by Section 1705.12 of the International Building Code and paragraph 2-2.4.3 of UFC 3-301-01. Provide a Statement of Special Inspections and Final Report in accordance with paragraph 2-2.4.3 of UFC 3-301-01.

-- End of Section --

SECTION 21 21 01

CARBON-DIOXIDE FIRE-EXTINGUISHING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM F402	(2018) Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide https://www.approvalguide.com/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 12	(2022) Standard on Carbon Dioxide Extinguishing Systems
NFPA 13	(2022; TIA 24-1) Standard for the Installation of Sprinkler Systems
NFPA 70	(2020) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 170	(2024; ERTA 1 2023) Standard for Fire Safety and Emergency Symbols

UNDERWRITERS LABORATORIES (UL)

UL Fire Prot Dir	UL Product IQ (updated online) at

https://productiq.ulpropsector.com/en

STATE OF ALASKA

Alaska IFC	(2021) International Fire Code with Alaska Amendments

1.2 SYSTEM DESCRIPTION

a. Provide a high-pressure carbon-dioxide fire-extinguishing system for protection of Tyee Powerhouse Unit No. 3 generator. Provide piping offsets, fittings, and any other accessories as required to provide a complete and usable system and to eliminate interference with other construction.

b. Design any portions of the fire-extinguishing system that are not indicated on the Contract Drawings, including but not limited to locating and sizing nozzles, piping, tanks, pressure switches, valves, and equipment. Design any portions of the releasing system that are not indicated on the Contract Drawings, including but not limited to locating initiating devices, notification appliances, terminal cabinets, raceways, and pathways.

c. The CO2 system controls will tie into the existing RSFACU located within the control room. The existing system is manufactured by Kidde and its model is Kidde Aries Netlink. Design and construct all necessary interfaces with the existing system to provide a complete and usable CO2 system in accordance with the Alaska IFC, NFPA 12, NFPA 70, and NFPA 72.

d. This work includes the installation of a Air Sampling Smoke Detection System in the Tyee Powerhouse Unit No. 3 generator in accordance with this specification and as indicated on the drawings. The system must be complete and usable in accordance with Alaska IFC, NFPA 70, NFPA 72, and the manufacturers instructions.

e. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with Alaska IFC, NFPA 12, NFPA 70, and NFPA 72, except as modified herein. The system layout on the drawings show the intent of coverage and suggested locations. Final quantity, system layout, and coordination are the responsibility of the Contractor.

1.3 SUBMITTALS

Provide all submittals to the Owner, whether for approval or information. Owner approval is required for submittals with an "O" classification. Submittals not having an "O" are submitted to the Owner for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installer's Qualifications; O

Supervisor's Qualifications; O

Designer's Qualifications; O

SD-02 Shop Drawings

Shop Drawings; O

Air Sampling Smoke Detectors; O

SD-03 Product Data

Carbon-Dioxide Supply; O

Pipe and Fittings; O

Piping Accessories; O

Manual Release Stations; O

Discharge Pressure Switches; O

Alarm Notification Appliances; O

Operating Instructions; O

Signs; O

SD-05 Design Data

Carbon-Dioxide Supply Calculations; O

Pipe and Orifice Sizing Calculations; O

Seismic Bracing Calculations; O

Air Sampling Smoke Detection System Calculations; O

SD-06 Test Reports

Test Procedures; O

Request for Formal Inspection and Tests; O

Final Test Report; O

SD-10 Operation and Maintenance Data

Operation And Maintenance Instructions; O

SD-11 Closeout Submittals

Special Tools

Spare Parts Data

Spare Parts

As-Built Drawings; O

Recordings

1.4 SUBMITTAL REQUIREMENTS

Provide submittals in quantities, formats, and transmission means as dictated by Section 01 33 00 SUBMITTAL PROCEDURES. Draw floor plans to a scale no less than 1/8 inch equals one foot. Utilize NFPA 170 compliant symbols.

Submit Shop Drawings (SD-02), Product Data (SD-03), and Calculations (SD-05) simultaneously. Submit all Product Data as a single combined package. Partial submittals; SD-02, SD-03, and SD-05 submittals not submitted simultaneously; SD-02, SD-03, and SD-05 submittals submitted prior to SD-01 submittals approval; and submittals not fully complying with the requirements of applicable NFPA standards and this specification; are not acceptable.

1.4.1 Submittal Schedule

Submit all Preconstruction Submittals (SD-01) within 14 days following Notice to Proceed and before any other classification of submittal. Provide submittals for SD-02, SD-03, and SD-05 no less than 45 days prior to the proposed start of construction on the subject system. Provide other submittals as specified in other paragraphs of this specification.

1.4.2 Shop Drawings

Provide job specific shop drawings reflecting the actual proposed installation conditions for this project. Do not submit the manufacturer's generic system layout plans, details, and diagrams. Provide drawings that are compliant with the Plans section of NFPA 12, NFPA 72, and the following.Submit plan views showing system layout, including nozzles, piping, hangers, and carbon-dioxide storage cylinders. Ensure drawings reflect the actual proposed pipe routing as it will be installed in the field. Clearly indicate the location, size, orientation, and type of all valves, pipe size reductions, and pipe fittings. Show initiating devices and notification appliances, along with system integration and required NFPA 72 details. Show an isometric view of the fire-extinguishing system. Show details of each type of hanger and pipe support to be provided. Utilize NFPA 170 compliant symbols.

For air sampling smoke detection systems, provide floor plan layouts indicating location of the fire alarm control unit, air sampling piping (lengths of pipe) and sampling ports (sizes and locations). Floor plan must also indicate geographic monitor zone boundaries, location of display control unit, bar level annunciation panels if separate, and all other associated equipment that is required to provide a complete operational system for protection of the Tyee Powerhouse Unit No. 3 generator.

1.4.3 Product Data

Provide manufacturer's product data sheets for each system component to be provided, including at least each item specified herein. Annotate product data sheets to indicate precise equipment that is to be provided, including an indication of all options selected. Submit copies of current listings or approvals for all equipment furnished. Submit listing or approval documentation from a nationally recognized testing laboratory (NRTL) for each piece of equipment showing that such equipment is listed or approved for use in fire protection systems. Submit listing or approval documentation from a NRTL showing that the proposed releasing solenoid is

compatible with the proposed releasing system fire alarm control unit (RSFACU).

1.4.4 Design Data

1.4.4.1 Supply Calculations

Submit carbon-dioxide supply calculations to substantiate that the provided carbon-dioxide storage capacity is adequate to protect the anticipated hazards. Ensure calculations consider residual carbon-dioxide that will be left in the supply piping, capacity for uncloseable openings, and sufficient redundant capacity as required herein.

1.4.4.2 Pipe and Orifice Size Calculations

Submit pipe and orifice size calculations to substantiate that the carbon-dioxide fire-extinguishing system piping and discharge orifices are sized appropriately to protect the anticipated hazard within the required period of time. Use system manufacturer provided sizing software or provide manufacturer supplied calculations.

1.4.4.3 Seismic Bracing Design

Prepare seismic bracing calculations and details as described in NFPA 13. The seismic design information applicable to this project includes:

Risk Category: IV.
Seismic Design Category: D.
Seismic Design Spectral Response Acceleration Parameter at Short Period (SDS): 0.3.
Seismic Design Spectral Response Acceleration Parameter at period of 1 second (SD1): 0.16.

1.4.5 Test Reports

Submit reports for inspections and tests specified under paragraphs titled "FIELD QUALITY CONTROL". Submit test reports in booklet form showing field tests performed to prove compliance with the specified performance criteria upon completion and testing of the installed system. Document readings, test results, and the final position of controls on each test report.

1.4.6 Operation and Maintenance Instructions

Submit the Operation and Maintenance Instructions indexed and in booklet form as a single file. Inscribe the following identification on the cover sheet: the words "CARBON-DIOXIDE FIRE-EXTINGUISHING SYSTEM OPERATION AND MAINTENANCE MANUAL", the name of the building, the number of the building, the name of the Installer, the name of the system manufacturer, and the Contract number. Provide instructions that are legible and easily read, with full size drawings included.

Provide submittals for SD-10 at least 14 days prior to the proposed start of training. Do not provide training prior to approval of SD-10 submittals. Include at least the following in the Operation and Maintenance Instructions:

a. "Data Package Five" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

b. Routine maintenance checklist arranged in a columnar format. List all installed components in the first column, state the maintenance activity or state no maintenance required in the second column, state the frequency of the maintenance activity in the third column, and provide a fourth column for additional comments or reference.

1.4.7 As-Built Drawings

Show the system as installed, including deviations from both the Contract Drawings and the approved shop drawings. Ensure the accuracy of the as-built drawings is plus or minus 6 inches for all discharge orifices and equipment locations, and plus or minus 12 inches for all piping. Maintain redlined as-built mark-ups throughout the duration of construction and incorporate these mark-ups into the native drawing files for the final As-Built Drawings Submittal.

Prepare the drawings in the same format, size, and layout as the approved shop drawings.

1.4.8 Air Sampling Smoke Detection System Calculations

Submit air sampling detection system design analysis calculations consisting of battery capacity, loading calculations, and fan speed and air flow/transport calculations. Include schematic diagrams showing pipe segments, pipe diameters, lengths of pipe, node numbers, and sample port diameters to verify the requirements are met. Calculations must take into account airflow in the Tyee Powerhouse Unit No. 3 generator.

1.5 SPECIAL TOOLS AND SPARE PARTS

Furnish special tools necessary for the maintenance of the equipment. Submit spare parts data for each different item of material and equipment specified, after approval of shop drawings, and not later than 60 days prior to the anticipated date of beneficial occupancy. Include a complete list of parts and supplies with the current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after one year of service.

Furnish the following spare parts:

a. Reserve Cylinders

b. Two air sampling smoke detection system filter assemblies

1.6 QUALITY ASSURANCE

1.6.1 Materials

Provide all labor, material, tools, and equipment necessary for and incidental to a complete and usable carbon-dioxide fire-extinguishing system.

Ensure all devices, appliances, and equipment for fire protection service are listed or approved by UL Fire Prot Dir or FM APP GUIDE for the intended use. For components that must function together to form a system, ensure they are listed or approved by the same NRTL.

1.6.2 Codes, Standards, and Manufacturer's Literature

Provide the system in accordance with Alaska IFC, NFPA 12, NFPA 70, NFPA 72, NFPA 90A, and as specified herein. Interpret reference to "authority having jurisdiction" to mean the Owner.

Follow all recommended installation and start-up practices stated in the manufacturer's literature or documentation.

1.6.3 Qualifications

1.6.3.1 Installer

Provide an Installer that is regularly engaged in the installation of the type and complexity of system specified herein. Installer must be certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with Level II or greater certification in Special Hazards Systems. Submit the Installer's Qualifications including written certificate demonstrating that the carbon-dioxide fire-extinguishing system Installer has been regularly engaged in the installation of such systems meeting NFPA standards for a minimum of three years immediately preceding commencement of this Contract. The installer must be thoroughly experienced in the installation of air sampling detection systems. Include proof of satisfactory performance on at least three projects similar to that required by these specifications, including the names and telephone numbers of using agency points of contact for each of these projects. Indicate the type of each system installed and include a written certification that each system has performed satisfactorily in the manner specified for a period of not less than 18 months following completion. Ensure Installer is able to provide service within 72 hours.

1.6.3.2 Supervisor

Provide the services of a qualified technician, factory trained, certified, and experienced in the installation and operation of the type of system being provided to supervise the installation, adjustment, preliminary testing and final testing of the system, and to provide instruction to Owner's operating and maintenance personnel.

Submit the Supervisor's Qualifications including name(s) of the Supervisor(s) who will oversee installation and testing of the system, and who will provide instruction to Owner personnel, along with the manufacturer's certification of the qualifications of the proposed Supervisor(s).

1.6.3.3 Designer

Prepare shop drawings, product data, design data, O&M manual(s), and as-built drawings by, or under the direct supervision of, the Designer. Ensure that the Designer is an individual who is experienced with the types of work specified herein and is currently certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with Level IV certification in Special Hazards Systems. Ensure the Designer for fire alarm portions,including the air sampling smoke detection system is certified by the National Institute for Certification in Engineering Technologies (NICET) as an engineering technician with Level III certification in Fire Alarm Systems. Submit the Designer's Qualifications including the name and documentation of

certification of the proposed Designer.

1.7 EXISTING CONDITIONS

Provide new equipment that is compatible with the existing system, manufactured by Kidde Fenwal. Ensure that new equipment is fullly compatible with existing system.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

Design the system in accordance with NFPA 12 and NFPA 72.

2.1.1 Room Total Flooding Systems

Provide both initial discharge and extended discharge.

For the initial discharge, provide uniform discharge to the protected space to achieve a flooding factor of 0.1 pounds of carbon-dioxide for each cubic foot of protected volume, in order to produce a minimum design carbon-dioxide concentration of 50 percent. Design the system such that a 34 percent carbon dioxide concentration is achieved within one minute, and a 50 percent concentration is achieved within two minutes.

For the extended discharge, provide additional discharge to maintain a minimum carbon dioxide concentration of 30 percent for a minimum hold time of 20 minutes.

2.1.2 Seismic Bracing

Provide seismic bracing in accordance with NFPA 13.

2.2 CARBON-DIOXIDE SUPPLY

Provide high-pressure carbon-dioxide storage cylinders complete with a full charge of carbon-dioxide, racks, manifolds, beam scales, and necessary components and appurtenances. Provide 100 pound cylinders. Calculate the quantity of cylinders neccessary to meet and maintain the design concentration specificed herein. Take actual enclosure leakage, as measured by the leakage test specified herein, into account by providing additional carbon-dioxide to compensate for leakage from the enclosure. In the event this calculated amount results in a partial cylinder, round the quantity of cylinders required up to the next highest whole number. Provide carbon-dioxide supply calculationsto validate the number of cylinders selected.

Provide addtional connected reserve cylinders equal to the number of installed system cylinders. Provide 100 pound cylinders which are interchangeable with the installed system cylinders.

Locate system cylinders where shown in the Contract Drawings.

2.2.1 Odorizer

Provide a pressure actuated wintergreen odorizer assembly on the initial discharge piping and the extended discharge piping. Arrange odorizer assemblies so that any discharge of carbon dioxide will pass through an odorizer assembly.

2.3 PIPE AND FITTINGS

2.3.1 Layout

Provide pipe and orifice sizing calculations to validate the system design. Locate discharge nozzles as shown on the Contract Drawings, or as required by system design.

Provide separate piping systems for the initial discharge and the extended discharge. A combined manifold is permitted when used with check valve(s) which inhibits the extended discharge supply from flowing into the initial discharge piping system.

Locate the pipe to minimize the potential for damage.

Provide a piping system for pressure relief discharge which discharges to the exterior of the facility.

2.3.2 Pipe

Provide ASTM A53/A53M, Type E or Type S, Grade A or Grade B, black or galvanized steel pipe. Ensure pipe nipples 6 inches long and shorter are Schedule 80 or stronger steel pipe.

1 inch and greater piping must be a minimum of Schedule 80. 3/4 inch and smaller piping must be minimum Schedule 40.

Comply with the manufacturer's written installation instructions or NFPA 12, whichever is more stringent.

2.3.3 Fittings

Provide fittings of the type and class required by NFPA 12. Provide tapered-reducing pipe fittings for changes in piping size; do not use bushings.

2.3.4 Lockout Valves

Provide each piping system with a manually operated lockout valve that includes positive visual indication of valve position. Equip each lockout valve with a status switch capable of reporting the valve's position to the RSFACU.

2.3.5 Discharge Orifices

Provide discharge orifices in accordance with NFPA 12.

2.3.6 Pressure Relief Piping

Provide each section of closed piping with a pressure relief device designed to operate at no less than 2,400 psi and no more than 3,000 psi, and which discharges through the pressure relief vent piping to the exterior. Piping between the cylinders and the lockout valve is considered closed piping.

2.4 PIPING ACCESSORIES

2.4.1 Escutcheon Plates

Provide one piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces. Provide paint finish on metal plates in unfinished spaces. Securely anchor plates in place with setscrews or other approved positive means.

2.4.2 Pipe Sleeves

Provide pipe sleeves where piping passes entirely through walls, ceilings, roofs, and floors. Provide sleeves of sufficient length to pass through the entire thickness of walls, ceilings, roofs, and floors.

a. Sleeves in Masonry and Concrete: Provide hot-dipped galvanized steel, ductile-iron, or cast iron sleeves at walls, ceilings, roofs, and floors. Core-drilling of masonry and concrete may be provided in lieu of sleeves as long as cavities in the core-drilled holes are completely grouted smooth.

b. Sleeves in Other Than Masonry and Concrete: Provide 26 gage galvanized steel sheets.

Secure sleeves in proper position and location. Provide one inch minimum clearance between exterior of piping and interior of sleeve or core-drilled hole. Firmly pack annular space with mineral wool insulation and seal both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide mechanically adjustable segmented elastomeric seal. Protect penetrations of fire resistance rated construction with listed firestopping assemblies.

2.4.3 Pipe Hangers and Supports

Provide MSS SP-58 compliant, Type 1 pipe hangers and supports, with adjustable type steel support rods, except as modified herein or indicated otherwise on the Contract Drawings. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to steel W or S beams with Type 21, or 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamps with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide seismic bracing calculations to validate seismic bracing designs.

2.5 SYSTEM CONTROL

Provide apparatus, accessories, components, and associated materials specified or required. Provide an automatic and manual type actuating control system complete and ready for operation. Provide main and reserve switch. Configure switch to select between main and reserve carbon-dioxide supplies, located adjacent to the cylinder bank or at the control panel. Provide complete "Class B" electrical supervision. Achieve automatic actuation by smoke detection within the air housing, located as shown in the Contract Drawings. Ensure system is activated upon generator differential signal.

2.5.1 Manual Release Stations

Provide manual release stations for the system. Provide dual action manual release stations that do not incorporate break-glass elements. Ensure manual release stations include language clearly indicating the intended use and are clearly distinguishable as different from fire alarm system manual pull stations in the building. Locate where shown in the Contract Drawings.

2.5.2 Sequence of Operation

2.5.2.1 General

Configure the system such that upon activation of the automatic activation or activation of a manual release station, the system immediately activates the discharge notification appliances; signals the building fire alarm control unit to activate the building fire evacuation alarms; sends a signal to the supervising station; sends a signal to initiate generator turbine shutdown sequence; sends a signal to initiate activation of 100 percent fresh air mode on the HVAC system; and initiates an adjustable zero to 60 second discharge time delay. Configure the system such that upon expiration of the discharge time delay, carbon-dioxide flows from the storage cylinders and discharges into the protected space.

Configure the system such that upon activation of the emergency manual discharge lever on the cylinder the system immediately activates discharge notification appliances; signals the building fire alarm control unit to activate the building fire evacuation alarms; sends a signal to the supervising station; sends a signal to initiate generator turbine shutdown sequence; sends a signal to initiate activation of 100 percent fresh air mode on the HVAC system; and initiates carbon-dioxide discharge into the protected area.

2.5.2.2 Pressure-Switch Operation

Provide a pressure-switch to initiate the following functions upon discharge of carbon-dioxide if not already initiated: activate discharge notification appliances; signal the building fire alarm control unit to activate the building fire evacuation alarms; send a signal to the supervising station; sends a signal to initiate generator turbine shutdown sequence; sends a signal to initiate activation of 100 percent fresh air mode on the HVAC system.

2.5.3 Discharge Pressure Switches

Provide each system with a discharge pressure switch monitored by the RSFACU. Ensure that the pressure switch supervises the pressure in the piping downstream of the releasing solenoid such that it is activated when gas is discharged. Provide switch with two sets of single-pole double-throw (SPDT) form-C contacts capable of connection to 24 VDC and 125 VDC outputs. Ensure the switch has screw terminal connections and is capable of being wired for a normally open or normally closed circuit.

2.5.4 Alarm Notification Appliances

Provide audible and visual alarms located as shown on the Contract Drawings. Electrically supervise all alarm circuits with the RSFACU. Power notification appliances from the releasing service fire alarm system. Ensurethat the discharge signals are distinct from those used by the

building fire evacuation system. Provide each notification appliance with a rigid plastic or metal identification sign with lettering a minimum of 1.5 inches high. Label the discharge alarms with the words "CARBON-DIOXIDE DISCHARGE". Locate the discharge alarms outside entrances to protected areas and provide them with warning signs reading "CARBON-DIOXIDE DISCHARGED WHEN FLASHING - DO NOT ENTER".

2.5.4.1 Alarm Horns

Provide 24 VDC, red, vibrating type, alarm horns suitable for use in an electrically supervised circuit that produce a sound output of at least 90 decibels at 10 feet. Configure discharge horns to produce a high-low horn pattern.

2.5.4.2 Visual Alarms

Provide 24 VDC, visual alarms suitable for use in an electrically supervised circuit. Ensure visual alarm appliances are the flashing stroboscopic type. Select strobe candela rating in accordance with NFPA 72 criteria for the given space. Ensure flash rate is between 60 and 120 flashes per minute. Visual alarms may be part of an audio-visual alarm assembly. Where more than two stroboscopic type appliances are located in the same field of view, provide synchronized operation.

2.6 OPERATING INSTRUCTIONS

Provide operating instructions at each manual release station and at the emergency manual actuation lever. Ensure that the instructions clearly indicate the steps for system operation. Submit a graphical representation of the proposed operating instructions as a part of the shop drawings or product data submittals. Provide instructions that incorporate raised or embossed white letters on red rigid plastic or enameled steel backgrounds. Ensure that lettering is a minimum of 0.25 inch high.

2.7 SIGNS

Provide signs in accordance with NFPA 12.

2.8 AIR SAMPLING SMOKE DETECTION SYSTEM

The air sampling smoke detection system must consist of a detector assembly housing an integral aspiration fan, filter, laser-based detection chamber and control, output and supervision circuitry. The system must consist of a piping or tubing distribution network that runs from the detector assembly(s) to the protected area(s) and is supported by air sampling smoke detection system calculations from a computer-based design modeling tool. The system must include configurable alarm and trouble relay outputs for interface to other systems where required.

a. System must be complete in all ways. It must include all engineering, and electrical installation, all detection and control equipment, auxiliary devices and controls, alarm interface, functional checkout and testing, training and all other operations necessary for a functional system.

b. System base detectors and modules must each accommodate up to 40 microbore sampling tubes where each tube has a sampling point at the end. Additional modules may be used to provide up to 20 sampling

holes per system.

c. Program alarm thresholds to the applicable relevant values. Clearly document the selected levels in the system documentation

d. All air sampling smoke detection devices and associated components must be new, standard products or the manufacturer's latest design and suitable to perform the functions intended.

e. The laser detection chamber must be of the mass light scattering type and capable of detecting a wide range of smoke particle types of varying size. A particle counting method must be employed for the purposes of:

(1) Preventing large particles from affecting the true smoke reading.

(2) Monitoring contamination of the filter (for example, dust and dirt) to automatically notify when maintenance is required. The particle counting method must not be used for the purpose of smoke density measurement.

f. Detector(s) must be self-monitoring for filter contamination and provide indication through system fault when replacement is necessary. Detectors which allow automatic reset of filter status upon removal and re-insertion are not permitted.

g. Detector(s) must contain relays for alarm and fault conditions. The relays must be software programmable to the required functions.

h. Detector(s) must permit configuration by programmers that are either integral to the system, portable or PC based.

i. Detector(s) must allow programming of:

(1) Smoke threshold alarm levels; ALERT, PRE-ALARM, FIRE 1 and FIRE 2.

(2) Time delays. Ensure the display control unit contains individual adjustable alarm time delay features for each of the alarm threshold levels. Provide an adjustment range between 0 and 60 seconds. Program the alarm threshold time delays to 30 seconds for alarm levels 1 and 2, and 15 seconds for alarm levels 3 and 4.

(3) Faults, including airflow, detector, power, filter and network, as well as an indication of the urgency of the fault.

(4) Configuration of relay outputs for remote indication of alarm and fault conditions.

(5) General purpose input functionality.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Become familiar with details of the work, verify dimensions in the field, and advise the Owner of discrepancies before performing the work.

3.1.1 Leakage Test

Conduct door fan test or similar to measure the leakage from the generator air housing. Calculate and compensate for leakage by the addition of carbon dioxide equal in volume to the expected leakage volume during the extinguishing period.

3.2 CONTINUITY OF PROTECTION

During installation of the system, ensure there is no loss of function of the existing carbon-dioxide systems or fire alarm system. Temporary interruption in operability of the existing systems, not to exceed eight hours in duration, is acceptable but must be coordinated with the Owner.

3.3 INSTALLATION

Provide equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing in accordance with NFPA 12, NFPA 70, NFPA 72, and NFPA 90A. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

3.3.1 Electrical

Provide electrical work associated with this Section in accordance with NFPA 70. Provide wiring in rigid metal conduit or intermediate metal conduit. Provide grounding and electrical clearances in accordance with NFPA 12 and NFPA 70. Add to or replace existing RSFACU batteries to ensure standby power complies with NFPA 12 and NFPA 72.

3.3.2 Manual Release Stations

Provide manual release stations where shown on the Contract Drawings. Mark each station to indicate its function.

3.3.3 Pipe and Fittings

Test, inspect, and approve piping before concealing. Provide fittings for direction changes in piping and for connections. Provide polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil for pipe jointing compound; apply only to male threads. Provide exposed ferrous pipe threads with one coat of zinc molybdate primer applied to a minimum dry film thickness of one mil.

3.3.4 Pipe Hangers and Supports

Provide additional supports for the concentrated loads in piping between hangers and supports, such as for valves. Support steel piping as follows:

Nominal Pipe Size (inches)	1.0 and Under	1.25	1.5	2	2.5	3	4	5	6

Maximum Spacing (feet)	7	8	9	10	11	12	14	15	17

3.3.5 Air Sampling Smoke Detector

Locate air sampling smoke detectors in accordance with the manufacturer's instructions. Air sampling smoke detectors must be installed as follows:

a. Air Sampling Smoke Detector Assembly:

(1) Detector assembly must be mounted to a wall at a height between 48 to 60 inches to top of detector measured above the finished floor.

(2) Mounting must be in a fully accessible and visible location.

(3) Mounting or attachment to site equipment, cable trays, movable walls, other equipment or equipment supports is not permitted.

(4) Piping network insertion into the detector inlet must not be glued.

(5) Air sampling smoke detector assembly must be installed in accordance with this specification section and the manufacturer's installation and instruction manuals.

(6) Flexible tubing for termination of the sampling pipe network into detector inlet is not permitted unless allowed by its listing.

(7) Provide red background with white lettering labels that are plastic or phenolic type with a minimum of 0.25-inch block lettering to indicate detector and zone.

(8) Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the ASD panel. The card must show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions must be approved by the Contracting Officer before being posted.

b. Pipe and Sampling Tube Mounting:

(1) The pipe and sampling tubing detection network must be mounted as per the design and manufacturer's specification. The hardware used for mounting will depend upon the design and site requirements.

(2) To minimize flexing, pipes must be secured every 5 feet.

(3) Pipes must be suspended between 1 and 4 inches below the ceiling. In areas with a suspended ceiling, the pipe network must be installed above the ceiling utilizing the manufacturer's capillary sample port supported by the ceiling.

(4) The sampling tubes must be of the same length or use the manufacturer's guidelines to run tubes of the required lengths.

(5) When installing a pipe network in areas subject to high temperature fluctuations allow for the contraction and expansion of pipes.

(6) Where expansion or contraction of pipes is likely either after installation or on a continuous basis, do not place pipe clips adjacent to couplings and socket unions as these may interfere with the movement of the pipe.

(7) No bends are permitted within the first 18 inches from the detector inlet.

(8) The routing of the piping and sample tube network must be coordinated with potential obstructions, including cable trays, grounding bars, and HVAC ductwork.

(9) All changes in direction must be made with standard elbows or tees.

(10) All joints must be air-tight and made by using solvent cement, except at the entry to the detector assembly. Refer to ASTM F402.

(11) All pipes must be supported by mechanical hangers attached to the structure of the building. Not more than 1-foot of pipe must extend beyond the last hanger of each sampling pipe. The final installation must result in no noticeable deflection in the piping network.

(12) Attachment of air sampling pipes to cable trays, "gray iron", and telecommunications equipment is prohibited.

(13) Clearly label pipe network to distinguish the pipe from other facility pipe work or protective cabling enclosures. For example: "SMOKE DETECTION SAMPLING TUBE - DO NOT DISTURB". Provide labels every 10 feet.

(14) Placement of the sampling tube must take into consideration appropriate sampling point locations and spacing.

c. Air Sampling Points:

(1) Open area ceiling sampling points must be oriented downward and must be within 1 to 4 inches below the underside of the ceiling above where the ceiling is smooth.

(2) Label all air sampling points with a round red label, each with a center hole to match the diameter of the drilled sampling point. For example: "AIR SAMPLING POINT DIA 0.125 INCHES". Indicate fractional dimensions in decimal format with a minimum of three decimal places.

3.4 PAINTING

Provide manufacturer coated equipment or field paint equipment. Clean, pretreat, prime, and paint new carbon-dioxide fire-extinguishing systems including valves, piping, conduit, hangers, supports, miscellaneous

metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat of zinc molybdate primer applied to a minimum dry film thickness of one mil. Shield operating devices with protective covering while painting is in process. Upon completion of painting, remove protective covering from operating devices. Remove devices which are painted and replace with new devices. Provide primed surfaces with the following:

3.4.1 Piping

Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of one mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic tape bands spaced at a maximum of 20 foot intervals throughout the piping systems with at least one band in each space.

3.5 CORROSION AND FUNGUS PREVENTION

Coat outdoor equipment with a rust inhibiting treatment and standard finish by the manufacturer. Protect dissimilar metals with approved fittings and treatment. Protect components against corrosion and fungus.

3.6 FIELD QUALITY CONTROL

Ensure installed piping is tested, inspected, and approved before covering or concealing.

Perform systems testing in accordance with NFPA 12.

3.6.1 Test Procedures

Submit detailed test procedures at least 30 days prior to proposed start of performing system tests. List all components of the installed system such as piping, hangers, nozzles, and tanks or cylinders. Include sequence of testing, time estimate for each test, and sample test data forms. Provide test data forms in a check-off format (pass or fail with space to add applicable test data; similar to the format in NFPA 72), and use them for the preliminary testing and the final testing. Provide test data forms that record the test results and:

a. Identify each test required by NFPA 12 Approval of Installations, NFPA 12 Testing of Systems, NFPA 12 Test and Maintenance Procedures, and herein, to be performed on each component, and describe how the test must be performed.

b. Identify each component as to type, location within the facility, and unique identity within the installed system. Provide necessary floor plan and site plan sheets showing each component location, test location, and alphanumeric identity.

c. Identify all test equipment and personnel required to perform each test.

d. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

e. Provide safety plan for keeping occupants safe from carbon dioxide discharge during testing. Include provisions for removing carbon dioxide from space after discharge.

3.6.2 Testing

3.6.2.1 Preliminary Tests

Prior to commencing other required tests, discharge a minimum of one 100 pound cylinder of carbon-dioxide to demonstrate the reliability and proper functioning of each pressure-operated switch and the discharge of carbon-dioxide gas from each system discharge nozzle. After discharge, clean wire screens at nozzles, if provided. If screens or nozzles show evidence of plugging, discharge an additional cylinder of carbon-dioxide gas with the nozzles removed prior to continuing on with full system discharge testing. Provide carbon-dioxide required for tests. Individually test each manual release station and other components and accessories to demonstrate proper functioning. Correct deficiencies prior to formal functional and operating tests of the system.

3.6.2.2 Request for Formal Inspection and Tests

After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable with the Request for Formal Inspection and Tests. Include the draft Carbon Dioxide System Acceptance Test Report from NFPA 12 as well as the names and titles of the witnesses to the preliminary tests in the letter. Submit request for final test at least 14 days prior to the proposed test date.

3.6.2.3 Final Testing

Final testing must include full discharge test with data collection to verify system meets performance requirments. Furnish instruments, labor, and materials required for the tests. Arrange for the Supervisor to conduct the tests. Repeat tests performed during preliminary testing as directed by the Owner. If deficiencies are found, make corrections and retest the system to ensure that they are resolved. Costs for witnessing of retesting incurred by the Owner and their representatives may be charged to the Contractor at the discretion of the Owner. After successful completion of tests, refill the storage cylinders with carbon-dioxide.

Collect and provide the following:

a. Carbon-dioxide concentration data at the top, middle, and bottom of the protected enclosure for the full duration of the test.

b. Plots of data which indicate the carbon dioxide concentration with respect to time, and clearly indicate that the system meets or exceeds the required concentration for 20 minutes after discharge.

c. Test data in an electronic spreadsheet.

3.6.2.4 Additional Tests

When deficiencies, defects, or malfunctions develop during required tests, suspend further testing of the system until proper adjustments, corrections, or revisions have been made to ensure proper performance of

the system. When these revisions require more than a one hour delay, notify the Owner when the additional work has been completed to arrange a new final test of the carbon-dioxide fire-extinguishing system. Repeat tests required prior to final acceptance, unless directed otherwise by the Owner.

3.6.2.5 Final Test Report

Provide a letter certifying that the installation is complete and fully operable with the Final Test Report. Include the finalized Carbon Dioxide System Acceptance Test Report from NFPA 12 as well as the names and titles of the witnesses to the final tests in the letter. Submit the final test report within 14 days of test completion.

3.6.3 System Acceptance

Following successful completion of final testing of the system, deliver as-built drawings and operation and maintenance instructions (O&M Manuals) to the Owner for review and acceptance. Submit the drawings and manuals within 14 days after the final testing of the system. Provide at least one set of as-built (marked-up) drawings at the time of, or prior to, the final testing for use in field verification.

3.7 CLOSEOUT ACTIVITIES

3.7.1 Training

3.7.1.1 Instruction of Owner Personnel

Manufacturer's Representative: Furnish services of manufacturer's technicians to supervise final system testing, conduct inspections of installed system, conduct system start-up, provide training, and make adjustments.

Conduct a training course for operating personnel with Manufacturer's field representative as designated by Owner.

Training course shall take place at the facility location and shall be specific to the installed system.

Instruct Owner operating and maintenance personnel, as designated by the Owner, for a minimum of eight total hours covering at least the following for all items of equipment provided under this Contract:

a. Theory of operation.

b. Procedures for start-up, operation, and shutdown.

c. Maintenance instructions.

d. Safety precautions.

e. Test procedures.

f. Field troubleshooting and diagnostic procedures.

g. Repair procedures for field repairs that can be made by replacing plug-in components.

h. Identification of all equipment locations including but not limited to releasing stations, valves, instruction manuals.

Provide instruction by the manufacturer's technical representative at the project site using the documents specified in the paragraph entitled "Operation and Maintenance Manuals".

3.7.1.2 Recordings

Record all training presented on-site utilizing recording equipment acceptable to the Owner. Perform recording such that all visual aids are clearly visible and all discussion is clearly understandable. Provide record copies of the recordings to the Owner within 14 days following completion of training.

-- End of Section --

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002; 6th ed) National Standards for Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS	(2015) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1780	(2023) HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition
SMACNA 1858	(2004) HVAC Sound And Vibration Manual - First Edition

1.2 DEFINITIONS

a. AABC: Associated Air Balance Council

b. HVAC: Heating, ventilating, and air conditioning

c. NEBB: National Environmental Balancing Bureau

d. Out-of-tolerance data: Pertains only to field acceptance testing of TAB report. This phrase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

e. TAB: Testing, adjusting, and balancing (of HVAC systems)

f. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed

g. TAB Agency: TAB Firm

h. TABB: Testing Adjusting and Balancing Bureau

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB

Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS			
Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems	International Standards for Environmental Systems Balance
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures	Field Readiness Check & Prelim. Field Procedures

1.3 WORK DESCRIPTION

The work includes testing, adjusting, and balancing (TAB) of new and existing heating, ventilating, and cooling (HVAC) air distribution systems including existing air handling system and existing and new ducts which are located within, on, under, between, and adjacent to buildings, including Records of Existing Conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct TAB of the indicated existing systems and equipment and submit the specified TAB Report for approval. Conduct TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance system (TAB) in compliance with this section.

1.3.2 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.

2. Air quantities at air terminals.

3. Air quantities and temperatures in air handling unit schedules.

Submit three copies of the TAB Schematic Drawings and Report Forms and TAB Procedures to the Owner's Representative, no later than 14 days prior to the start of TAB field measurements.

1.4 SUBMITTALS

Action Submittals are subject to review and approval by Owner or Owner's designated Representative. Informational Submttals are for Owner's information and records. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

1.4.1 Action Submittals

SD-01 Preconstruction Submittals

TAB Schematic Drawings And Report Forms;

TAB Procedures;

SD-06 Test Reports

TAB Report;

1.4.2 Informational Submittals

SD-07 Certificates

Independent TAB Agency And Personnel Qualifications;

SD-01 Preconstruction Submittals

Records Of Existing Conditions;

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Owner's Representative for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor (Specialist): Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team

field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Owner's Representative.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section.

3.2 PRE-TAB MEETING

Meet with the Owner's Representative to develop a mutual understanding relative to the details of the TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 TAB PROCEDURES

3.3.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

Comply with the the requirements of AABC MN-1 or SMACNA 1780 (TABB) and SMACNA 1858 (TABB),except as supplemented and modified by this section.

Provide instruments and consumables required to accomplish the TAB work. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Preliminary Procedures

Use the approved TAB Procedures as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.3.3 TAB Air Distribution Systems

3.3.3.1 Air Handling Units

Prior to demolition of existing ductwork, test air balance of the existing air handling system including air handling unit fans, exhaust fans, ducts, plenums, mixing boxes, and air distribution devices for supply air and outside air. Test system in 100% outside air mode. Submit air balance report with records of existing conditions.

3.3.4 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates indicated on the contract documents. This TAB work includes adjustment of balancing dampers, and supply diffusers. Additionally, retest air balance of the existing air handling unit system and adjust available air balance components as required to rebalance the existing air distribution devices to within plus or minus 5 percent of the flow rates reported in the records of existing conditions. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the Owner's Representative for direction.

3.3.5 TAB Reports

After completion of the TAB field work, prepare the TAB field data for TAB Engineer's review and certification, using the reporting forms approved in the TAB Procedures. Data required by the approved data forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Owner's Representative, the TAB work and thereby the TAB Report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP.

3.4 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.5 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

SECTION 23 30 00

HVAC AIR DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	(2022) Ventilation for Acceptable Indoor Air Quality
ASHRAE 70	(2020) Method of Testing the Performance of Air Outlets and Inlets

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A924/A924M	(2022a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B766	(2023) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM E84	(2023) Standard Test Method for Surface Burning Characteristics of Building Materials

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2017; Version 1.2) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 701	(2023; ERTA 1 2023) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966	(2020) HVAC Duct Construction Standards Metal and Flexible, 4th Edition
SMACNA 1981	(2008) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd Edition

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2022) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 6	(2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL Bld Mat Dir	(updated continuously online) Building Materials Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between ductwork and piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in ductwork, and all fittings and other components required to install the work as indicated and specified.

1.3 SUBMITTALS

Action Submittals are subject to review and approval by Owner or Owner's designated Representative. Informational Submittals are for Owner's information and records. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings;

SD-03 Product Data

Diffusers;

Indoor Air Quality For Duct Sealants;

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions;

SD-10 Operation and Maintenance Data

Operation And Maintenance Manuals;

SD-11 Closeout Submittals

Indoor Air Quality During Construction;

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide hot-dip galvanized ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Detail Drawings

Submit detail drawings showing ductwork layout including the location of

all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to show ductwork relationship to other parts of the work, including clearances required for operation and maintenance.

1.4.4 Test Procedures

Conduct performance tests as required in Section 23 05 93 Testing, Adjusting and Balancing for HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored material at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all assembled duct segments until installed.

PART 2 PRODUCTS

2.1 SEISMIC ANCHORAGE

Anchor ductwork in accordance with applicable seismic criteria for the area and as defined in SMACNA 1981

2.2 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.3 DUCT SYSTEMS

2.3.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, provide square elbows with factory fabricated turning vanes.

b. Provide sealants with a maximum flame spread index of 25 and maximum smoke developed index of 50 when tested in accordance with ASTM E84 and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Provide duct sealant products that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table). Submit documentation validating indoor air quality for duct sealants.

2.3.1.1 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a

composite connector system that complies with NFPA 701 and is classified as "flame-retardant fabrics" in UL Bld Mat Dir.

2.3.2 Diffusers

Provide factory-fabricated units of steel and aluminum construction as indicated in the Diffuser Schedule on the Drawings that distribute the specified quantity of air evenly over space intended. Provide outlets for diffusion, spread, and throw as required for specified performance. Certify performance according to ASHRAE 70. Provide diffusers with volume damper with accessible operator, unless otherwise indicated. Provide opposed blade type volume dampers for all diffusers.

2.3.2.1 Diffusers

Provide diffuser types indicated. Provide diffusers with air deflectors of the type indicated. Provide sponge rubber gaskets between duct-mounted diffusers and duct flanges for air leakage control. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller.

2.4 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Owner's Representative in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Owner's Representative of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Provide an area in front of all access

doors that clears a minimum of 42 inches. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices), and as required in accordance with NFPA 70.

3.2.1 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.2 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.3 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation as required and then marked to indicate location of test hole for future use.

3.3 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.4 CLEANING

Thoroughly clean surfaces of ductwork and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. Protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.5 PENETRATIONS

Prepare openings for duct mains, branches, and other penetrating items, and protect or repair penetrated assemblies as required to match the existing condition. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.5.1 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for square and rectangular ducts from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches maximum dimension or less, and a minimum of 8 fasteners where the opening is 20 inches maximum dimension or less.

3.6 FIELD PAINTING OF MECHANICAL EQUIPMENT

Provide touch-up painting in accordance with manufacturer's specifications and this Article, as required to repair scuffed or damaged finishes on diffusers and other supplied components. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide white finish coat as specified by manufacturer.

3.6.1 Temperatures less than 120 degrees FA

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees FA.

3.7 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of preconstruction air balance testing of the existing systems.

3.8 CLEANING AND ADJUSTING

Thoroughly clean ducts of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe surfaces clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and provide new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Perform and document that proper "indoor air quality during construction" procedures have been followed; provide documentation showing that after construction ends, and

prior to occupancy, new filters were provided and installed. Maintain system in this clean condition until final acceptance. Maintain all equipment installed under the contract until closeout documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.9 OPERATION AND MAINTENANCE

3.9.1 Operation and Maintenance Manuals

Submit Operation and Maintenance Manuals in PDF format at least 2 weeks prior to closeout. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

-- End of Section --

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

ASTM INTERNATIONAL (ASTM)

ASTM A1011/A1011M	(2015) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM D709	(2013) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017) National Electrical Safety Code

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA 101	(2013) Standard for Installing Steel Conduits (Rigid, IMC, EMT)
NECA/NEIS 1	(2015) Good Workmanship in Electrical Construction

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA FB 1	(2014) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA WD 6	(2016) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations

UL 514A	(2013) Metallic Outlet Boxes
UL 514B	(2012; Reprint Nov 2014) Conduit, Tubing and Cable Fittings
UL 6	(2020) Electrical Rigid Metal Conduit-Steel
UL 870	(2016) Wireways, Auxiliary Gutters, and Associated Fittings
UL 94	(2013; Reprint Jul 2015) Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 360	(2013; Reprint Jan 2015) Liquid-Tight Flexible Steel Conduit
UL 1565	(2013) Standard for Safety Positioning Devices

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" designation; submittals having an "I" designation are for information only. A designation following the "O" or "I" designation identifies the office that will review the submittal for the OWNER. The following must be submitted in accordance with SECTION 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Within 90 calendar days after Notice to Proceed, submit complete descriptive literature and specifications of each product or system of products listed with original, legible manufacturer's cut sheets and data sheets to clearly indicate physical construction, operation, electrical characteristics, ratings, and associated hardware, as applicable. Include manufacturer's catalog numbers and designations, and clearly cross-reference with shop drawings as appropriate. Product data submitted for approval must clearly show conformance with these specifications, including, but not being limited to, product manufacturers' declarations of conformance to applicable technical standards. Product data must be approved prior to procurement of associated materials and equipment.

Rigid Metal Conduit; O

Liquid-Tight Flexible Metal Conduit; O

Non-Metallic Wiring Duct (Channel); O

Rigid Metallic Conduit Fittings; O

Flexible Conduit Fittings; O

Conduit Hangers; O

Wire Ways; O

Receptacles; O

Receptacle Boxes and Pull Boxes; O

Enclosures; O

Terminal Blocks; O

Escutcheons and Nameplates; O

SD-08 Manufacturer's Instructions

Spare Parts; O

1.3 GENERAL REQUIREMENTS

1.3.1 Materials, Equipment and Installation

New materials and equipment must be furnished and any defective material or equipment damaged in the course of installation must be replaced or repaired. Testing must be performed to check the installation of and the proper operational functions of the electrical equipment. The installations must be in accordance with the National Electrical Code, NFPA 70, and the National Electrical Safety Code, IEEE C2, except where otherwise specifically shown or specified, in which case the drawings and specifications must govern. Omission of details on the drawings or in the specifications must not be construed as permitting deviations from Code requirements.

1.3.2 Standard Products

Material and equipment must be the standard products of manufacturers regularly engaged in the manufacture of these products and must essentially duplicate items that have been in satisfactory use for at least 5 years prior to proposal due date.

1.3.3 Corrosion Prevention

1.3.3.1 General

All equipment must be protected to prevent deterioration from corrosion. The general requirements are specified below; however, other corrosion-resisting treatments that are the equivalent of those specified may be used. Materials used for corrosion prevention must be submitted for approval under SD-03 Product Data.

1.3.3.2 Fastenings and Fittings

Screws, bolts, nuts, pins, studs, springs, washers and other miscellaneous fastening and fittings must be of corrosion-resistant material or must be treated in an approved manner to render them resistant to corrosion. All fastenings which are to be exposed directly to the weather must be of corrosion-resisting material.

1.3.3.2.1 Corrosion-Resisting Materials

Corrosion-resisting steel, copper, brass, bronze, copper-nickel-copper alloys are acceptable corrosion-resisting materials.

1.4 DELIVERY, STORAGE, AND HANDLING

Ship the equipment and/or materials as completely assembled and wired as

feasible so as to require a minimum of installation work. Each shipping section is properly match marked to facilitate reassembly. Provide equipment with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Carefully pack and ship separately any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment. Mark these devices with the number of the panel which they are to be mounted on and fully identified. Wrap all finished painted surfaces and metal work to protect from damage during shipment. Prepare all parts for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck. Ensure sections of equipment crated for shipment will pass though any limiting doors, passageways, or hatches including those that will be encountered when moving the equipment to the installation location. Carefully package and clearly mark all spare parts and accessories.

1.5 CONTRACT DRAWINGS

1.5.1 General

a. The contract drawings indicate the work to be accomplished in as much detail as is practical. Except for such modifications as may be required for coordination with equipment actually furnished, they constitute the working drawings for construction and for purchase of required materials. The contract drawings must be superseded by manufacturer's shop drawings when available

b. Field verify all existing dimensions, details, and features relevant to requirements for equipment, apparatus, and other coordinating features required for the design, manufacture, and installation of the new equipment and accessories.

1.5.2 Departure From Drawings

If departures from the contract drawings are necessary, details of such departures and reasons for them must be submitted not later than 90 days before scheduled installation date. No such departures will be made without prior written approval. The control schemes shown on the contract drawings are not intended to exclude the Contractor's method for accomplishing the functions indicated. However, if any alternate equipment is approved, the Contractor must bear the cost and be responsible for furnishing and installing any additional wiring devices that are required.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Compliance with Standards

Equipment shall be new and meet all applicable NEMA and UL construction and rating requirements. No equivalent will be acceptable. Immediately notify the OWNER of any requirements of the specifications or Contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

2.1.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and have been in satisfactory industrial use for 5 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

2.2 CONDUIT, RACEWAYS, DUCTS, FITTINGS AND HANGERS

2.2.1 Rigid Metal Conduit

Rigid metal conduit, including couplings, shall conform to UL 6 and/or ANSI C80.1 and must be zinc-coated both inside and outside by hot-dip galvanizing method.

2.2.2 Liquid-Tight Flexible Metal Conduit

Liquid-tight flexible metal conduit shall be made from steel strip that is zinc-coated by the hot-dip galvanizing method with an integral or separate bonding wire or and water-proof extruded PVC cover and conforming to UL 360.

2.2.3 Non-Metallic Wiring Duct (Channel)

Non-metallic wiring duct (channel)shall be two piece construction, halogen free with a a flame class of V-0 as specified in UL 94 and have a UL recognized for continuous use temperature of 95 degrees Celsius conforming to UL 1565. Ducts shall have an open slotted base with solid snap-on cover.

2.2.4 Rigid Metallic Conduit Fittings

Threaded fittings for rigid conduit shall be made of solid zinc or malleable iron and listed to UL 514B and/or NEMA FB 1. Threadless fittings shall not be used. Malleable iron fittings must be zinc-coated both inside and outside by hot-dip galvanizing method. Hubs must have a grounding screw on the locknut. Expansion fittings must have a maximum of 4 inches of travel and have external flexible copper braid bonding jumper.

2.2.5 Flexible Conduit Fittings

Flexible conduit fittings shall be made from steel or malleable iron with a zinc coating for flexible metal conduit with positive bonding, and conforming to UL 514B.

2.2.6 Conduit Hangers

Conduit hangers shall be fabricated from two or more galvanized steel hanger rods, a galvanized steel horizontal member, clamps, and other attachments as necessary for securing hanger rods and conduits. Hanger rods must not be smaller than 3/8-inch diameter and threaded either full length or for a sufficient distance at each end to permit at least 1-1/2 inches of adjustment. The horizontal member must be manufactured from hot rolled carbon steel with a galvanized finish conforming to ASTM A1011/A1011M. Hangers must be designed for hanging conduit. Conduit strut brackets must be made from a minimum of 12 gauge, hot rolled carbon steel with a galvanized finish conforming to ASTM A1011/A1011M.

2.2.7 Wire Ways

Metallic wire ways shall be painted with with knockouts. Wire ways shall have screw covers conforming to UL 870.

2.3 BOXES AND ENCLOSURES

2.3.1 Receptacle Boxes and Pull Boxes

Provide receptacle boxes and pull boxes made of malleable iron conforming to UL 514A with threaded fittings and must be zinc-coated both inside and outside by hot-dip galvanizing method.

2.3.2 Enclosures

Provide steel NEMA Type 12 enclosures that conform to UL 50 and NEMA 250, made from a minimum of 12 Standard Gage thickness and painted Munsell color system 5BG 7/0.4 high gloss (ANSI No. 70 gray), with provisions for locking. Piano type hinges are not acceptable for enclosure doors.

2.4 RECEPTACLES

Receptacles shall be industrial grade, NEMA 5-20R receptacles, 20A, 125 VAC, 2-pole, 3-wire duplex or NEMA 5-30R receptacles, 30A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6.

2.5 CONTROL EQUIPMENT

2.5.1 Terminal Blocks

2.5.1.1 Markings

Each connected terminal must have the circuit designation or wire number marked on or near the terminal in permanent contrasting color. White or other light-colored plastic marking strips, fastened by screws to each terminal block, must be provided for control wire designations. The manufacturer's wire number and the OWNER's wire number must both be shown for each connected terminal on the marking strips with permanent marking fluid. The marking strips must be reversible to permit marking both sides, or two marking strips must be furnished with each block, to accommodate the two sets of wire numbers.

2.5.1.2 Control Signal Type

Provide control signal type terminal blocks of double row terminal type rated for 600 volts and 30 amps. Terminals must be plated brass with #8-32 phil-slot screws that can accept lugs with a maximum width of 0.42-inches.

2.5.1.3 Short-Circuiting Type

Provide short-circuiting type terminal blocks for all current transformer secondary leads with provisions for shorting together all leads from each current transformer without opening any circuit. Short-circuiting the terminals of only one current transformer must not short-circuit the terminals of any other current transformer.

2.5.1.4 Power Terminal Blocks

Provide power distribution blocks for branch circuits and feeders 600 volts and less, with a minimum rating of 30 amps and accommodate wire size #12 AWG and larger. Power distribution blocks must be double row type and have lugs suitable for copper conductors, must be two-pole for single-phase circuits (phase and neutral conductors, or two phase conductors), and three-pole for three-phase circuits (three phase conductors). Three-phase four-wire circuits, where used, must have a three-pole block for the phase conductors and a single-pole block for the neutral, which must be mounted next to the block for the phase conductors. For conductors rated more than 50 amperes, screws must have hexagonal heads. Conducting parts between connected terminals must have adequate contact surface and cross-section to operate without overheating.

2.6 ESCUTCHEONS AND NAMEPLATES

a. Provide nameplates made from melamine plastic conforming to ASTM D709.

b. Nameplates must be 0.125 inch thick, black with white center core. Surface must be matte finish. Corners must be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be 1 inch by 2.5 inches. Lettering must be a minimum of 0.25 inch high, normal block style.

c. Plates must be fastened with black-finished or silver-finished, corrosion-resisting, round-head machine screws or approved nonadhesive metal fasteners.

d. Spare locations, such as spare breakers, must have blank nameplates installed, that can be engraved in the future.

2.7 SPARE PARTS

Provide the following spare parts that are duplicates of the original parts furnished and interchangeable therewith. The spare parts must be packaged for long term protection and storage according to the manufacturer's instructions. The packaging must be legibly labeled to identify
the spare parts. A list of the furnished spare parts must be included in the Operation and Maintenance Manual.

a. One spare receptacles of each type and rating used.

b. One spare safety switches of each type and rating used.

c. Two spare terminal blocks of each type and rating used.

PART 3 EXECUTION

3.1 SEISMIC REQUIREMENTS

The structural design calculations for seismic restraints and detail drawings for electrical conduit and equipment in this section must be developed by the Contractor in accordance with the requirements of Section 13 48 73, SEISMIC CONTROL FOR MISCELLANEOUS EQUIPMENT.

3.2 CONDUIT SYSTEM INSTALLATION

3.2.1 General

a. Conduit systems must be installed in accordance with NECA/NEIS 1 and NECA 101. Pull boxes must be furnished and installed, complete with covers, in conduit runs as required by NFPA 70 and good practice in the industry.

b. Do not install conduit exhibiting damage of any kind. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or replace conduit.

c. Exposed conduit must be installed to avoid interference with other work. Structural steel must not be cut, drilled or bent to avoid interference except with written approval. Exposed conduit must be installed to conform to the shape of the surface over which it is run and must be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Supports must be used at entrance or exit from all conduit fittings, boxes, cabinets and changes of direction of conduit.

3.2.2 Thread Compound

Conduit joints and connections must be made conductive, watertight and rustproof by the application of a blend of colloidal copper and rust inhibitors. Each threaded joint must be thoroughly cleaned to remove all cutting oil before the compound is applied.

3.2.3 Liquid-Tight Flexible Conduit

Use of liquid-tight flexible conduit must be limited to make electrical connections to vibration-isolated equipment connections and must not exceed 36-inches in length.

3.2.4 Cutting and Threading

All cuts must be made with a hacksaw and then manually reamed, or made by a powered cutting/reaming tool approved for this use. Manual roller type pipe cutters must not be used on conduits. All cuts must be square and the conduit opening must not be constricted. After threading, conduit ends must be checked and reamed to remove any additional burrs, and the entire conduit must be thoroughly cleaned to remove all cuttings, dirt and oil from its interior. Conduit threads must be tapered using National Pipe Thread dies and be clean-cut. No running threads will be permitted. Conduit unions must be used where standard couplings cannot be used. All conduit joints must be wrench tight. Threadless fittings shall not be used on conduit runs.

3.2.5 Bends

a. Ensure that conduit runs between devices do not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the device.

b. Make field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use long radius conduit for elbows larger

than 2-1/2 inches.

3.2.6 Expansion Fittings

Expansion fittings must be installed at all crossings of concrete expansion joints and where necessary to compensate for thermal expansion greater than 1/4-inch on a straight run. Expansion fittings must be installed in accordance with the manufacturer's instructions. Expansion fittings must be installed such that the external bonding jumpers are visible for inspection.

3.2.7 Coordination

The conduit must be installed in the most direct and workmanlike manner so that interference between piping, ducts, conduit, mechanical, electrical, and structural features will be avoided. In case interference does develop, the OWNER will decide which work must be relocated regardless of which work was first installed. The rerouting must be made without additional cost to the OWNER. The Contractor must carefully examine previously installed work prior to developing layout and installation plans for conduit and accessories to determine that installation can be made without interference with other work.

3.2.8 Termination of Conduit

All conduit terminations to sheetmetal boxes and enclosures must be made using grounding hubs.

3.2.9 Grounding and Bonding of Conduit

The entire conduit system must be electrically continuous and bonding jumpers must be used across all expansion fittings and between conduits entering and leaving electrical utility vaults, panelboards, switchboards, and cabinets. No welding or brazing of the grounding conductor to the conduit must be allowed. Insulated ground bushings must be used to bond metallic conduits. Conduits terminating at cabinets and panelboards must be grounded at the equipment by grounding bushings or grounding hub connected to the grounding system by a No. 8 wire, or as approved. Conduit runs must be grounded at both ends.

3.2.10 Conduit Cleaning

All new and existing conduit that will be reused must be cleaned by the contractor before pulling wire. The contractor must all clean the conduit by pulling a clean, dry, tight fitting rag through each conduit run.

3.2.11 Conduit Labeling

All new conduit shall have metal tags that identify the conduit name, as specified in the conduit and cable schedules at each equipment and wall penetration.

3.2.12 Conduit Inspection

After a conduit system is installed and cleaned, but prior to pulling conductors, it must be given a visual inspection and a metal test mandrel must be drawn through the conduit in the presence of the OWNER. Should the mandrel fail to pass through the conduit, a new bend or length of conduit must be installed at the points of obstruction.

3.3 BOX AND ENCLOSURE INSTALLATION

3.3.1 General

Boxes must be provided in the wiring or raceway systems wherever required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Indicated elevations (if any) are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70.

3.3.2 Installation

All boxes and enclosures must be straight and true with horizontal or vertical structural lines. The final installation must not be out of plumb more than 1/4-inch over the full length nor be deformed more than 1/16-inch per linear foot nor more than a total of 1/4-inch in any surface. Gaskets for gasketed boxes must be treated with graphite or other approved paste at the time the cover is assembled to the box to prevent it from sticking. Blank covers must be installed on boxes where devices are not indicated. Open knockouts must not be permitted. Unused conduit openings must be plugged with an approved fitting. Exposed enclosures on concrete surfaces must be fastened with anchors near each corner. Enclosures with threaded hubs must be provided with proper size hubs to fit conduit being installed. Threaded reducers will not be permitted.

3.4 ESCUTCHEONS AND NAME PLATE INSTALLATION

Escutcheons and name plates must be installed as indicated in the contract drawings. Mounting screws must be flush with the back of the panel to prevent damaging wires. Escutcheons and name plates must be level, evenly spaced and aligned with its associated devices. Escutcheons and name plates must visible to the operators.

3.5 PAINTING

3.5.1 New Equipment

Paint new electrical equipment as required to match finish of adjacent surfaces or to the specified criteria. Painting must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.5.2 Existing Equipment

Any paint damaged during modifications to existing equipment must be repaired by degreasing, sanding, feather-edging, priming, and finishing with an approved paint of matching color. Tiny nicks and other similar damage may, if approved, be repaired with matching finish color alone.

3.6 INSPECTION AND TESTING

3.6.1 Field Testing

a. Tests and inspections shall establish:

1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

b. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

c. Set, test, and calibrate protective devices, circuit breakers, fuses, power monitoring meters, and other applicable devices in accordance with values established by short circuit, coordination, and harmonics studies as specified in this Section.

d. Adjust mechanisms and moving parts of equipment for free mechanical movement.

e. Verify nameplate data for conformance to Contract Documents and approved Submittals.

f. Realign equipment not properly aligned and correct unlevelness.

g. Properly anchor electrical equipment found to be inadequately anchored.

h. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screwdriver to manufacturer's recommendations, or as otherwise specified in NETA ATS.

i. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

j. Provide proper lubrication of applicable moving parts.

k. Inform Owner's Representative of working clearances not in accordance with NFPA 70.

l. Investigate and repair or replace equipment installed under this contract for the following:

1. Electrical items that fail tests.

2. Active components that do not operate in accordance with manufacturer's instructions.

3. Damaged electrical equipment.

m. Electrical Enclosures:

1. Remove foreign material and moisture from the enclosure interior.

2. Vacuum and wipe clean enclosure interior.

3. Remove corrosion found on metal surfaces.

4. Repair or replace door and panel sections having dented surfaces, as determined by Owner's Representative.

5. Repair or replace poorly fitting doors and panel sections, as determined by Owner's Representative.

6. Repair or replace improperly operating latching, locking, or interlocking devices.

7. Replace missing or damaged hardware.

8. Finish: Provide matching paint and touch up scratches and mars.

n. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

o. Checkout and Startup:

p. Induction Motors:

1. Inspection and testing limited to motors rated 5 hp and larger.

2. Inspect for the following:

a. Proper electrical and grounding connections. Verify that multi-voltage motors are connected for the appropriate voltage.

b. Shaft alignment.

c. Torque mark alignment on bolts and frames.

d. Blockage of ventilating air passageways.

e. Proper operation of space heaters and brakes, as applicable.

f. Short circuit and overload relay settings for protective devices are correct for the motor installed.

g. With the motor operating, check for:

1) Excessive mechanical and electrical noise.
2) Overheating.
3) Correct rotation.
4) Proper operation of vibration detectors, resistance temperature detectors, and other motor-inherent protective devices.
5) Excessive vibration, in excess of values in NETA ATS Table 100.10.

3. Perform the following tests:

a. Insulation Resistance Tests:

1) In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.11 for a duration of one minute with resistances tabulated at 30 and 60 seconds.

2) Insulation resistance values shall be equal to, or greater than, ohmic values established by manufacturer.

b. Measure running current and voltage and evaluate relative to load conditions and nameplate full-load amps.

q. Grounding Systems:

1. Inspect for the following:

a. Proper connection and tightness of equipment and circuit grounds in motor control centers, panelboards, and switchgear assemblies.

b. Proper termination and tightness of ground bus connections in motor control centers, panelboards, and switchgear assemblies.

c. Effective core and equipment grounding.

d. Proper fit and tightness of accessible connections to grounding electrodes.

e. Inspect accessible exothermic weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

2. Perform the following tests:

a. Fall-of-Potential Test:
1) In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
2) Record data and provide to Owner's Representative.

b. Two-Point Direct Method Test:
1) In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
2) Record data and provide to Owner's Representative.

c. Neutral Bus Isolation:
1) Test each neutral bus individually with neutral bonding jumper removed at Service Entrance or separately derived system.
2) Evaluate ohmic values by measuring resistance between ground bus and neutral bus.
3) Investigate values less than 50 megaohms.
4) Record data and provide to Owner's Representative.

r. Wire and Cable:

1. Inspections and tests shall be performed after installation and prior to placing cables in service.

2. Inspect for the following:
a. For each individual power conductor No. 6 AWG and larger:
1) Physical damage.
2) Conformance of connections with Drawings.
3) Bends exceeding manufacturer's minimum allowable bending radius.
4) Conformance of color coding and identification with Specifications.

b. Mechanical connections for proper lug type, proper lug installation, and bolt torque level in accordance with NETA ATS, Table 100.12.

c. Proper shield grounding, termination, and identification of shielded instrumentation cables.

d. Proper termination and identification of control cables.

e. Proper termination of neutrals and grounds for power cables terminated through window-type CTs.

3. Perform the following tests for each individual power conductor No. 6 AWG and larger:

a. Insulation Resistance Tests:
1) Apply 1,000-volt dc megohmmeter for 600-volt insulated conductors.
2) Test each conductor from phase-to-phase and phase-to-ground for 15 seconds or until the value stabilizes.
3) Evaluate ohmic values by comparison with conductors of same length and type.
4) Investigate values less than 100 megohms after stabilization.

b. Continuity test by ohmmeter method to ensure proper cable connections.
4. Control wire and instrumentation cable shall be tested for continuity, polarity, undesirable ground, and origination.
5. Cables failing the tests shall be replaced with a new cable or repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

s. Panelboards:

1. Inspect for the following:

a. Defects and physical damage.

b. Labeling and nameplate compliance with requirements of up-to-date Drawings and panelboard schedules.

c. Check panelboard mounting, area clearances, and alignment and fit of components.

d. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

e. Perform visual and mechanical inspection for overcurrent protective devices.

2. Perform the following tests in accordance with the manufacturer's instructions:

a. Exercise and perform operational tests of mechanical components and other operable devices.

b. Insulation Resistance Tests:
1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
2) Each phase of each bus section.
3) Phase-to-phase and phase-to-ground for one minute.
4) With breakers open and with breakers closed.
5) Insulation resistance values shall be equal to, or greater than, ohmic values established by manufacturer.

c. Ground continuity test ground bus to system ground.

t. Molded Case Circuit Breakers:

1. Inspection and testing is limited to circuit breakers with frames rated 100A and larger and to motor circuit protectors rated 50A or larger.

2. Inspect for the following:

a. Proper mounting and cracked casings.

b. Proper conductor size.

c. Proper operation of switch handle for each enclosed breaker intended for use as a disconnecting means.

d. Conformance of service or feeder designation to Contract Documents.

e. Connection bolt torque level in accordance with NETA ATS, Table 100.12.

f. Conformance of frame size and trip setting to Contract Documents.

g. Suitability of terminals for 75 degrees C rated insulated conductors.

3. Perform the following tests:

a. Operate breaker to verify smooth operation.

b. Insulation Resistance Tests:
1) Applied 1,000-volt dc megohmmeter for 480V breakers in accordance with NETA ATS, Table 100.1.
2) Pole-to-pole and pole-to-ground with breaker contacts opened for one minute.
3) Pole-to-pole and pole-to-ground with breaker contacts closed for one minute.
4) Insulation resistance values shall comply with NETA ATS, Table 100.1.

3.6.2 CLEANING

a. Before final acceptance, the electrical Work shall be thoroughly cleaned to the Owner's Representative's satisfaction:

1. Exposed parts shall be thoroughly cleaned of cement, plaster, and other materials.

2. Temporary tags, markers, stickers, etc. shall be removed.

3. Oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped, and cracks and corners scraped out.

4. Touch-up paint shall be applied to scratches on panels, cabinets, luminaires, and poles.

5. Electrical cabinets or enclosures shall be vacuumed.

6. Light fixtures shall be cleaned inside and out.

b. Debris and refuse from cleaning shall be disposed of off the Site.

-- End of Section --

SECTION 26 05 13

MEDIUM-VOLTAGE CABLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B33	(2010; R 2014) Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 400.2	(2013) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE 48	(2009) Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
IEEE 386	(2006) Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
IEEE 400	(2012) Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above
IEEE 1202	(2006) Flame-Propagation Testing of Wire and Cable

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 74/ICEA S-93-639	(2012) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1685	(2000) Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" designation; submittals not having a "O" designation are for information only. When used, a designation following the "O" designation identifies the office that will review the submittal for the OWNER. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit within 60 days after Notice To Proceed:

Medium-Voltage Cable; O

Medium-Voltage Cable Terminations

Ground Conductors; O

Cable Cleats; O

Cable Identification; O

Cable Pulling Calculations; O

Splices; O

SD-05 Design Data

Submit within 90 calendar days of Notice to Proceed.

Cable Pulling Calculations; O

SD-06 Test Reports

Submit three certified copies within 10 days after completion of tests:

Factory Inspection and Tests; O

Insulation Resistance Test; O

High Potential Test; O

Shield Resistance Test; O

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 General

The cables shall be furnished one length to a reel or coil. Each length,

and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Cables for exclusively DC applications shall be identified as such. Reels shall remain the property of the Contractor. Seal ends of cable on reels from moisture with suitable heat-shrinkable caps and mastic compounds. Cables on reels shall be stored in an area reserved for that purpose and protected from damage and weather. Reels shall be stored with the axis hole parallel to the horizontal plane. Cables on reels stored laying flat on the side of the reel will not be accepted. Reels shall be rolled only in the direction indicated by the manufacturer. cables shall be unreeled or uncoiled slowly to prevent damage to the sheath by sudden bending. unreeling or uncoiling shall be stopped if kinks appear and shall not proceed until kinks have been removed. Kinked cable will be rejected. Improperly handled cable may be rejected.

PART 2 PRODUCTS

2.1 MEDIUM-VOLTAGE CABLE

2.1.1 General

All wire and cable shall be provided by the Contractor and shall conform to the requirements specified herein. Characteristics, including conductor size, stranding, number of conductors, rated circuit voltage, cabling, and other requirements for each type of service, shall be as indicated on the drawings, or as specified under the detailed requirements of these specifications for the particular construction or use, unless otherwise stated.

2.1.2 Wire and Cable Schedule

Wire and cable shall be furnished in accordance with the requirements of the Conduit and Cable Schedules, and as indicated on the drawings. Estimated quantities listed in the Conduit and Cable Schedules are approximate for bidding purposes and shall be verified by the Contractor.

2.1.3 Governing Standards

Materials, construction and tests, unless otherwise specified, shall conform to the applicable requirements of NEMA WC 74/ICEA S-93-639 as applicable.

2.2 MATERIALS

2.2.1 Submittal Requirements

The Contractor shall submit catalog data to the OWNER for review and/or approval as indicated in the submittal register. Data shall demonstrate compliance with the specifications requirements for all wire and cable types to be provided.

2.2.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with NEMA WC 74/ICEA S-93-639 as applicable.

2.2.3 Conductors

2.2.3.1 Material for Conductors

Conductors shall conform to all the applicable requirements of Part 2 of Section 2 of NEMA WC 74/ICEA S-93-639 as applicable and shall be annealed copper wire conforming to ASTM B3. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used. Tin-coated copper conductors shall conform to ASTM B33. Conductors shall be stranded as required by subparagraph entitled Stranding.

2.2.3.2 Size

Minimum wire size shall be No. 6 AWG for 5kV cable and and No. 2 AWG for 15kV cable.

2.2.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in Appendix H of NEMA WC 74/ICEA S-93-639 as applicable. All conductors shall have class B stranding.

2.2.4 Insulation

2.2.4.1 Insulation Voltage Rating and Insulation Level

The rated voltage of the insulation shall be 5,000 volts for all circuits operating between 2,000 volts up to 5,000 volts, with 133 percent insulation level, suitable for normal operation at 105 degrees C. The rated voltage of the insulation shall be 15,000 volts for all circuits operating above 5,000 volts, with 133 percent insulation level, suitable for normal operation at 105 degrees C.

2.2.4.2 Insulation Material

Except as otherwise specified, insulation shall be cross-linked thermosetting type (XLPE or XLPO) or an ethylene-propylene rubber (EPR) type meeting the requirements of Section 4.1 of NEMA WC 74/ICEA S-93-639, as applicable. Polyvinyl Chloride (PVC) insulation and thermoplastic type T insulation will not be accepted.

2.2.4.3 Insulation Thickness

The insulation thickness for each conductor shall be based on its rated voltage and insulation material for 133% insulation levels.

a. Single-Conductor Cables Rated over 5kV to 15kV - The insulation thickness for single-conductor cables rated 5kV to 15kV shall be as required NEMA WC 74/ICEA S-93-639 Section 4, minimum 220 mils.

b. Multiple-Conductor Cables Cables Rated 5kV to 15kV - The insulation thickness of the individual conductors of multiconductor cables cables rated 5kV to 15kV shall be as required by NEMA WC 74/ICEA S-93-639 Section 4, minimum 220 mils.

2.2.4.4 Insulation Shielding

Shielding shall be provided for all cables rated 5kV and higher. Shielding for all cables rated 5kV and higher shall conform to the

requirements of Sections 5 and 6 of NEMA WC 74/ICEA S-93-639.

2.2.5 Jackets

All cables shall have jackets meeting the requirements of Section 7.1 of NEMA WC 74/ICEA S-93-639 as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.2.5.1 Jacket Material

The jacket shall be one of the materials listed below, in accordance with the applicable paragraphs of Section 7 of NEMA WC 74/ICEA S-93-639. Polyvinyl chloride compounds will not be permitted. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. Heavy-duty black neoprene (CR-HD).

b. Heavy-duty chlorosulfonated polyethylene (CSPE-HD).

c. Heavy-duty chlorinated polyethylene (CPE-HD).

d. Low smoke zero halogen (LSZH).

e. Crosslinked polyolefin (XLPO).

2.2.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below:

a. Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by the tables in Section 7 of NEMA WC 74/ICEA S-93-639 as applicable, and shall be in addition to the conductor insulation thickness for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by Section 7 of NEMA WC 74/ICEA S-93-639 as applicable.

b. Single conductor cables shall have a jacket thickness as required by the tables in Section 7 of NEMA WC 74/ICEA S-93-639 as applicable.

2.2.6 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to Section 8 of NEMA WC 74/ICEA S-93-639 as applicable, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of

multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.2.7 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.3 SPECIAL WIRE AND CABLE

2.3.1 Ground Conductors

Ground conductors shall be bare, soft-drawn, Class A or B stranded copper cables sized in accordance with NFPA 70, or NEMA WC 74/ICEA S-93-639 Section 8 as applicable.

2.3.2 Jumper Cables

Unshielded jumper cables may be used only for internal direct connection of bus to surge protection devices within a circuit breaker enclosure or transformer enclosure. Cables listed as Jumper Cable with the appropriate voltage rating may be used. Cables listed as Welding Cable will not be accepted.

2.4 MEDIUM-VOLTAGE CABLE TERMINATIONS

2.4.1 General

Medium-voltage cable terminations shall meet IEEE 48 requirements for Class 1A, rated 15kV. Terminations shall utilize stress cones with long barrel, NEMA two-hole or four-hole compression-type terminals approved for connection to copper conductors. The shield and shield insulating jacket of shielded cables shall be maintained to a point as close to the terminals as possible. The shield insulating jacket shall not be stripped from the shield except where necessary to make the ground connection. All cable shields shall be grounded at one end only unless otherwise indicated. Grounding shall comply with Section 26 05 26, GROUNDING.

2.4.2 Cold-Shrink Type

Terminator shall be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber or similar material resistant to atmospheric contamination, ultra violet rays, and oxidative decomposition. Termination shall not require heat or flame for installation. Termination kit shall contain all necessary materials, except lugs may be separate.

2.4.3 Heat-Shrinkable Type

Terminator shall consist of a uniform cross-section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is non-tracking, and is resistant to atmospheric

contamination, ultra violet rays, and oxidative decomposition. Skirts or sheds shall be heat-shrinkable and of the same material. Termination kit shall contain all necessary materials, except lugs may be separate.

2.4.4 Load Break and Nonload Break Types

Load-break and nonload-break terminations shall meet IEEE 386 requirements.

2.5 INSPECTION AND TESTS

2.5.1 General

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer. Testing in general shall comply with Section 9 of NEMA WC 74/ICEA S-93-639 as applicable. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below. In addition to the manufacturer's routine sample testing, each reel provided must have passed an insulation resistance test and a shield continuity test. No wire or cable may be shipped until after the manufacturer's test reports have been submitted and approved.

2.5.2 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE 1202 flame tests (formerly under IEEE 383) or UL 1685 flame tests. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of Section 10.6 of NEMA WC 74/ICEA S-93-639 as applicable. If such tests, however, have previously been made on identical cables, these tests need not be repeated.

2.5.3 Independent Tests

The OWNER may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or DC high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

3.1.1 General

For the purposes of this contract, the term "internal cabling" shall be used to designate the Contractor's factory installed cable furnished with the furnished equipment, and the term "external cabling" shall be used to designate field installed cable. Schedules of external cable are as shown in the drawings, showing information on cable numbers, sizes and estimated lengths, number of conductors, the function, and origins and terminations. Although estimated cable lengths are shown on the schedule for bidding purposes, the Contractor shall be responsible for determining the actual cable length required to make an installation of all new cables without splices. Different voltages shall not be run within the same

multiconductor cable. The Contractor shall submit the manufacturer's installation instructions.

3.1.2 External Cabling

All external cable shall conform to paragraph MEDIUM-VOLTAGE CABLE. All cable shall be installed in accordance with NFPA 70 requirements. All necessary materials, tools and equipment required for proper handling and installation of wire and cable in conduits, cable trays, and elsewhere shall be furnished by the Contractor. Each cable shall be connected to the associated equipment at both ends, and new cable shall be continuous and without splices between the equipment termination points. Cables left unterminated for future termination by others shall have both exposed ends enclosed by a heat-shrink insulating boot of the same voltage rating as the cable and of a material compatible with the cable jacket material. Any cable damaged during installation shall be removed and replaced. Installation of cable shall include installation of all supporting devices and all terminations required to complete the circuits as required.

3.1.3 Phasing

All terminal connections for power cables and conductors shall be made in such manner that the phasing will be as marked on the equipment, or indicated on the approved shop drawings. The Contractor shall verify phasing on existing wiring before disconnecting and removing. The Contractor is also responsible for verifying that the phasing on new wiring is the same rotation as presently existing wiring. Normal phasing for existing equipment is A-B-C from left to right, from top to bottom and from front to back when facing the front of the equipment but contractor to verify. After cables have been terminated and the connection torqued, insulate all exposed parts to the cable's voltage rating.

3.1.4 Cable Pulling Requirements

Cable shall be pulled in a manner which will preclude damage to the conductor, insulation or jacket. Cable shall be pulled by the conductor and not solely by the insulation, jacket, or sheath. Pulling tension shall not exceed the manufacturer's recommended maximum. Strain gages shall be used when pulling cable if any kind of mechanical pulling device is required for installation. Caution should be used to avoid exceeding the side wall rating of the cable. Any cable or conductor damaged during installation shall be removed and replaced with equivalent cable or conductor. Installation of cable shall include installation of all supporting devices and all terminations and identifications required to complete the circuits as shown on the drawings and as required.

3.1.4.1 Cable Pulling Calculations

Cable pulling calculations shall be performed by a qualified engineer. The calculations shall show that the cable manufacturer's maximum allowed pulling force and maximum allowed sidewall pressure will not be exceeded, and that cables may be installed without splices. If the calculations show that a splice is required at any point to avoid damage to the cable, this shall be immediately brought to the attention of the OWNER.

3.1.5 Installation in Conduit

Cable shall not be pulled into conduit runs until the conduit has been checked and determined to be clean and dry by pulling a clean, dry, tight

fitting rag through each run. Only approved lubricants may be used to facilitate pulling of conductors.

3.1.6 Installation in Cable Trays

Cable pulling sheaves of adequate size shall be used where necessary to prevent damage to the cable. Cables shall be placed straight and parallel in the trays in a flat spaced arrangement. There shall be minimum crossing of cables in trays. Cables shall be secured to the tray with cable cleats designed for short circuit withstand bracing and installed at the manufacturer's recommended spacing. Identification markers shall be installed at intervals not to exceed 18 feet. After all work in the area containing new cables is complete, the trays shall be thoroughly cleaned of all dirt and trash generated by the new cable installation. Cable moved in the cleaning process shall be repositioned and final cable positions in the trays checked and corrected if necessary.

3.1.7 Bends

The minimum radius to which an insulated conductor or a multiconductor cable may be bent, without specific approval, whether permanently or temporarily during installation, shall be 12 times the overall diameter of the completed cable for tape shielded cables and 10 times the overall diameter for other cables. For multiconductor cable, follow manufacturer's recommendation for type of cable involved.

3.1.8 Cable Cleats

Cleats shall be provided for securing cables in cable tray. Cleats for supporting the weight of cables installed in vertical wireways shall be as required per NFPA 70 for adequate support. The size of each clamp shall be in accordance with the manufacturer's recommendations for each diameter and weight of cable to be secured or supported.

3.1.9 Splices

Splices will be permitted only with written approval from the OWNER, and only if the Contractor can verify the need for a splice based on cable pulling calculations. All splices shall be made in accessible cabinets, boxes or outlets. No splices will be allowed inside conduits. Splices shall be made with solderless compression connectors and either a heat shrink or a cold shrink splice kit rated at 133 percent insulation installed per manufacturer's instructions.

3.1.10 Terminations

All cable shields shall be grounded at one end only unless otherwise indicated. Heat shrink, cold shrink or tape type stress cone terminating and splice kits shall be installed in accordance with the cable manufacturer's recommendations and as approved. Installation of the stress cone terminations shall be as described in the kit instructions, except the taping of conductor terminals shall be extended over the terminal fitting and the terminal of the device to which the conductor is attached.

3.1.11 Cable Identification

All cables shall be identified on both ends by the designations as shown on the Contract drawings or as otherwise shown on approved shop drawings.

All cables shall be clearly identified with the cable designation by either embossed 1-inch diameter brass tags, by embossed aluminum band markers, by tube-type markers as described in subparagraph Marking, or by 1-inch acrylic tags marked as described in subparagraph Marking. Tags or band markers shall be securely fastened to the cables at each termination, junction or pull box, where cables enter or leave cable trays, and as required at other points of access. Cables and individual conductors of multiconductor cables shall be identified with markers at each termination. Installed markers shall be uniform in position on the cable and legends shall be visible when conductors are terminated at the equipment.

3.1.11.1 Marking

Tubing shall be sized to fit the wire being marked and shall have black marking on a light colored background. Tube-type markers shall be suitable for contact with the type of insulation material used. Tubing shall have permanent black marking on a light-colored background. The markers shall have been tested by an independent testing laboratory or by the manufacturer to indicate that the markers will not stain or discolor when subjected to an accelerated aging test while in contact with wire insulating materials and ultraviolet light exposure.

3.1.12 Ground Conductors

A ground conductor shall be run for all circuits. If not an integral part of a multiple conductor cable, a separate ground conductor shall be provided. Ground conductors shall be installed as continuous pieces of copper cable whenever possible. Exposed ground cable runs shall be supported to follow conduit, equipment or concrete wall contours. Support clamps or clips shall be of corrosion resistant metal and existing equipment bolts or screws shall be used where possible for fastening. Drilling of equipment housings or frames will be permitted only when approved. Concrete anchors shall be used for wall fastening.

3.2 FIELD ACCEPTANCE TESTING

3.2.1 Testing

Testing shall be per IEEE 400 and NETA ATS recommended procedures.

a. Submit Test Reports in accordance with referenced standards in this section.

b. After completion of the installation and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified.

c. Contractor must provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

d. Field Acceptance Testing and submittals shall be performed as described herein.

e. Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices must be used to isolate the circuits under test.

f. Suitable records shall be kept of all tests, indicating the insulation-resistance tests, high voltage tests, continuity tests, phase rotation tests high potential tests, and conductor identification markings. A duplicate record of all tests shall be furnished to the OWNER. Prior to testing, the wire and cable test record form shall be submitted for approval. Test reports shall provide room for the OWNER's signature. After installation, but just prior to terminal connection, each conductor shall be tested as follows:

(1) Perform a Conductor Continuity Test on each wire and each individual conductor of a multiconductor cable to insure correct connections end-to-end.

(2) Perform a Shield Continuity Test on each cable shield.

(3) Perform a Shield Resistance Test on each cable shield. Shield resistance shall be less than 10 ohms per 1000 feet of cable.

(4) Perform an Insulation Resistance Test on each field-installed conductor with respect to ground and adjacent conductors in a cable assembly. Applied potential must be 2500 volts DC for 5kV and 15kV rated cable. Minimum insulation resistance values must not be less than 1000 Megohms for 5kV rated cable, and 5000 Megohms for 15kV rated cable.

(5) Perform High Potential Test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential must be 23kV AC for 5kV rated cable, and 44kV AC for 15kV rated cable. VLF testing may be performed in accordance with IEEE 400.2. The Contractor may perform DC testing only with the approval of the cable manufacturer for 36kV DC for 5kV rated cable, and 64kV DC for 15kV rated cable.

(6) Perform a Phase Rotation Test on all three-phase circuits using a phase-rotation indicating instrument.

(7) Tests shall be witnessed by the OWNER and the wire and cable installation test reports shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.

3.2.2 Acceptance

Final acceptance will depend upon the successful performance of wire and cable under test. Conductor shall not be energized until the final test reports are reviewed and approved by the OWNER.

-- End of Section --

SECTION 26 05 19

INSULATED WIRE AND CABLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B33	(2010; R 2014) Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-100-685	(2016) Thermoplastic Insulated and Jacketed Telecommunications Station Wire For Indoor/Outdoor Use

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1202	(2006) Flame-Propagation Testing of Wire and Cable

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 57/ICEA S-73-532	(2004) Control, Thermocouple Extension, and Instrumentation Cables
NEMA WC 66/ICEA S-116-732	(2013) Category 6 and 6A, 100 Ohm, Individuality Unshielded Twisted Pairs, Indoor Cables (With Or Without An Overall Shield) For Use In Lan Communication Wiring Systems
NEMA WC 70/ICEA S-95-658	(2009) Non-Shielded Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(2014; Reprint Feb 2015) Thermoset-Insulated Wires and Cables
UL 1569	(1999) Metal-Clad Cables
UL 1685	(2000) Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" designation; submittals not having a "O" designation are for information only. When used, a designation following the "O" designation identifies the office that will review the submittal for the OWNER. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit within 60 days after Notice To Proceed:

Insulated Wire and Cable; O

Signal and Communications Cable; O

Cable Supports; O

Control Panel Shop Wiring; O

Switchboard Wire; O

Ground Conductors

Wire Marking

Terminations

Metal-Clad Cable

Ethernet Cable; O

SD-06 Test Reports

Submit three certified copies within 10 days after completion of tests:

Factory Inspection and Tests; O

Insulation Resistance Test; O

Shield Resistance Test; O

Field Acceptance Testing; O

1.3 DELIVERY, STORAGE, AND HANDLING

Wire and cable shall be furnished one length to a reel or coil. Each length, and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Cables for exclusively DC applications shall be identified as such. Reels shall remain the property of the Contractor. Cables on reels shall be stored in an area reserved for that purpose and protected from damage. Reels shall be stored with the axis hole parallel to the horizontal plane. Cables on reels stored laying flat on the side of the reel will not be accepted. Reels shall be rolled only in the direction indicated by the manufacturer. cables shall be unreeled or uncoiled slowly to prevent damage to the sheath by sudden bending. Unreeling or uncoiling shall be stopped if kinks appear and shall not proceed until kinks have been removed. Kinked wire and cable will be rejected. Improperly handled wire and cable may be rejected.

1.4 FACTORY INSPECTION AND TESTS

1.4.1 General

Factory inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer. Testing in general shall comply with Section 6 of NEMA WC 57/ICEA S-73-532 or Section 6 of NEMA WC 70/ICEA S-95-658 as applicable. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below. In addition to the manufacturer's routine sample testing, each reel provided must have passed an insulation resistance test. No wire or cable may be shipped until after the manufacturer's test reports have been submitted and approved.

1.4.2 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE 1202 flame tests (formerly under IEEE 383) or UL 1685 flame tests. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of Section 6.16 of NEMA WC 57/ICEA S-73-532or Section 7.3 of NEMA WC 70/ICEA S-95-658 as applicable. If such tests have previously been performed on identical cables of the same design and is indicated in the product data, these tests need not be repeated.

1.4.3 Independent Tests

The OWNER may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, partial discharge tests, dissipation factor tests, or DC high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

PART 2 PRODUCTS

2.1 INSULATED WIRE AND CABLE

2.1.1 General

All wire and cable shall be provided by the Contractor and shall conform to the requirements specified herein. Characteristics, including conductor size, stranding, number of conductors, rated circuit voltage, cabling, and other requirements for each type of service, shall be as indicated on the drawings, or as specified under the detailed requirements of these specifications for the particular construction or use, unless otherwise stated.

2.1.2 Wire and Cable Schedule

Wire and cable shall be furnished in accordance with the requirements of the Conduit and Cable Schedules, and as indicated on the drawings. Estimated quantities listed in the Conduit and Cable Schedules are approximate for bidding purposes and shall be verified by the Contractor.

2.1.3 Governing Standards

Materials, construction and tests, unless otherwise specified, shall conform to the applicable requirements of NEMA WC 57/ICEA S-73-532 and NEMA WC 70/ICEA S-95-658 as applicable.

2.2 MATERIALS

2.2.1 Submittal Requirements

The Contractor shall submit catalog data to the OWNER for review and/or approval as indicated in the submittal register. Data shall demonstrate compliance with the specifications requirements for all wire and cable types to be provided.

2.2.2 Rated Circuit Voltages

All wire and cable shall have minimum 600 volt rated circuit voltages in accordance with NEMA WC 70/ICEA S-95-658.

2.2.3 Conductors

2.2.3.1 Material for Conductors

Conductors shall conform to all the applicable requirements of Section 2 of NEMA WC 70/ICEA S-95-658 and shall be annealed copper wire conforming to ASTM B3. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used. Tin-coated copper conductors shall conform to ASTM B33. Conductors shall be solid or stranded as required by subparagraph entitled Stranding. Aluminum conductors will not be accepted.

2.2.3.2 Wire Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 12 AWG for potential transformer circuits; No. 14 AWG for relaying, control, and annunciation circuits; and No. 16 AWG for low voltage control circuits.

No. 18 AWG may be submitted as a variance for PLC module interconnection wiring if required by terminal size limitations, but shall not be run outside the PLC enclosure. The submittal shall include the reason for the variance request.

2.2.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in Appendix G of NEMA WC 70/ICEA S-95-658. Conductors No. 10 AWG and smaller shall be solid for 120 volt lighting and receptacles, and for all other uses shall have Class B or Class C stranding as defined in Table 1 of ASTM B8. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall be Class H or K stranding as defined in Appendix G of NEMA WC 70/ICEA S-95-658. All other conductors shall have class B stranding.

2.2.4 Insulation

2.2.4.1 Insulation Voltage Rating and Insulation Level

The rated voltage of the insulation shall be 600 volts for all circuits operating below 600 volts, with 100 percent insulation level unless otherwise specified.

2.2.4.2 Insulation Material

Except as otherwise specified under paragraph SPECIAL WIRE AND CABLE, insulation shall be cross-linked thermosetting polyethylene (XLPE), cross-linked polyolefin (XLPO) type, or an ethylene-propylene rubber (EPR) type, meeting the requirements of Section 3 of NEMA WC 70/ICEA S-95-658. Cables accepted as a variance for No. 18 under paragraph WIRE SIZE may have a non-PVC thermoplastic insulation and shall be UL Listed. Polyvinyl Chloride (PVC) insulation will not be accepted.

2.2.4.3 Insulation Thickness

The insulation thickness for each conductor shall be based on its insulation material.

a. Single-Conductor Cables - The insulation thickness for single-conductor cables shall be as required by NEMA WC 70/ICEA S-95-658 Section 3.3 Tables for Insulation Classes R, X, and E.

b. Multiple-Conductor Control Cables - The insulation thickness of the individual conductors of multiple-conductor (multiconductor) cables shall be as required by NEMA WC 70/ICEA S-95-658 Section 3.3 Tables for Insulation Classes R, X, or E for cables used for power, or NEMA WC 57/ICEA S-73-532 Section 3.3 Tables for insulations XLPE, ER, SR, CSPE, or EP composites for cables used for control and related purposes.

2.2.4.4 Insulation Shielding

Shielding, where specified for control cables, shall conform to the requirements of Section 4.1 of NEMA WC 57/ICEA S-73-532.

2.2.5 Jackets

All cables shall have jackets meeting the requirements of Section 4.2 of NEMA WC 57/ICEA S-73-532 or Section 4.1 of NEMA WC 70/ICEA S-95-658, and as specified herein. Individual insulated conductors listed in UL 44 Table 19 as optional or none for jacket type need not be jacketed. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.2.5.1 Jacket Material

The jacket shall be one of the materials listed below, in accordance with the applicable paragraphs of NEMA WC 70/ICEA S-95-658. Polyvinyl chloride compounds will not be permitted. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

a. Black neoprene (CR).

b. Chlorosulfonated polyethylene (CSPE).

c. Cross-linked (thermoset) chlorinated polyethylene (XL-CPE). CPE thermoplastic may be submitted as a variance if the Contractor can show that excessive lead time for the other specified materials will hinder the construction schedule.

d. Cross-linked polyolefin (XLPO) may be submitted as a variance if the Contractor can show that excessive lead time for the other specified materials will hinder the construction schedule.

Cables accepted as a variance for No. 18 under paragraph WIRE SIZE may have a thermoplastic jacket if it is UL listed and is rated for low smoke and/or zero halogen. PVC jackets will not be accepted.

2.2.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below:

a. Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by Section 4.1 of NEMA WC 70/ICEA S-95-658, and shall be in addition to the conductor insulation thickness for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by Section 4.1 of NEMA WC 70/ICEA S-95-658.

b. Single conductor cables, if nonshielded, shall have a jacket thickness as specified in Section 4.1 of NEMA WC 70/ICEA S-95-658. If shielded, the jacket thickness shall be in accordance with the

requirements of Section 4.1 of NEMA WC 70/ICEA S-95-658.

2.2.6 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to Section 5 of NEMA WC 57/ICEA S-73-532 or Section 5 of NEMA WC 70/ICEA S-95-658 as applicable, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.2.7 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.2.8 Color-Coding

Only one color-code method shall be used for each cable construction type. Colored braids will not be permitted. Control cable color-coding and wire insulation color shall be in accordance with Table E-2 of NEMA WC 57/ICEA S-73-532. Power cable color-coding for 208/120 volt systems shall be black for Phase A, red for Phase B, blue for Phase C, and white for grounded neutral. Color coding for 480/277 volt systems shall be brown for Phase A, orange for Phase B, yellow for Phase C, and gray for grounded neutral. Green shall be used only for grounding conductors if insulated.

2.3 SPECIAL WIRE AND CABLE

2.3.1 Control Panel Shop Wiring

Wiring for factory assembled control panels or factory assemblies of electrical components for miscellaneous equipment shall conform to NEMA WC 57/ICEA S-73-532, and NEMA WC 70/ICEA S-95-658, as applicable. All wire shall be single conductor stranded copper in accordance with Section 2 of NEMA WC 57/ICEA S-73-532. Insulation shall be rated for 600 volts with thickness in accordance with Section 3 of NEMA WC 70/ICEA S-95-658. Conductors shall be Class C stranding, except hinge wire shall be Class D or Class K stranding as defined in Appendix G of NEMA WC 70/ICEA S-95-658. Conductor size shall be No. 16 AWG minimum. The completed installation shall conform to all requirements of NFPA 70.

Type MTW wiring may be accepted as a variance to these requirements only for factory assembled components or internal wiring of governor control panels.

2.3.2 Switchboard Wire

Control wiring provided in the switchboards shall be single conductor 600-volt, Type SIS, or approved equal meeting the requirements of UL 44. Stranding shall be Class K as defined in Appendix G of

NEMA WC 70/ICEA S-95-658.

2.3.3 Signal and Communications Cable

The cable shall conform to the applicable requirements of UL 44 and NEMA WC 57/ICEA S-73-532. Conductors shall be tinned copper conforming to Section 2.3 of NEMA WC 57/ICEA S-73-532 with Class C or Class K stranding as defined in Appendix G of NEMA WC 70/ICEA S-95-658. Minimum conductor size shall be No. 16 AWG. Conductors shall be insulated for 600 volts with a thermoset insulation conforming to NEMA WC 57/ICEA S-73-532 Section 3.3 Tables for insulations XLPE, SR, CSPE, or EP composites. Overall shielding shall be provided by aluminum-Mylar tape to provide 100 percent coverage. A drain wire in continuous contact with the shield shall be provided as described in NEMA WC 57/ICEA S-73-532 Section 4.1 for metal thickness of 0.001 inch or less. Overall shields shall be provided for multiple-shielded pair or triplet cables. A thermoset jacket shall also be provided over shielded pairs or triplets of multiple-grouped cables in accordance with Section 4.2 and Table 4-1 of NEMA WC 57/ICEA S-73-532 for equivalent diameter of single conductor cables. Individual conductors of shielded and jacketed twisted pairs and triplets and jackets over paired or tripled conductors shall be color coded in accordance with Appendix E of NEMA WC 57/ICEA S-73-532. Polyvinyl chlorine (PVC) insulation or jacketing will not be accepted. Individual conductors and cable assemblies shall pass the flame tests described in paragraph FLAME TESTS.

2.3.4 Ground Conductors

Ground conductors shall be bare, soft-drawn, Class A or B stranded copper cables sized in accordance with NFPA 70. Ground conductors size No. 10 and smaller shall be solid. Ground conductors size No. 8 and larger shall be Class A stranded, but may be Class B stranded for sizes #1 and larger.

2.3.5 Metal-Clad Cable

Cables indicated to be armored or metal-clad shall be metal-clad Type MC. Type AC will not be accepted. The use of MC cable is limited to the specific locations shown or otherwise specified. The metallic covering shall be a continuous sheath of interlocked steel strip, interlocked aluminum strip, corrugated copper alloy tube, or corrugated bronze alloy tube conforming to the requirements of NEMA WC 70/ICEA S-95-658 Section 4.3, or UL 1569. Galvanized steel wire armor will not be accepted. Unless indicated otherwise, metal-clad cable shall have insulation as described in paragraph INSULATION, and an outer jacket as described in paragraph JACKETS. Individual conductors and cable assemblies shall pass the flame tests described in paragraph FLAME TESTS.

2.3.6 Ethernet Cable

Ethernet cable shall be unshielded twisted pair (UTP), four-pair 24 AWG solid copper, color-coded wire complying with ICEA S-100-685, plenum-rated (CMP) throughout. Category shall be CAT 6 conforming to NEMA WC 66/ICEA S-116-732. Individual conductor insulation shall be a polyolefin material rated at least 300 volts. PVC insulation will not be accepted. Overall core foil shields are not required, but must be grounded at one end only during installation, if provided as a variance. Cable outer jackets shall comply with NEMA WC 66/ICEA S-116-732 Section 5.1.2 for low halogen materials. PVC jackets will not be accepted.

2.4 TERMINATIONS

Terminals and lugs shall be approved for connection to copper conductors. Long barrel, NEMA two-hole or four-hole compression-type terminals shall be furnished for terminating cables No. 2 AWG and larger.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

3.1.1 General

For the purposes of this contract, the term "internal wiring" shall be used to designate the Contractor's factory installed wiring furnished with the furnished equipment, and the term "external wiring" shall be used to designate field installed wiring. Schedules of external wire and cable are as shown in the drawings, showing information on cable numbers, sizes and estimated lengths, number of conductors, the function, and origins and terminations. Although estimated cable lengths are shown on the schedule for bidding purposes, the Contractor shall be responsible for determining the actual cable length required to make an installation of all new cables without splices. Different voltages shall not be run within the same multiconductor cable. The Contractor shall submit the manufacturer's installation instructions.

3.1.2 External Wiring

All external wire and cable shall conform to paragraph INSULATED WIRE AND CABLE. All wire and cable shall be installed in accordance with NFPA 70 requirements. All necessary materials, tools and equipment required for proper handling and installation of wire and cable in conduits, cable trays, and elsewhere shall be furnished by the Contractor. Except for spares, each wire and cable shall be connected to the associated equipment at both ends, and new cable shall be continuous and without splices between the equipment termination points. Spares shall have exposed ends taped over and labeled as "spare". Any cable damaged during installation shall be removed and replaced. Installation of wire and cable shall include installation of all supporting devices and all terminations required to complete the circuits as required.

3.1.3 Phasing

All terminal connections for power cables and conductors shall be made in such manner that the phasing will be as marked on the equipment, or indicated on the approved shop drawings. The Contractor shall verify phasing on existing wiring before disconnecting and removing. The Contractor is also responsible for verifying that the phasing on new wiring is the same rotation as presently existing wiring. Normal phasing for existing equipment is A-B-C from left to right, from top to bottom and from front to back when facing the front of the equipment but contractor to verify. After cables have been terminated and the connection torqued, insulate all exposed parts to the cable's voltage rating.

3.1.4 Cable Pulling Requirements

Wire and cable shall be pulled in a manner which will preclude damage to the conductor, insulation or jacket. Wire and cable shall be pulled by the conductor and not by the insulation, jacket, or sheath. Pulling

tension shall not exceed the manufacturer's recommended maximum. Strain gages shall be used when pulling cable if any kind of mechanical pulling device is required for installation. Caution should be used to avoid exceeding the side wall rating of the cable. Any cable or conductor damaged during installation shall be removed and replaced with equivalent cable or conductor. Installation of wire and cable shall include installation of all supporting devices and all terminations and identifications required to complete the circuits as shown on the drawings and as required.

3.1.5 Installation in Conduit

Cable shall not be pulled into conduit runs until the conduit has been checked and determined to be clean and dry by pulling a clean, dry, tight fitting rag through each run. Where existing conduits are being reused, the conduit shall be cleaned with a tight-fitting wire brush mandrel. Only approved lubricants may be used to facilitate pulling of conductors.

3.1.6 Installation in Cable Trays

Cable pulling sheaves of adequate size shall be used where necessary to prevent damage to the cable. Cables shall be placed straight and parallel in the trays. There shall be minimum crossing of cables in trays. Cables shall be fastened in the cable tray at intervals not to exceed 6 feet. If two or more single conductors comprising a circuit to and from electrical equipment are routed in a cable tray, they shall be bundled together at intervals not to exceed six feet with approved cable ties. Identification markers shall be installed on each tied bundle at intervals not to exceed 18 feet. After all work in the area containing new cables is complete, the trays shall be thoroughly cleaned of all dirt and trash generated by the new cable installation. Cable moved in the cleaning process shall be repositioned and final cable positions in the trays checked and corrected if necessary.

3.1.7 Bends

The minimum radius to which an insulated conductor or a multiconductor cable may be bent, without specific approval, whether permanently or temporarily during installation, shall be 12 times the overall diameter of the completed cable for tape shielded cables and 10 times the overall diameter for other cables. In these instances where this radius is not possible, approval will be required for minimum radii as specified in NFPA 70. For multiconductor cable, follow manufacturer's recommendation for type of cable involved.

3.1.8 Cable Supports

3.1.8.1 Cable Clamps

Clamps for protecting and supporting the weight of cables installed in vertical wireways shall be as required per NFPA 70 for adequate support. The size of each clamp shall be in accordance with the manufacturer's recommendations for each diameter and weight of cable to be supported or protected.

3.1.8.2 Support Grips

Heavy duty galvanized steel wire mesh support grips must be used to support the weight of cables installed in vertical wireways and cable

shafts for adequate support as required per NFPA 70 Table 300.19(A). Size each support grip in accordance with the manufacturer's recommendations for each diameter and weight of cable to be supported or protected. Closed mesh type support grips must be used except where the dynamics of the cable installation require open mesh, in which case this should be annotated on the submittal.

3.1.9 Splices

Splices will be permitted only with written approval. All splices shall be made in accessible cabinets, boxes or outlets. Splices will not be permitted where a pullbox would eliminate the need for a splice. No splices will be allowed inside conduits.

3.1.10 Terminations

All wire and cable connections shall be made at terminal blocks or lugs using ferrules. The shield and shield insulating jacket of shielded signal cables and conductors, if applicable, shall be maintained to a point as close to the ferrules as possible. The shield insulating jacket shall not be stripped from the shield except where necessary to make the ground connection. All signal cable shields shall be grounded at one end only. Spare conductors shall be terminated on an available unused terminal of a terminal block and labeled as SPARE at both ends, or if left unterminated shall have the exposed ends wrapped in insulating tape and labeled as SPARE at both ends.

3.1.11 Wire Marking

All wires and cables shall be identified on both ends by the designations as shown on the Contract drawings or as otherwise shown on approved shop drawings. All wires and cables shall be clearly identified with the cable designation by either embossed 1-inch diameter brass tags, by embossed aluminum band markers, by tube-type markers as described in subparagraph Marking, or by 1-inch phenolic tags marked as described in subparagraph Marking. Tags or band markers shall be securely fastened to the cables at each termination, junction or pull box, where cables enter or leave cable trays, and as required at other points of access. Wires, cables and individual conductors of multiconductor cables shall be identified with markers at each termination. Installed markers shall be uniform in position on the wire and cable, and legends shall be visible when conductors are terminated at the equipment.

3.1.11.1 Marking

Tubing shall be sized to fit the wire being marked and shall have black marking on a light colored background. Tube-type markers shall be suitable for contact with the type of insulation material used. Tubing shall have permanent black marking on a light-colored background. The markers shall have been tested by an independent testing laboratory or by the manufacturer to indicate that the markers will not stain or discolor when subjected to an accelerated aging test while in contact with wire insulating materials and ultraviolet light exposure.

3.1.12 Ground Conductors

A ground conductor shall be run for all circuits. If not an integral part of a multiple conductor cable, a separate ground conductor shall be provided. Ground conductors shall be installed as continuous pieces of

copper cable whenever possible. Exposed ground cable runs shall be supported to follow conduit, equipment or concrete wall contours. Support clamps or clips shall be of corrosion resistant metal and existing equipment bolts or screws shall be used where possible for fastening. Drilling of equipment housings or frames will be permitted only when approved. Concrete anchors shall be used for wall fastening.

3.2 FIELD ACCEPTANCE TESTING

3.2.1 Testing

Testing shall be per NETA ATS recommended procedures.

a. Submit Test Reports in accordance with referenced standards in this section.

b. After completion of the installation and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

c. Contractor must provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

d. Field Acceptance Testing and submittals shall be performed as described herein. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs must be approved by the OWNER Quality Assurance Representative (GQAR) prior to acceptance of the repair.

e. Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices must be used to isolate the circuits under test.

f. Suitable records shall be kept of all tests, indicating the insulation-resistance tests, high voltage tests, continuity tests, and conductor identification markings. A duplicate record of all tests shall be furnished to the OWNER. Prior to testing, the wire and cable test record form shall be submitted for approval. Test reports shall provide room for the OWNER's signature. After installation, but just prior to terminal connection, each conductor shall be tested as follows:

(1) Perform a Conductor Continuity Test on each wire and each individual conductor of a multiconductor cable to insure correct connections end-to-end.

(2) Perform a Shield Continuity Test on each cable shield.

(3) Perform a Shield Resistance Test on each cable shield. Shield resistance shall be less than 10 ohms per 1000 feet of cable.

(4) Perform an Insulation Resistance Test on each field-installed conductor with respect to ground, with adjacent conductors grounded. Applied potential must be 1000 volts DC. Take readings after 1 minute and until the reading is constant for 15 seconds.

Minimum insulation-resistance values must not be less than 100 Megohms.

(5) Tests shall be witnessed by the OWNER and the wire and cable installation test reports shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.

3.2.2 Acceptance

Final acceptance will depend upon the successful performance of wire and cable under test. Conductor shall not be energized until the final test reports are reviewed and approved by the OWNER.

-- End of Section --

SECTION 26 05 26

GROUNDING AND GROUND TESTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NETA ATS	(2017) Standard for Acceptance Testing Testing Specifications for Electrical Power Equipment and Systems

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B187/B187M	(2016) Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 80	(2013) Guide for Safety in AC Substation Grounding
IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 837	(2014) Standard for Qualifying Permanent Connections Used in Substation Grounding
IEEE C2	(2017) National Electrical Safety Code

International Electrotechnical Commission (IEC)

IEC 62561-7	(2018) Lightning Protection System Components (LPSC) - Part 7: Requirements for Earthing Enhancing Compounds

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467 (2013; Rev thru 2017) Grounding and Bonding Equipment

1.2 SUBMITTALS

OWNER approval is required for submittals with a "O" designation; submittals not having a "O" designation are for information only. When used, a designation following the "O" designation identifies the office that will review the submittal for the OWNER. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's descriptive data shall include catalog cuts, literature, and other data as necessary to describe details of construction, methods of installation or mounting, and input/output interface characteristics which verify conformance with specifications. Where a catalog sheet covers more than one size or type of equipment, the specific item contemplated shall be identified in the catalog sheet by underlining or other suitable means. Items not applicable shall be marked out. Submit within 30 days of Notice To Proceed:

Ground Conductors; O

Ground Connections; O

Ground Bus; O

Ground Inserts; O

Ground Rods; O

Ground Enhancement Material; O

Switch Operating Platforms; O

Wire Mesh Ground Mat; O

Antioxidant Compounds; O

SD-06 Test Reports

Submit within 10 days after completion of tests:

Switchyard Ground Resistance Measurement

Five certified copies of test reports shall be submitted by the Contractor.

SD-07 Certificates

Submit not less than 10 days prior to grounding system testing:

a. Submit the testing organization's qualifications, name, and contact information. The organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and

systems for a minimum of five years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with ANSI/NETA ATS.

b. Submit the Grounding Test Technician's qualifications, name, and resume. Include a list of three comparable grounding system testing jobs performed by the technician with specific names and contact information for reference. The technician shall be certified by NETA with a minimum of 5 years' experience inspecting and testing electrical systems and devices.

1.3 GENERAL REQUIREMENTS

Unless otherwise indicated, the materials and equipment to be furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such items and shall be the manufacturer's latest standard marketed design.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 GROUND CONDUCTORS

Ground conductors shall be soft-drawn copper conforming to ASTM B3, with Class B stranding as defined in Table 1 of ASTM B8. Ground conductors size #6 AWG and larger shall be Class A stranded, but may be Class B stranded for sizes #1 and larger. Ground conductors size #10 AWG and smaller shall be solid for lighting, receptacles and power branch circuits. Copper braid may be used only for connection to moving parts of equipment or where the flexibility necessary to make a connection cannot be provided by conventional conductor; in such cases, the braid shall be rated for the same or greater current of the equivalent required conventional conductor, and the connectors used shall be designed for bonding braided conductor.

2.2 GROUND CONNECTIONS

All outdoor and below grade connections and taps shall be an exothermic weld type or an irreversible type using high compression crimps designed for grounding, meeting IEEE 837 requirements. All exposed connections and taps shall utilize UL 467 approved pressure type connectors.

2.3 GROUND BUS

Ground bus shall be 1/4-inch copper bar meeting ASTM B187/B187M requirements. Minimum width of 2 inches and minimum length 12 inches or as otherwise indicated in the drawings. Bus installation shall be complete with 600 volt rated standoff insulators and stainless steel mounting brackets. Holes shall be tapped in standard NEMA sizes and configurations for connection of ground lead terminals.

2.4 GROUND INSERTS

Ground inserts shall be ground plates of high strength, high-conductivity

cast copper alloy featuring threaded bolt holes suitable for NEMA terminal connections sized #2AWG - 500kcmil, with provision for an irreversible high compression crimp connection to a similarly sized ground conductor, similar to BURNDY YGF series.

2.5 GROUND RODS

Ground rods shall be minimum 10 foot length, 3/4 inch diameter, copper clad steel conforming to UL 467.

2.6 WIRE MESH GROUND MAT

Where wire mesh ground mat is indicated to be used, the mat fabric shall be a prefabricated wire mesh that is a standard product designed specifically for grounding by Burndy, Erico, Harger, or others as approved. The mesh material shall be solid #6 AWG copper-clad steel wire. Mesh spacing shall be 6-inch by 6-inch maximum. All crossovers shall have been brazed with a silver alloy and non-corrosive flux.

2.7 GROUND ENHANCEMENT MATERIAL

Ground enhancement material shall be a granular cementitious material having a resistivity of 2 ohm-cm or less and designed for the purpose of reducing grounding system resistivity, meeting IEC 62561-7 requirements.

2.8 SWITCH OPERATING PLATFORMS

Switch operating platforms shall be provided at high-voltage disconnect switch operators as shown on the drawings, 4' x 4' minimum dimensions using 2-foot wide strips of serrated galvanized steel grating, groove welded together. Grating shall be 1 1/2-inch by 3/16-inch bars spaced 1 3/16 inches apart, with twisted cross rods spaced 4" apart. Platforms shall have insulators fitted in each corner having a maximum height of 5 inches and a minimum cantilever strength of 575 lbs, mounted on 6-inch by 6-inch footer plates of 1/4-inch galvanized steel. Provide a grounding terminal connection welded to the forward edge of the platform and as close to the switch operating pipe as practicable, tapped for a #4/0 ground terminal.

2.9 ANTIOXIDANT COMPOUNDS

Antioxidant compounds must be designed for electrical connections between copper and aluminum, or other dissimilar metals. For copper to steel connections, the compound must be composed of copper flake, bronze flake, and nickel or zinc flake, and must be labeled by the manufacturer for steel to copper connections. Copper to aluminum compound connections must not be used for copper to steel connections and vice versa.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 General Requirements

The ground system shall comply with Article 250 of NFPA 70, paragraph 123 of IEEE C2, the drawings, and the following specifications.

3.1.2 Equipment Installation

All equipment being installed shall have a bare equipment grounding conductor, sized in accordance with NFPA 70, or larger if shown on the drawings, connected to the switchyard ground grid and the powerhouse ground grid. Where such connection to the powerhouse grid or a ground bus is not available at the equipment, a properly sized bare or green insulated copper equipment grounding conductor shall be run with the feeder conductors. All branch circuits from lighting panelboards shall have the equipment grounding conductor run with the branch circuit conductors regardless of the grounded continuity of the conduit system. All conduits whether exposed, buried, or embedded shall be terminated with grounding bushings and grounded.

3.1.3 Cleaning of Surfaces to be Bonded

Thoroughly clean surfaces that comprise the bond before joining. Apply an appropriate abrasive with gentle and uniform pressure to ensure a smooth and uniform surface. Then clean bare metal with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, oxidation, and other contaminants. Bond to the cleaned area within one hour after cleaning. Apply an approved antioxidant compound to both contact surfaces as recommended by the antioxidant manufacturer where connecting dissimilar metals and where connections are exposed to weather.

3.2 GROUND CONDUCTORS

3.2.1 General Requirements

Equipment grounding conductors for switchgear, 480 volt panelboards, and motor control centers, and the grounding conductor for separately-derived systems such as transformers and diesel engine-generators, are to be connected to the nearest point of attachment to the powerhouse grounding system at a ground insert or a ground bus. If such connection point is not available, the equipment grounding conductor shall be run back to the source's ground bus or as indicated on the drawings. Provide equipment grounding bars in all panelboards. Cable tray must have a continuous ground conductor run with the tray and bonded to an existing cable tray ground where the tray connects to existing tray, or to a grounding point inside the powerhouse. Bond or join together all equipment grounding conductors, including metallic raceway systems used as such, in each wiring box or equipment enclosure. Check metallic raceways and grounding conductors to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, must also be bonded to these grounding conductors by an approved means per NFPA 70. When boxes for receptacles, switches, or other utilization devices are installed, any designated grounding terminal on these devices must also be bonded to the equipment grounding conductor junction with a short jumper.

3.2.2 Minimum Ground Conductor Sizes

Minimum sizes of ground conductors and ground leads areas indicated on the drawings.

3.3 GROUNDING CONNECTIONS

All equipment shall be grounded as shown on the drawings and as required by NFPA 70 unless indicated otherwise. Switchyard equipment grounding connections below grade shall be exothermic weld type or an irreversible

type using high compression crimps designed for grounding. For exposed connections other than at the equipment terminals, the connection shall use UL 467 approved connectors of the irreversible high compression crimp type unless exothermic is indicated on the drawings. Powerhouse equipment grounding connections shall use UL 467 approved connectors, irreversible high compression crimp type if outdoors. Solder type connectors will not be permitted. Where two hold ground connections are provided on equipment, two hole lugs shall be used.

3.4 GROUND INSERT INSTALLATION

Chip out concrete around the existing embedded ground conductor to expose the existing lead and connect the new ground insert to the exposed lead. Patch concrete around the ground insert with nonshrink grout and paint to match existing finish.

3.5 WIRE MESH GROUND MAT INSTALLATION

Wire Mesh Ground Mat fabric may be used only where indicated on the drawings, or for remedial grounding if required to reduce step potential to acceptable test levels where additional ground rods and/or large grid conductors are not feasible. Wherever wire mesh ground mat is used, all separate pieces of mesh shall be overlapped and bonded together as recommended by the mesh manufacturer, and the mesh shall be bonded to the grounding grid on at least two opposing sides. If jumpers are required for bonding the mesh to the grid, the jumpers shall be minimum #4/0 AWG and limited to 10 feet in length; otherwise, the mesh shall be extended to reduce the jumper length as required. Bonding of mesh to grid conductor or jumper shall be exothermic welds or irreversible high compression crimp type suitable for joining the differing sizes of conductor. For remedial grounding, the mesh fabric may be installed on earth grade but shall be given a 3-inch top cover of matching soil prior to installing or reinstalling the gravel cover.

3.6 SWITCH OPERATING PLATFORM GROUNDING

A minimum #4/0 AWG ground lead shall connect the switch operating platform platform to the switch operating mechanism ONLY, and shall not connect directly to a local grounding grid point. The switch operating mechanism ground lead shall connect to the nearest local grounding grid point.

3.7 SWITCHYARD GROUND GRID MODIFICATION

3.7.1 Conductors

Grounding grid conductors in the switchyard are shown on contract drawing H02-D-53-0181-R01 and reference drawing H02-D-53-5001-R52. Locations are approximate. Grid conductors are approximately 34 inches below earth grade and are likely to be disturbed by excavation. Field verify locations of grid conductors during site work. Excavation near grid conductors shall be by hand. Conductors damaged during excavation shall be repaired by jumpering across the break with matching size conductor and exothermic welds or irreversible compression crimp connectors, and rerouted around the disturbance if required for equipment installation.

3.7.2 Backfill And Compaction

Backfill shall match existing. Finished backfill level shall match existing after compaction. Gravel cover shall match existing.

3.7.3 Extension of Switchyard Fence Grounding

Direct-bury a bare copper grounding conductor around the outside perimeter of the extended fence line, at least 36 inches from the fence, forming an extension of the fence ground loop, sized to match existing. Connect the loop extension to the existing loop at both ends of the extension. Bond a radial array of bare copper grounding conductors from the outermost ground grid extension conductor from inside the fence line to the fence ground loop, at 10-foot intervals, sized to match existing. Bond fence components to the fence ground loop with bare #4 AWG copper bonding jumpers. Extend the gravel cover to 36 inches beyond the extended fence line.

3.7.4 Work Sequencing

Coordinate installation of the grounding system with the excavation required for installing transformer pads wherever an oil containment system is specified for the transformer. Any part of the grounding system that would be located beneath the oil containment fabric must be installed and inspected prior to installation of the oil containment fabric.

3.8 SWITCHYARD GROUND RESISTANCE MEASUREMENT

3.8.1 Basic Measurement Requirements

Ground resistance test, step potential tests, and touch potential tests shall be performed by a certified Grounding test Technician. Submit the Grounding Test Technician's Qualifications and the Testing Organization's Qualifications for approval. Test results shall be reported to the OWNER to verify the performance of the finished grounding system and to serve as a baseline for possible future improvements and measurements. The test shall be the fall of potential method described in paragraph 19.1.5 of IEEE 80 and paragraphs 6.5 and 8.2.2.4 of IEEE 81, or as otherwise recommended by ANSI/NETA ATS paragraph 7.13. The test report shall include a sketch of the switchyard showing locations of test electrodes, a compilation of the readings, and graphical results of the readings as described in IEEE 81 figures 6 and 7 to substantiate the determination of the switchyard ground resistance.

3.8.2 Execution of Ground Resistance Test

Unless recommended otherwise by the Grounding test Technician, the current probe shall be placed on one side of the switchyard. A minimum of twelve readings with the potential probe shall be taken on the opposite side of the switchyard. The potential probe reading locations shall be spaced equidistant from each other. The furthest shall be at least 500 feet from the ground test electrode and the closest shall be not less than within 30 feet of the switchyard fence line. The ground test electrode shall be an existing node (a ground rod or an exothermic cross-connection of ground mat conductors) of the switchyard ground mat centrally located and excavated by hand to expose the node for test connection, or insertion of a test probe into the soil adjacent to the node. Avoid having to damage any existing oil containment fabric to make the necessary connection if near a transformer. The current probe shall have a maximum resistance of 500 ohms. Test voltage shall be 100 volts maximum. If that is not achievable on the day of testing, water shall be poured around the ground test electrode until the test may be performed with a maximum of 100 volts. Safety precautions described in IEEE 81 paragraph 5.1 shall be

followed.

3.8.3 Additional Measurement and Observational Requirements

Electrical tests and visual inspections of all bolted connections shall be performed as listed in ANSI/NETA ATS paragraph 7.13. Step potential throughout the fenced-in area shall be verified. Touch potentials throughout the fenced-in area shall be verified with the steel supporting structures, the fence, and the electrical equipment.

3.8.4 Reporting Requirements

The switchyard grounding system resistance calculated from the results of the Basic Measurement Requirements shall be documented in a report, with the calculations and measurement results attached. The report shall include a marked up copy of the Contractor's sketch of the switchyard layout with dimensions showing test probe locations, a compilation of the readings, and graphical results of the readings. Step and touch potentials deemed hazardous by the shall be indicated on the sketch.

3.8.5 Remedial Grounding

As described in IEEE 80 and ANSI/NETA ATS, a measured ground resistance at the test electrode of 0.5 ohms is the maximum acceptable value. In the event the measured ground resistance at the test electrode exceeds this value, and/or if step and touch potentials exceed safe levels as recommended by the Grounding Test Technician for the conditions in the switchyard, the OWNER may elect to authorize additional compensated work by exercising Optional Materials and Labor to install remedial grounding as directed and to repeat the ground resistance test and update the test report accordingly.

-- End of Section --

SECTION 26 05 36

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This specification includes the design, fabrication, assembly, installation and grounding of cable tray systems for Tyee Lake Powerhouse.

The cable tray system shall be designed by the Contractor. Contractor-design of the cable tray system shall comply with IEEE 422 paragraph 9.3 and with NEMA VE 1. Design load shall include a safety factor of 1.5 per NEMA VE 1.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A1008/A1008M	(2024) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A1011/A1011M	(2015) Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 422	(2012) Guide for the Design of Cable Raceway Systems for Electric Generating Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA VE 1	(2017) Metal Cable Tray Systems
NEMA VE 2	(2013; ERTA 2016) Cable Tray Installation

Guidelines

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 2020 National Electrical Code

1.3 SUBMITTALS

OWNER approval is required for submittals with a "O" designation. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit within 60 days after Notice To Proceed:

Cable Tray Installation Plan; O

SD-02 Shop Drawings

Submit within 60 days after Notice To Proceed:

Fabrication And Assembly Drawings; O

Installation Drawings; O

SD-03 Product Data

Submit within 60 days after Notice To Proceed:

Cable Tray Components; O

Hangers and Supports; O

Cable Tray Accessories

SD-05 Design Data

Submit within 60 days after Notice To Proceed:

Cable Tray Fill Calculations; O

Cleat Manufacturer's Spacing Calculations; O

SD-08 Manufacturer's Instructions

Submit within 60 days after Notice To Proceed:

Manufacturer's Instructions; O

1.4 DRAWINGS

Installation drawings and Fabrication And Assembly Drawings shall be submitted for approval. Drawings shall be coordinated with all other work in the immediate area that could come in conflict with the installation. Drawings shall include layout of cable tray work, including details of both horizontal and vertical supports. Both horizontal and vertical supports shall be as specified in paragraph SUPPORTS.

1.5 QUALIFICATIONS

Manufacturer shall have a minimum of 5 years documented experience specializing in the manufacturing of products specified in this section.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Delivery

Cable trays shall be bundled for shipment to prevent movement or damage during shipment. Accessories and small components shall be boxed and placed on a pallet. Fork extensions shall be used to off load skidded cable trays bundles from trailers. Cable trays shall not be off loaded by attaching a chain or rope to the bottom rung and dragging out of the trailer. Upon receipt, inspect the cable trays for shipping damage. Damaged cable trays shall not be repaired. Return all damaged cable trays to the manufacturer.

1.6.2 Storage

Cable trays stored outside shall be loosely stacked, elevated of the ground and covered to prevent staining or damaging the cable trays. Cable trays shall be stored away from high traffic areas.

1.6.3 Handling

Cable trays shall be handled to prevent damage. If lifting cable trays with a crane, ensure that the sling is properly located to prevent damage.

PART 2 PRODUCTS

2.1 CABLE TRAY COMPONENTS

All cable tray segments and components used in the cable tray system shall conform to the applicable requirements of NEMA VE 1.

2.1.1 Material

Side rails, covers, splice plates, and rungs shall be made from structural quality steel meeting the minimum mechanical properties of ASTM A1011/A1011M Grade 33 for 14 gauge and heavier, or ASTM A1008/A1008M, Grade 33 Type 2 for 16 gauge and lighter.

2.1.2 Finish

Steel cable tray components and fittings shall be hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

2.1.3 Cable Tray Sections and Fittings

Cable trays shall be ladder type that meets the following requirements:

a. Tray Width shall be 24 inches wide.

b. Minimum Fill Depth shall be 3 inches.

c. Outside depth shall not exceed the inside depths by more than 1-1/4 inch.

d. Cable tray rated load for straight spans and fittings shall be suitable for at least 75 lb./ft. as described in NEMA VE 1 Annex B. Rated span/load shall be marked on each straight span and fitting.

e. Ladder type tray shall have maximum 9-inch rung spacing.

2.2 CABLE TRAY ACCESSORIES

2.2.1 Splice Plates and Expansion Joints

Splice plates and expansion joints shall be pre-drilled and compatible with the cable tray system. Splice plates and expansion joints shall have the same finish as the cable trays. Expansion plates shall allow for a minimum of 1 inch of expansion or contraction of the cable tray.

2.2.2 Cable Tray Grounding Conductor Clamp

Cable tray grounding conductor clamps be of malleable iron and shall be specifically designed for use with cable trays. Clamps shall be sized for the grounding conductor used. Clamps shall have separate fasteners/set screws for securing the clamp to the tray and for securing the grounding conductor to the clamp.

2.2.3 Cable Tray Conduit Clamp

Cable tray conduit clamps shall have a cast iron body with a steel hook. They shall be sized to match the conduit size. Clamps shall have independent means for securing the clamp to the cable tray and for securing the conduit to the clamp. Clamps shall be designed to bond the conduit to the cable tray. Metal conduit straps shall not be used for this purpose.

2.2.4 Barrier Strip

Barrier strips shall be solid and compatible with the cable tray system. The barrier shall have the same loading depth and finish as the cable tray.

2.2.5 Cable Cleats

Cable cleats shall be single cable type, rated to resist the electromechanical forces from a minimum 10 kA peak fault. Cleat spacing shall be determined by the cleat manufacturer. Cable cleats shall be sized for the cable size and configuration. The mounting bracket shall be compatible with the cable tray.

2.2.6 Cable Tray Dropouts

Cable tray dropouts shall span the entire width of the cable tray rung and provide a smooth surface for dropping cables out of the cable tray. The dropout shall have a minimum radius of 4 inches.

2.2.7 Cable Tray Covers

Cable tray covers shall be sheet steel, hot-dip galvanized after fabrication, flange attachment, complete with clamps. Top covers shall have a 2 to 3 pitch peak.

2.3 HANGERS AND SUPPORTS

a. Supports shall be fabricated from minimum 12 gauge steel channel, 1-5/8 by 1-5/8 inches, with a continuous 7/8-inch wide slot, hot-dip galvanized after fabrication. Supports shall provide at least 1-1/8 inch bearing length for each rail and shall have provision for tray hold-down clamps and fasteners. Neither cable tray nor supports shall be attached to the new or existing equipment. Supports must provide at least 1-1/8 inch bearing length for each rail and have provision for tray hold-down clamps and fasteners.

b. Existing supports may be re-used as indicated on the drawings to the extent practicable.

PART 3 EXECUTION

3.1 GENERAL

a. Cable tray installation shall comply with NEMA VE 2 guidelines.

b. All equipment surrounding the cable tray installation shall be protected from damage. Existing equipment, pipes, cable trays, etc., shall not be used to support the cable trays during installation.

3.2 INSTALLATION

3.2.1 General

A Cable Tray Installation Plan shall be submitted prior to commencing any work. The plan should detail the sequencing, scheduling, outages, needed to install the cable trays. The plan should also address how the trays will interface with the existing equipment and the handling of critical loads that must remain energized during outages. Required outages must conform with the outage windows specified elsewhere, if any. The cable trays and supports shall be installed per the approved installation drawings.

3.2.2 Manufacturer's Instructions

Cable tray Manufacturer's Instructions shall be submitted for review. The instructions shall include any special tools, installation, inspection and cable installation requirements needed to install the cable tray system.

3.2.3 Cable Tray System Layout

Unless otherwise indicated on the drawings. The required vertical spacing for cable trays is a minimum of 6 inches, measured from the bottom of the upper tray to the top of the lower tray. A minimum clearance of 6 inches shall be maintained where possible between the top of a tray and beams, piping, etc., to facilitate installation of cables in the tray.

3.2.4 Interference with Existing Equipment

Cable trays shall not be installed within 6 inches of existing equipment. This allows for access for maintenance or modification work. This minimum distance also allows for some air flow around the tray. Personnel shall not stand on existing equipment, pipes, conduits or cable trays during the installation of the new cable trays.

3.2.5 Hangers and Supports

Hangers and supports and their associated anchors shall be installed per the manufacturer's instructions and as indicated on the approved installation drawings.

3.2.6 Tolerances

Installation shall be level, straight, and true to line or grade within + 1/8-inch in 10 feet and within an accumulative maximum of 1/2-inch. Vertical structures shall be plumb within a tolerance of 1/8-inch per 10 feet of length. Install hold-down clamps or fasteners at all support points.

3.2.7 Field Modifications

When a required cable tray length is less than standard lengths the cable tray field modifications shall be made by qualified personnel. After cutting, all edges shall be smooth and all burrs shall be removed. Holes for splice plates shall be located in the field modified cable tray using an existing splice plate as a template. After drilling the holes, remove all burrs.

3.2.8 Coating Repairs

Cable trays that are Hot-Dip Galvanizing after fabrication shall be touched up after cutting, drilling or deburring, or if the coating becomes damaged. Touch-up of the galvanized finish shall be done according to ASTM A780/A780M.

3.3 CONDUIT TERMINATION

Conduits terminating at new and existing cable trays shall be secured to the cable trays with cable tray conduit clamps specifically designed for this purpose.

3.4 GROUNDING

Cable trays shall be grounded and electrically continuous. A continuous bare ground conductor (minimum #4 AWG copper) shall be routed along the entire length of each new cable tray run and secured with cable tray grounding conductor clamps. Bonding jumper should be used to ensure electrical continuity between cable trays connected with expansion splice plates, adjustable splice plates and discontinuous cable trays. The cable tray shall only be connected to the station ground at one end. Cable trays shall not be used as the Equipment Ground Conductor. The individual circuits will be required to have their own Equipment Ground Conductor.

3.5 Cable Cleats

The Contractor must coordinate between the cable manufacturer and the cleat manufacturer for cleat spacing suitable for the specified fault current while still allowing enough length of the cables between cleats to flex by thermal expansion under full load. Cleat spacing for short circuit restraint in horizontal runs shall be supported by the cleat manufacturer's spacing calculations. Approval of these calculations shall not relieve the Contractor from remedying the cleat spacing and repairing the existing cable tray at no additional cost to the OWNER if the cleated

cables damage the existing tray due to thermal expansion under a 24-hour load test. This load test shall be performed after cables have been cleated but prior to acceptance of the cable tray system. Cable cleats shall be installed per the manufacturer's instructions and the required spacing. Cable cleats shall not be over tightened to ensure the cables are not damaged. The cable shall not bulge at either side of the cable cleat strap under no load conditions.

3.6 Cable Tray Fill

Cable tray fill shall be in accordance with Article 392 of NFPA 70. The cable tray fill and cable orientation shall minimize the need to derate the cable ampacity of the circuits. Provide Cable Tray Fill Calculations which include the following:

a. Cable tray fill calculation

b. Cable ampacity adjustments

-- End of Section --

SECTION 26 05 48

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1	(2009; R 2016) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.22M	(1981; R 2017) Metric Plain Washers

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A500/A500M	(2023) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A603	(2019) Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A992/A992M	(2022) Standard Specification for Structural Steel Shapes
ASTM B695	(2021) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and

Steel

ASTM E580/E580M (2022) Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions

ASTM F436 (2011) Hardened Steel Washers

ASTM F959/F959M (2017a; R 2023) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series

ASTM F3125/F3125M (2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC156 (2012) Acceptable Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2024) International Building Code

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

MFMA-4 (2004) Metal Framing Standards Publication

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2023; with Change 1, 2023) Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2021; Reprint Jan 2024) UL Standard for Safety Luminaires

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)

VISCMA 413 (2014) Installing Seismic Restraints for Electrical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Components, supports, and attachments must comply with following structural design criteria:

Risk Category: IV.
Seismic Design Category: D.
Seismic Design Spectral Response Acceleration Parameter at Short Period (SDS): 0.3.
Seismic Design Spectral Response Acceleration Parameter at period of 1 second (SD1): 0.16.

Apply the seismic requirements described in this section and on the drawings to the electrical components listed in paragraph ELECTRICAL COMPONENTS.

Electrical components and their supports must be attached or anchored to structure.

1.2.2 Electrical Components

Provide seismic supports and attachments for the following electrical components in accordance with the requirements of this specification:

Components with Importance Factor (Ip) = 1.0:
Battery Systems
Control Panels
Generators
Light Fixtures
Motors
Switchgear
Switchboards
Storage Racks
Transformers
Unit Substations
Distribution Systems Conduit, Cable Tray, and Raceway

1.2.3 Supports and Attachments

Provide seismic supports and attachments for electrical components.

Contractor must retain services of a Registered Professional Engineer to design supports and attachments, and isolation and energy dissipation systems for electrical components. Supports and attachments, and isolation and energy dissipation systems that induce torsion in structural members are not permitted.

Submit copies of the Design Calculations and Design Drawings. Calculations and Drawings must be stamped and signed by Contractor's Registered Professional Engineer.

1.3 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Equipment Requirements; O

Lighting Fixtures; O

SD-03 Product Data

Supports and Attachments; O

Equipment Requirements; O

Lighting Fixtures; O

Flexible Fittings; O

Anchors; G

SD-05 Design Data

Design Calculations; O

Design Drawings; O

SD-06 Test Reports

Anchors; O,

SD-07 Certificates

ICC ES AC156 Shake Table Test; O,

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

Equipment must be rugged enough to survive design seismic event.

Submit detail drawings of supports and attachments along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed in paragraph ELECTRICAL COMPONENTS. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Submit calculations and drawings that are stamped and signed by Contractor's registered professional engineer. Design must be based on actual equipment and system layout. Design must include calculated loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods. Include drawing for Designated Seismic System Equipment indicating the equipment location in the facility to be used for the installation. Equipment must be rigidly or flexibly mounted as indicated. Roof mounted equipment both vibration isolated and nonisolated, must have support members designed and anchored to building structure.

2.1.1 Rigidly (Base and Suspended) Mounted Equipment

The following specific items of equipment must be constructed and assembled to withstand the seismic forces specified in UFC 3-301-01. Entirely locate each item of rigid electrical equipment and rigidly attach on one side only of a building expansion joint. Provide items such as electrical conduit, which cross the building expansion joint with flexible joints that are capable of accommodating displacements equal to the full width of the joint in each orthogonal direction.

Generators
Substations
Transformers
Switch Boards and Switch Gear
Free Standing Electric Motors

Equipment furnished under this Contract must be rigidly mounted. For any rigid equipment which is rigidly anchored, provide flexible joints for electrical conduit, cabletray, busway, and raceway, that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions. Designated Seismic Systems (DSS) for RC IV buildings assigned to Seismic Design Category (SDC) C, D, E, or F and Risk Category IV components needed for continued operation after an earthquake must have two nuts provided on each bolt.

2.1.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment must be constructed and assembled to resist seismic loads and meet associated seismic criteria.

Nonrigid or Flexibly-Mounted:

2.2 LIGHTING FIXTURES

Provide lighting fixtures and supports and attachments conforming to UL 1598.

2.3 SUPPORTS AND ATTACHMENTS

Material used for members listed in this section and on the drawings, must conform with the following:

a. Plates, rods, and rolled shapes, ASTM A36/A36M, ASTM A572/A572M Grade 50, or ASTM A992/A992M.

b. Wire rope, ASTM A603 pre-stretched, with Class C weight zinc-coated wires throughout rope. Connect rope at ends using ferrule or saddle-type wire rope clamp systems. Ferrule clamps must be qualified by testing for use in seismic applications per VISCMA 413. Saddle-type clamps must be used with minimum of two clamps at each end of wire rope.

c. Tubes, ASTM A500/A500M, Grade B.

d. Pipes, ASTM A53/A53M, Grade B.

e. Angles, ASTM A36/A36M.

f. Channels (Struts) with in-turned lips and associated hardware for fastening to channels at discrete points conforming to MFMA-4.

g. Fasteners:

(1) High-strength bolts, ASTM F3125/F3125M, Grade A325, heavy hex.

(2) Nuts, ASTM A563. Use heavy hex nuts for high strength bolts and anchor bolts.

(3) Washers, ASME B18.22M and ASME B18.21.1, except use ASTM F436

washers for high strength bolts.

(4) Galvanized coating, ASTM A153/A153M.

(5) Direct Tension Indicator Washers, ASTM F959/F959M. Provide ASTM B695, Class 55, Type 1 galvanizing. Submit product data for direct tension indicator washers.

h. Anchor bolts:

(1) Cast in anchors: Refer to Section 05 12 00 STRUCTURAL STEEL and 05 50 13 MISCELLANEOUS METAL FABRICATIONS for requirements.

(2) Post-installed anchors: Refer to Section 03 30 00 CAST-IN-PLACE CONCRETE for requirements.

i. Welding: Refer to Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS for requirements.

2.4 FLEXIBLE FITTINGS

Provide flexible fittings to allow conduit, cabletray, busway, and raceway systems to accommodate seismic movement between equipment and conduit, cabletray, busway, and raceway systems and supporting structure. Use specification grade steel fittings conforming to other specifications . Provide suitable watertight expansion fittings that maintain electrical continuity by bonding jumper or other means. Flexible fittings must accommodate minimum of 4 inches seismic movement in each orthogonal directions.

PART 3 EXECUTION

3.1 SUPPORTS AND ATTACHMENTS

Provide supports and attachments with continuous load path to distribute electrical component seismic loads to structure.

Provide supports and attachments for electrical components that conform to the arrangements shown. Install vertical diagonal braces at a 45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 413.

Provide bolted and welded connections for supports and attachments in accordance with UFC 3-301-01.

Provide welding in accordance with AWS D1.1/D1.1M. Grind visible welds smooth in the finished installation.

3.2 BUILDING DRIFT

Do not attach electrical components to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided. Electrical components, supports, and attachments must be capable of accommodating building story drifts, deflections, and relative displacements.

3.3 CONDUIT, CABLETRAY, BUSWAY, AND RACEWAY

Provide supports and attachments for conduit, cabletray, busway, and

raceway conforming to the requirements of UFC 3-301-01.

3.4 LIGHTING FIXTURES

Provide lighting fixtures and supports conforming to the following:

3.4.1 Pendant Fixtures

Provide pendant fixtures conforming to the requirements of UFC 3-301-01.

3.4.2 Ceiling Attached Fixtures

3.4.2.1 Recessed Fixtures

Support recessed individual or continuous-row mounted fixtures by a seismic-resistant suspended ceiling support system built in accordance with ASTM E580/E580M. Provide supports and attachments for the fixtures conforming to the requirements of UFC 3-301-01. Recessed lighting fixtures not over 56 pounds in weight and not required to be supported separately from the structure, may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Provide lock or screw attachments for fixture accessories, including diffusers and lenses.

3.4.2.2 Surface-Mounted Fixtures

Attach surface-mounted individual or continuous-row fixtures to a seismic-resistant ceiling support system built in accordance with ASTM E580/E580M. Provide supports and attachments for the fixtures conforming to the requirements of UFC 3-301-01.

3.4.3 Assembly Mounted on Outlet Box

Design a supporting assembly, that is intended to be mounted on an outlet box, to accommodate mounting features on 4 inch boxes, plaster rings, and fixture studs.

3.4.4 Wall-Mounted Emergency Light Unit

Design and secure attachments for wall-mounted emergency light units for the worst expected seismic disturbance at the site.

3.5 ANCHORS

3.5.1 General

Submit copies of test results to verify the adequacy of the specific anchor and application, as specified. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices allowing adequate edge distance and embedment depth for restraint anchor bolts. Identify position of reinforcing steel and other embedded items prior to drilling holes for post-installed anchors. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength. Fill annular gap with nonshrink grout at equipment anchor bolts where clearance between anchor and equipment support hole exceeds 0.125 inches.

3.5.2 Cast-In-Place Anchors

Use templates to locate cast-in-place bolts accurately and securely in formwork. Provide anchor bolts with an embedded straight length with heavy hex nut and plate washer as to provide required strength and ductility. Anchor bolts that exceed the normal depth of equipment foundation piers or pads must either extend into concrete floor or the foundation or increase depth of the piers or pads to accommodate bolt lengths.

3.5.3 Post-Installed Anchors

Install in accordance with the anchor manufacturer's instructions.

3.6 EQUIPMENT SUPPORT REQUIREMENTS

3.6.1 Suspended Equipment

Provide supports and attachments for components supported from structural systems. Provide supports and attachments that consist of angles, rods, wire rope, bars, channels (struts) or pipes arranged as shown in bracing submittals and secured at both ends with not less than 1/2 inch bolts. Provide sufficient supports and attachments to resist seismic forces as specified in UFC 3-301-01 without exceeding capacity of structural components. Provide, for approval, specific force calculations in accordance with UFC 3-301-01 for the project.

Submit details of supports and attachments for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight when hangers are inclined. Where interference is present, the inclined hanger slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 413.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Bolt components to floor or pads. Provide bolts to resist seismic forces in accordance with paragraph ANCHORS.

3.6.2.2 Overturning Resistance

Use the ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads to determine if overturning forces need to be considered in the sizing of anchor bolts. Provide calculations to verify the adequacy of the anchor bolts for combined shear and tension. Provide bolts to resist seismic forces in accordance with paragraph ANCHORS.

3.7 SPECIAL TESTING FOR SEISMIC-RESISTING COMPONENTS

Electrical components designated as Designated Seismic Systems required to remain operational after an earthquake must be seismic qualified by shake table testing conforming to ICC ES AC156 Shake Table Test procedures. The manufacturer is to provide a certification by a fully qualified testing

agency for the specific components. Prequalified certifications are acceptable unless noted otherwise.

Components that are required to be certified must bear permanent marking or nameplates constructed of a durable heat and water resistant material.

Provide component identification nameplates in accordance with UFC 3-301-01.

Mechanically attach nameplates to electrical components.

3.8 SPECIAL INSPECTION FOR COMPONENTS, SUPPORTS, AND ATTACHMENTS

Perform special inspections for seismic-resisting systems, designated seismic systems, components, supports and attachments, and equipment per ICC IBC 1705.13.4; electrical components per ICC IBC 1705.13.6.

-- End of Section --

SECTION 26 08 01

SYSTEMS TESTING AND COMMISSIONING

PART 1 GENERAL

1.1 DESCRIPTION

This Section covers the testing and commissioning of electrical and mechanical equipment installed under this contract. The work under this contract alters and interfaces with numerous systems within an operating Powerhouse. Therefore, final acceptance of installed equipment shall include both the commissioning of the installed work and the verification of the overall OWNER system. The Contractor has lead responsibility for the verification of the overall OWNER system.

1.2 REFERENCED PUBLICATIONS

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1248	(1998; R 2007) Guide for the Commissioning of Electrical Systems in Hydroelectric Power Plants

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.3 SUBMITTALS

OWNER approval is required for submittals with a "O" designation; submittals not having a "O" designation are for information only. The following shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit within 90 days after Notice To Proceed:

Commissioning Engineer's Qualifications; O

SD-05 Design Data

Submit a minimum of 90 days prior to start of commissioning:

Commissioning Plan; O

SD-06 Test Reports

Submit a minimum of 14 days prior to start of system commissioning:

Circuit Functionality Test Report; O

Submit within 30 days after completion of tests:

Commissioning Report; O

1.4 GENERAL REQUIREMENTS

All work shall be in accordance with the provisions of EM 385-1-1, NFPA 70E and the Project Hazardous Energy Control Program (Safe Clearance Procedure). Work under this Contract will require outages to energized systems. Proper sequencing of the testing shall be required to minimize the duration of outages for the generating units.

1.5 ROLES AND RESPONSIBILITY

During commissioning, the OWNER, the Contractor, and equipment manufacturer's erecting engineer will each have roles and responsibilities. Those common to all phases of testing are as follows:

a. The Contractor shall notify the OWNER not less than 30 days prior to starting any test and confirm the start date 7 days advance notice.

b. The Contractor shall provide one or more fully qualified craftsmen to assist during system commissioning for both the Contractor's Commissioning and Testing, and the OWNER's Commissioning and Testing

c. The OWNER will perform all clearance requirements and operation of existing equipment and components necessary for the Contractor to perform commissioning testing.

1.5.1 Construction Test Phase

The construction test phase shall consists of all the equipment specific field tests as specified in the individual equipment specific technical specifications and as identified in paragraph 3.5.

a. During the Construction Test Phase, the Contractor has the lead role and shall coordinate the scheduling for and performance of all contract required inspections and field tests as specified in all technical specifications and as listed in paragraph 3.5.

b. The OWNER will furnish device settings that are required for the equipment testing during this phase unless otherwise specified in the specifications. Requests for settings shall be made a minimum of 30 days prior to when they are required for testing.

1.5.2 Preoperational Test Phase

The preoperational test phase shall consists of testing each individual piece of equipment furnished for proper operation and for testing of the interface(s) between multiple pieces of new equipment and between the new

equipment and the existing plant equipment. The pre-operational test phase also includes the verification of the OWNER's systems.

a. During the Preoperational Test Phase, the Contractor has the lead role and is responsible for the coordination, performance, and oversight of commissioning activities.

b. The Contractor shall provide support during the commissioning activities to correct deficiencies that are identified during the testing.

c. The Contractor shall be responsible for scheduling the Equipment Manufacturer's Erecting Engineer who is responsible to perform commissioning activities for their specific equipment.

d. The Contractor will perform systems testing during this phase.

1.5.3 Operational Test Phase

The operational test phase shall consists of operating the equipment in an energized state. The equipment will be operated under normal conditions as well as at the equipment's operational limits to demonstrate proper performance over the full range of operating conditions.

a. During the Operational Test Phase, the Contractor has the lead role and will be responsible for coordination, performance, and oversight of these commissioning activities.

b. The Contractor shall be responsible for monitoring the performance of the furnished equipment during the various operating conditions as required in the equipment specific technical specifications.

c. The Equipment Manufacturer(s) (Commissioning Engineer) will be responsible for calibrating and performing operational tests and performance tests for their specific equipment.

1.6 COMMISSIONING ENGINEER

1.6.1 Qualifications

The Contractor's Commissioning Engineer must have a minimum five years experience in preparing commissioning plans and performing commissioning testing of electrical and mechanical equipment of comparable type and complexity in the powerhouse. The Commissioning Engineer's qualifications shall be submitted in résumé format for approval.

1.6.2 General Responsibilities of Contractor's Commissioning Engineer

The Commissioning Engineer's responsibilities include, but not be limited to the following:

a. Preparation and execution of the testing and commissioning plans, including activities of all involved subcontractors.

b. Participation in testing coordination meetings necessary to develop and execute the above plans.

c. Submit detailed Commissioning Plan

d. Oversee the testing of installed equipment.

e. Certify by signature and submit Commissioning Report.

f. During testing where the OWNER has lead responsibility, participate in testing coordination meetings to resolve interface issues between Contractor-installed equipment and the overall OWNER system.

1.7 COMMISSIONING PLAN

Prepare an overall commissioning plan that incorporates all Contract requirements,the equipment manufacturer's commissioning activities, and OWNER's commissioning activities. The plan shall be submitted for all equipment installed by the Contractor, including existing equipment necessary to be removed and reinstalled. The plan shall be specifically developed to confirm operation (function) of individual components, or circuits, as well as complete systems. The plan shall include, but not be limited to, the following:

a. A schedule for all Contractor, OWNER, and equipment manufacturer commissioning activities.

b. Equipment inspections, detailed step-by-step test procedures and reports to meet the requirements of the technical specifications, manufacturer recommendations, and applicable guidance for tests and test descriptions given in IEEE 1248 for all installed equipment.

c. Calibration information to include a list of each instrument used during testing, stating calibration requirements by the instrument manufacturer and the past year calibration history of the instrument.

d. Redline drawings indicating the as-installed condition of all equipment and wiring at the time of commissioning.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EQUIPMENT

Following installation, the equipment shall be inspected, tested, and commissioned following applicable procedures listed in NETA ATS IEEE 1248.

3.2 FIELD TESTING

During the construction and installation of electrical and mechanical equipment, the contractor shall perform the necessary inspections to ensure that the installation is in accordance with manufacturer's instructions and the design documents.

b. Detailed testing shall be performed on all installed equipment as specified in the Sections listed in paragraph DESCRIPTION to ensure that operation and performance conform to contract documents. All tests shall be witnessed by the OWNER. The Contractor shall notify the OWNER not less than 30 days prior to starting any test and confirm start date with 7 days advance notice.

c. The following data shall be recorded and submitted for all tests:

(1) Description of test

(2) Description of equipment tested

(3) Calibration information to include a list of each instrument used during testing, stating calibration requirements by the instrument manufacturer and the calibration history of the instrument. The calibration history shall include dates calibrated and calibration procedures used.

(4) Description of operation of all affected system components

3.3 CONTRACTOR'S COMMISSIONING AND TESTING

The following testing is required as part of the Contractor's commissioning process:

3.3.1 Circuit Functionality Test

All circuits installed by the contractor shall be given a complete functionality test, verifying that devices operate properly, and that the function of the circuit is as designed. This shall include tracking and verifying energy and/or signals are present at each point in the circuit at the proper time and in the proper sequence. The contractor shall also verify that the conductors and terminations are properly labeled. The contractor shall tabulate these results, certify them, and submit a circuit functionality test report prior to the system commissioning.

3.4 OWNER COMMISSIONING AND TESTING

After the Contractor has completed all testing required under these specifications, the OWNER will conduct an independent verification of the results and a system commissioning procedure. The Contractor shall participate in these activities by reviewing and becoming familiar with the OWNER commissioning plan, and by participating in the commissioning process. The Contractor shall provide one or more fully qualified craftsmen to assist in the testing, by taking readings, observing equipment, verifying settings, and making adjustments as instructed by the OWNER's Commissioning Engineer.

3.5 COMMISSIONING AND TESTING EQUIPMENT

Individual commissioning plan shall be provided for each equipment or group of equipment. A commissioning report shall be provided upon completion of testing and commissioning.

-- End of Section --

SECTION 26 12 16

DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.1 GENERAL INFORMATION

This SECTION covers the supply, installation and testing requirements for indoor, dry-type transformers.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASME INTERNATIONAL (ASME)

ASME B1.1	(2024) Unified Inch Screw Threads (UN and UNR Thread Form)

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 SUBMITTALS

Owner approval is required for submittals with a "O" designation. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit within 90 days after receipt of Notice to Proceed

Electrical Equipment Drawings; O

SD-03 Product Data

Submit within 75 days after receipt of Notice to Proceed

Transformer; O

Nameplates; O

SD-06 Test Reports

Field Test Report; O

The field test reports shall be submitted within 30 days of completion of all field acceptance tests.

SD-08 Manufacturer's Instructions

Field Test Procedure; O

The manufacturer's field test procedures shall be submitted for review and approval 60 days prior to the scheduled date of field testing after delivery.

Transformer Shipping Plan; O

The manufacturer's transformer shipping plan shall be submitted for review and approval 60 days prior to the scheduled date of delivery at Tyee Lake Powerhouse.

SD-10 Operation and Maintenance Data

Submit no later than 60 days prior to completion of work.

Operation and Maintenance Data; O

1.4 PRODUCT DATA

Manufacturer's catalog cuts shall be composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents. Catalog data shall be submitted not later than 45 calendar days after date of receipt of written Notice to Proceed.

1.5 ELECTRICAL EQUIPMENT DRAWINGS

Detailed electrical drawings shall show physical arrangement, construction details, connections, wiring diagrams, materials used in fabrication, access requirements for installation and maintenance, physical size, electrical characteristics, mounting and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded.

PART 2 PRODUCTS

2.1 GENERAL

Transformers supplied as part of this Contract shall meet all applicable industry standards and requirements.

2.2 SERVICE CONDITIONS

2.2.1 General

Unless specified below, units shall be built for operation in indoors, ventilated enclosures in a non-hazardous environment.

2.3 TRANSFORMER

2.3.1 Type and Rating

Transformer shall be indoor ventilated dry-type, self-cooled, NEMA Class AA, with 150 degrees C insulation and shall conform to the applicable requirements of NEMA TR 1. The transformers shall be rated as indicated. The transformer shall be designed to carry rated load continuously without exceeding 80 degrees C (Class 150 degrees C) temperature rise above 40 degrees C ambient temperature when installed in its ventilated sheet metal enclosure and cooled by natural air circulation.

2.3.2 Winding taps

Transformers shall be supplied with de-energized, high-voltage full-capacity taps. Taps shall be four total, with two at +2.5% each above nominal voltage and two at -2.5% each below nominal voltage.

2.4 CONSTRUCTION

2.4.1 Insulation System

Transformer coils shall be impregnated using a VPI process. Coils shall be pre-heated before application of resin. Resin shall be pressure impregnated under vacuum followed by positively pressurized dry-air or nitrogen to assure complete impregnation free of voids or air pockets. Windings shall be completely cured via oven. After landing the coils on the core and completing final adjustments, the entire assembly shall be treated with resin and oven-baked until fully cured.

2.4.2 Windings

Windings shall be copper.

2.4.3 Bus Connections

The bus connections shall be tinned or silver-plated.

2.4.4 Core and Coils

The core, coils and metal enclosure of the transformer shall be rigidly attached to a structural steel base suitable for moving the complete transformer by the use of rollers. Jacking facilities and removable lifting eyes shall be provided on the core and coil assembly. The core laminations shall be free from burrs which may puncture the insulation between laminations and shall be securely fastened to prevent excessive vibration in normal service or displacement under short-circuit conditions. Four 2-1/2 percent full-capacity taps, 2 above rated voltage and 2 below rated voltage, shall be provided in the high-voltage windings, and suitable means shall be provided for changing the taps while the transformer is de-energized. The terminal board shall be accessible through a door or removable panel in the enclosure. All transformer leads and taps shall be securely braced to prevent displacement or injury during transit or installation and under short-circuit condition.

2.4.5 Ground Bus

A continuous ground bus shall be installed inside the transformer enclosure including the transition and termination compartments. It shall

be copper not less than 2 inch by 1/4 inch. The ground bus shall be mechanically connected to the core, frame and enclosure. The used of ground cables in lieu of bus is not allowed. The ground bus shall be bonded to the bus within the switchgear. In the high voltage compartment the bus shall be installed up the wall to allow close connection to allow the connection of the medium voltage cable shields. A burndy type YA lug shall shall be provided to connect a 1/0 AWG copper cable to the powerhouse ground bus.

2.4.6 Temperature Rise

The average winding temperature rise, as measured by resistance, shall be 80 degrees Celsius.

2.4.7 Enclosures and Mounting

2.4.7.1 General

Enclosures shall be of a ventilated, dead-front, freestanding construction. All enclosures shall be constructed to prevent inadvertent access to energized parts and the ingress of solid foreign objects. Enclosures shall be constructed to a minimum of Type 1 as defined in NEMA 250, or equivalent, unless defined otherwise in this specification. The enclosure shall be constructed such that all points are solidly bonded to the cubicle ground connection. All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. Ventilating openings shall be provided as required for proper ventilation. The openings shall be of the grille type, and shall be provided with corrosion-resistant insect-proof screens on the inside. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. The enclosures shall be painted ANSI 61 Light Gray color.

2.4.7.2 Incoming Sections

A metal-enclosed high voltage transition compartment shall be provided for terminating the incoming cables. Ground bus and support for cable bracing shall be included in this section. Access to the interior of the compartment shall be through removable bolted panels or bolted hinged doors. Connections between the terminals of the incoming cables and the high-voltage winding terminals of the adjacent transformer shall be by means of copper bus. Heavy-duty clamp type terminal lugs shall be provided for connecting the high-voltage cables to the transformer high-voltage bus. The design shall allow adequate space for bending and bracing of cable. The termination point for the cable shall be no less than 3 feet from where the cable enters the enclosure.

2.4.8 Outgoing Section

A metal-enclosed low voltage transition compartment shall be provided for connecting the transformer bus to the low voltage conductors. Access to the interior of the compartment shall be through removable bolted panels or bolted hinged doors. The connections shall be made of copper bus.

2.5 NAMEPLATES

The transformer shall be provided with a cast bronze, stainless steel, or anodized aluminum nameplate. The nameplate shall include the following information:

(a) Date of Manufacture
(b) Manufacturing plant location and address
(c) Voltages
(d) Voltage taps
(e) Winding configuration
(f) Full Load kVA
(g) Efficiency
(h) X/R Ratio
(i) Impedance

2.6 WIRING

Wiring for accessories shall be adequately supported to prevent damaging the conductors due to vibration or maintenance activities and shall be connected to accessible terminal blocks. The frame members and conduit shall be utilized to protect exposed wiring from damage and all wiring on base shall be protected from stepping on during maintenance activities. Entrance of wiring and raceways into cabinet enclosures shall be by bushings designed for the purpose and all cabinets and conduit shall be adequately bonded to ground by bonding jumpers or fitting approved for grounding. Insulation and jackets of wiring shall be non-PVC.

2.7 OPERATION AND MAINTENANCE DATA

Operation and maintenance data shall comply with the requirements of Section 01 33 00 SUBMITTAL PROCEDURES and shall include complete operating, maintenance, and storage data regarding the transformer and its related equipment and shall be included the Operation & Maintenance Manual. The data shall include the manufacturer's name, model number, catalog cuts, parts list, service manual, drawings, and a brief description of all equipment and their basic operating features. The data shall list routine maintenance procedures, possible breakdowns and repairs, and a trouble-shooting guide including detailed instructions for removal, overhaul, reconditioning, and reinstallation of replaceable components. In addition, the data shall also contain recommended frequency of inspections and cleaning.

PART 3 EXECUTION

3.1 SHIPMENT

Transformers designed for indoor operation shall be thoroughly protected against the entrance of dust, rain, and snow if shipped by open flatbed truck. The Contractor shall submit for approval a Transformer Shipping Plan detailing the Contractors shipping method and shipping protection. The Owner may reject transformers subjected to excessive moisture or contamination due to improper protection during shipment. Transformer cabinets showing visible signs of impact or trauma upon arrival may be rejected by the Owner. The Owner will not be responsible for shipping costs on rejected transformers.

3.2 FIELD TESTING AND ACCEPTANCE

3.2.1 General

The Contractor shall perform field acceptance testing to verify that each transformer is undamaged from shipping and fit for service. A field test procedure shall be submitted for approval 60 days prior to field

acceptance testing. The procedure shall include the required tests, listed below, at a minimum, in addition to a schedule showing expected durations, and a list of test equipment used to complete testing. The field tests, including test equipment, test methods, measurements, and computations, shall be in accordance with the applicable requirements of IEEE C57.12.01 and IEEE C57.12.91, and shall be subject to the approval of the Contracting Officer.

3.2.2 Inspections

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS, and performed by the transformer field engineering services personnel.

Visual and mechanical inspection

(a) Compare equipment nameplate information with specifications and approved shop drawings.

(b) Inspect physical and mechanical condition. Check for damaged or cracked insulators.

(c) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(d) Perform specific inspections and mechanical tests as recommended by manufacturer.

(e) Verify correct equipment grounding.

3.2.3 Required Electrical Tests and Values

The Contractor shall perform the following electrical tests, at a minimum, after installing the unit in its final location. This list shall not preclude any field testing required for warranty purposes:

(a) Perform insulation resistance tests between windings and each winding to ground and calculate the polarization index. The polarization index shall be greater than 1.0.

(b) Perform power factor testing

(c) Perform turns-ratio tests at all tap positions, if applicable. Turns-ratio tests shall not deviate more than 0.5% from adjacent coils or the factory test results.

(d) If the core is not solidly grounded, perform a core insulation resistance test. The core insulation resistance shall be greater than 1.0 megaohm at 500 VDC test value.

The Contractor shall perform its testing activities, and coordinate and provide time in the construction schedule for this testing. During the Contractor testing, the Contractor shall provide skilled craftworkers to support the testing activities. Craftworkers shall be appropriate trades and skill level required for the particular tests to be performed. Craftworkers will only be required to make adjustments or changes to

Contractor-installed equipment when a need is identified during performance of the testing activities.

3.2.4 Test Report

A field test report for each transformer shall be submitted within 30 days of completion of tests. The test report shall contain all tests completed, with test equipment used for each test.

3.2.5 Commissioning

The Contractor shall be responsible for performing all equipment commissioning required by the equipment manufacturers and as noted in Section 26 08 01 SYSTEMS TESTING AND COMMISSIONING.

3.2.6 Field Applied Painting

The Contractor shall touch-up any paint damage caused to the enclosure paint through the course of this Contract by applying the manufacturer's recommended paint system in accordance with manufacturer's instructions. The touch up color shall match the manufacturer's paint.

-- End of Section --

SECTION 26 28 00

SWITCHBOARDS AND PANELBOARDS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the 208/120V panelboard PP-U3A and 125VDC panelboard PP-U3B.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B187/B187M	(2016) Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar and Shapes
ASTM D1535	(2014) Specifying Color by the Munsell System

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA PB 1	(2011) Panelboards
NEMA PB 2	(2011) Deadfront Distribution Switchboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(2014; Reprint Feb 2015) Thermoset-Insulated Wires and Cables
UL 489	(2016) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 50	(2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
UL 67	(2009; Reprint Apr 2015) Standard for Panelboards
UL 891	(2005; Reprint Oct 2012) Switchboards

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit within 60 calendar days after notice to proceed for the approval of the OWNER Representative.

Switchboard Drawings;

Panelboard Drawings;

SD-03 Product Data

Submit within 60 calendar days after notice to proceed for the approval of the OWNER Representative.

Switchboards;

Panelboards;

Nameplates;

Molded Case Circuit Breakers;

Terminal Blocks;

Indicating Devices;

Instrument Transformers

Spare Parts List;

SD-05 Design Data

Submit within 60 calendar days prior to the proposed date of test for the approval of the OWNER Representative.

Factory Test Procedures;

Field Testing and Commissioning Plan;

SD-06 Test Reports

Submit within 30 days after completion of field testing and commissioning.

Field Testing and Commissioning Report;

SD-09 Manufacturer's Field Reports

Submit within 30 days after completion of factory testing.

Factory Test Reports;

SD-10 Operation and Maintenance Data

Submit within 60 days after completion of field testing and commissioning.

Operation and Maintenance Manuals;

1.4 DESIGN AND MANUFACTURER DOCUMENTS

1.4.1 Switchboard Drawings

Submit for approval the following switchboard drawings:

1.4.1.1 Assembly and Detail Drawings

Submit assembly and detailed drawings and data to demonstrate that all parts of the equipment will conform to the requirements and intent of the specifications. The drawings and data shall include sectional views of switchboard units, description of removable elements, all relays and other devices, equipment lists, and nameplate schedules.

1.4.1.2 Outline drawings

For coordination of equipment and physical location. Drawings shall include the overall dimensions and weights of the equipment; the size and location of conduit and cable entrances; details of provisions for bolting equipment to the floor, walls, and ceilings; the equipment crate sizes and proposed routing to the installation site within the facility.

1.4.1.3 Schematic Diagrams and Wiring Diagrams

Schematic diagrams shall show the one line diagrams of the switchboard assembly, complete assembly full line wiring diagram showing that the equipment will function in a way to meet the requirements and intent of the specifications. All controls and external connections indicated by the Contract drawings shall be accounted for. Point to point connection or wiring diagrams shall show all terminal blocks and connections between the blocks and switchboard equipment, and shall provide a space at least 3 inches below and adjacent to the terminal blocks in which external circuits, conduits or connections may be shown. The wiring diagrams shall be made as seen by an observer of the actual wiring, and space on the drawings shall be provided for the addition of devices where actual mounting space exists on the structure. Drawings shall also show the proposed arrangement of terminal blocks and supports for incoming cables. The wiring drawings shall show the circuit final destination.

1.4.2 Panelboard Drawings

Submit for approval the following panelboard drawings:

1.4.2.1 Assembly and Detail Drawings

Submit detail drawings for the panelboards consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the OWNER to check conformity with the requirements of the contract documents. Include within drawings details of the bus layout.

1.4.2.2 Outline Drawings

Ensure outline drawings for panelboards indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

1.4.2.3 Schematic Diagrams

Schematic diagrams shall show the one line diagrams of the panelboard assembly.

1.5 NOTIFICATION OF SHIPMENT

Provide written notification to the OWNER 14 calendar days prior to shipment of equipment.

1.6 DELIVERY, STORAGE, AND HANDLINGS

The switchboard and panelboard shall be shipped as completely assembled and wired as feasible. The switchboard and panelboard and any other equipment shall be wrapped suitably or otherwise protected from damage during shipment. All electrical material delivered to site, until immediately prior to installation, shall be protected from damaging environmental and construction activities. The equipment shall be kept dry and free from precipitation and condensation during storage, installation, and after installation. All electrical equipment shall be stored in completely enclosed containers and in a humidity-controlled environment. Method of on-site storage and storage containers will be subject to approval by the OWNER.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Compliance with Standards

Equipment shall meet NEMA and UL standards and rating requirements as specified. No equivalent will be acceptable. Immediately notify the OWNER of any requirements of the specifications or Contractor proposed materials or assemblies that do not comply with NEMA or UL. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

2.1.2 Coordination

The general arrangement of the switchboards and panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as indicated will be subject to the approval of the OWNER. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. Completely assemble all equipment at the factory. The switchboards may be disassembled into sections, if

necessary, for convenience of handling, shipping, and installation.

2.1.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and have been in satisfactory industrial use for 5 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

2.2 SWITCHBOARDS

2.2.1 General

The switchboards shall be dead-front switchboards conforming to NEMA PB 2 and labeled under UL 891. The switchboards shall be completely enclosed self-supporting metal structures with the required number of vertical panel sections, buses, molded-case circuit breakers, and other devices as shown on the drawings.

2.2.2 Ratings

Provide equipment with the following ratings:

a. Voltage rating: 480Y/277,208Y/120 volts AC, 125 volts DC, three-phase, 3 or 4-wire as indicated.

b. Continuous current rating of the main bus: as indicated.

c. Short-circuit current rating: as indicated.

d. UL listed and labeled.

2.2.3 Construction

Provide the following:

a. Switchboard: consisting of one or more vertical sections bolted together to form a rigid assembly and front aligned as indicated.

b. All circuit breakers: front accessible.

c. Where indicated, "space for future" or "space" means to include a vertical bus provided behind a blank front cover. Where indicated, "provision for future" means full hardware provided to mount a breaker suitable for the location.

d. Completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring.

2.2.4 Enclosure

Provide the following:

a. Enclosure: NEMA ICS 6 Type as indicated fabricated entirely of 12 gauge steel.

b. Enclosure: Bolted together with removable bolt-on side and rear covers.

c. Front doors: provide with padlockable vault handles with a three point latch.

d. Paint color: ASTM D1535 light gray No. 61.

2.2.5 Bus

All buses shall be of copper and shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B187/B187M. The buses shall be insulated for not less than 600 volts. Tap connections shall be brazed, pressure-welded or bolted. All splices for field assembly shall be bolted. The buses shall be mounted on insulating supports of wet process porcelain, glass polyester, or suitable molded material, and shall be braced to withstand not less than 65,000 symmetrical amperes ac.

2.2.6 Ground Bus

A continuous copper ground bus shall be provided and secured to each vertical section along the entire length of the switchboard. A full clamp-type solderless copper or copper alloy lug for No. 500kcmil AWG stranded copper cable shall be provided at each end of the bus for connection to the station grounding system.

2.2.7 Components

Each switchboard shall be equipped with molded-case circuit breakers conforming to paragraph MOLDED CASE CIRCUIT BREAKERS and with frame sizes, trip ratings, and terminal connectors for attachment of outgoing power cables as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses.

2.2.8 Indicating Devices

Switchboard type ammeter and voltmeter shall be analog and shall be provided where indicated on the drawings. The instrument shall be designed for back-connected, semi-flush mounting. Meters shall be 4 1/2 inch minimum rectangular type. Devices shall be provided for local indications of the 125VDC system. The display shall have the following features and characteristics:

2.2.8.1 Ammeter

a. Power Supply: 125VDC

b. DC Ammeter: meter shall have input signal of 4-20mA with a display range of 0-XA.

2.2.8.2 Voltmeter

a. Power Supply: 125VDC

b. DC Voltmeter: meter shall have input signal of 0-150V with a display range of 0-XV.

2.2.9 Instrument Transformers

All transformers used for metering shall meet the requirements of NEMA C12.11 and IEEE C57.13. Voltage transformers shall be protected with removable primary and secondary fuses. Fuses shall be installed in each ungrounded lead and located adjacent to the transformers in an easily accessible place. If cable connections to current transformer primary are required, terminals of an approved solderless type and proper size shall be furnished. If current transformers are connected to buses, proper connections shall be furnished, complete with bolts, nuts, washers and other accessories.

2.2.10 Wiring

All control wire shall be stranded tinned copper switchboard wire with 600V flame-retardant insulation Type SIS meeting UL 44 and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall not be smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480V circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points. Indented ring tongue terminals shall be used for all control wiring terminated at terminal blocks.

2.2.11 Terminal Blocks

2.2.11.1 Control Circuit Terminal Blocks

Control circuit terminal blocks for control wiring shall be molded or fabricated type with barriers, rated not less than 600V. The terminals shall be removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts. The terminals shall be not less than No. 10 in size and shall have sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal. If space is a constraint, modular, pull apart, terminal blocks may be proposed provided they are of the channel or rail-mounted type. The Contractor shall submit data showing that the proposed alternative will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts. Not less than four (4) spare terminals or 15% shall be provided at each block or group of blocks whichever is greater.

2.2.11.2 Short-Circuiting Type

Short circuiting type terminal blocks shall be furnished for all current transformer secondary leads as shown in the contract drawings and shall have provisions for short-circuiting together all leads from each current transformer without opening any circuit. Short-circuiting the terminals of only one current transformer shall not short-circuit the terminals of any other current transformer.

2.2.11.3 Load Terminal Blocks

Load terminal blocks rated not less than 600 volts and of adequate capacity shall be provided for the power circuits not connected directly to a

circuit breaker. The terminals shall be of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, screws shall have hexagonal heads. Conducting parts between connected terminals shall have adequate contact surface and cross-section to operate without overheating. Each connected terminal shall have the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.2.11.4 Marking Strips

White or other light-colored plastic marking strips fastened by screws to the molded sections at each control and short-circuiting terminal block shall be provided for circuit designation. Each connected terminal of each block shall have the circuit designation or wire number neatly printed on the marking strip with durable marking fluid. Wire numbers shall be taken from the Contract drawings if shown, otherwise from approved Contractor shop drawings. Terminals for use with grounding conductors shall be green or yellow/green in color and of the same type and size per above. One reversible or two marking strips shall be furnished with each block.

2.3 PANELBOARDS

2.3.1 General

Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboards shall be designed for installation in surface-mounted or flush-mounted cabinets accessible from the front only, as shown on the drawings.

2.3.2 Rating

Provide equipment with the following ratings:

a. Voltage rating: as indicated.

b. Continuous current rating of the main bus: as indicated.

c. Short-circuit current rating: as indicated.

d. UL listed and labeled.

2.3.3 Construction

Provide the following:

a. Where indicated, "space for future" or "space" means to include a vertical bus provided behind a blank front cover. Where indicated, "provision for future" means full hardware provided to mount a breaker suitable for the location.

b. Completely factory engineered and assembled.

2.3.4 Enclosure

Enclosures shall meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than No 10 gauge if flush-mounted or mounted outdoors, and not less than No 12 gauge if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with Section 26 05 00, BASIC ELECTRICAL MATERIALS AND METHODS paragraph PAINTING. Outdoor cabinets shall be of NEMA 3R and a removable steel plate in the bottom for field drilling for conduit penetrations. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 1/8 inch. Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 24 inches long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets. Enclosure shall have nameplates in accordance with paragraph NAMEPLATES. Directory holders, containing a neatly typed or printed directory under a transparent cover, shall be provided on the inside of panelboard doors.

2.3.5 Bus

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be of copper and shall be tin or silver-plated throughout. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B187/B187M. The sizes of buses and the details of panelboard construction shall meet or exceed the requirements of NEMA PB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Multiple section panelboards, where required, shall be of the same short circuit rating and come with properly rated through-feed or sub-feed lugs for the interconnection of the multiple sections. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

2.3.6 Components

Each branch circuit, and the main buses where specified or shown on the drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Circuit breakers of the same frame size and rating shall be interchangeable.

2.4 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. All poles of

each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

2.4.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The OWNER reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. Submit outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

2.4.2 480VAC Circuit Breakers

Circuit breakers for 480VAC circuits shall be rated 600VAC, and shall be an UL listed minimum interrupting capacity of 65,000 symmetrical amperes at 600 VAC.

2.4.3 120/240VAC Circuit Breakers

Circuit breakers for 120VAC circuits shall be rated not less than 120/240 or VAC, and shall be an UL listed minimum interrupting capacity of 22,000 symmetrical amperes at 600 VAC.

2.4.4 125VDC Circuit Breakers

Circuit breakers for 125VDC circuits shall be two-pole, rated 125/250VDC or 125VDC, and shall be an UL listed minimum interrupting capacity of 22,000 symmetrical amperes at 250VDC.

2.5 NAMEPLATES

Provide nameplates made of melamine plastic, 0.125" thick, black with white center core. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1" by 2.5". lettering shall be a minimum of 0.25" high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

a. Switchboards

b. Panelboards

2.6 SPARE PARTS

Furnish spare parts as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished. Parts

shall be listed on the Spare Parts List.

2.6.1 Switchboard Spare Parts

a. One - complete spare breaker, including bell alarms of each type and size provided

b. One - control transformer of each type and rating

c. Twelve - Fuses of each type and size

2.6.2 Panelboard Spare Parts

a. One - complete spare breaker of each type and size provided

PART 3 EXECUTION

3.1 FACTORY TESTS

Each item of equipment supplied under this Contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the OWNER Representative unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the OWNER.

a. Submit manufacturer's routine factory test procedures and production line tests for all switchboards and panelboards, within a minimum of 60 days prior to the proposed date of tests. Notify the OWNER a minimum of 30 days prior to the proposed date of the tests so that arrangements can be made for the OWNER to be present at the tests.

b. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the OWNER. Submit factory test reports documenting all results, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken.

c. Report shall be signed and dated by the Contractor's and OWNER's Representatives. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and OWNER. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

3.1.1 Switchboards Tests

3.1.1.1 Production Tests

Each switchboard shall be completely assembled and given applicable production tests for assembled switchboard as specified in NEMA PB 2.

3.1.1.2 Short Circuit Tests

If the unit is not UL labeled for the specified short circuit current requirement, design tests may be submitted demonstrating that satisfactory short-circuit tests have been made on a switchboard of similar type of construction and having the same available short circuit rating as the switchboards specified to be furnished under these specifications.

3.1.2 Panelboards Tests

Each panelboard shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

3.2 EQUIPMENT INSTALLATION

3.2.1 Safety and Coordination

The work under this Contract is subject to the safety clearances and operating procedures currently practiced by the Tyee Lake Powerhouse. All the construction activities shall be coordinated with the OWNER's Representative so that the construction will not adversely affect the daily operation of the Powerhouse. Safety clearances shall be obtained before opening, entering or working on any existing electrical equipment.

3.2.2 Compliance with Standards

Unless otherwise specified, execution of all installation work shall be in accordance with the National Electrical Code, NFPA 70, the National Electrical Safety Code and IEEE C2. If a deviation from the above standards is specifically shown or specified, the drawings and specifications shall govern. Omission of details on the drawings or in the specifications shall not be construed as permitting deviations from the Code requirements.

3.2.3 Switchboards

3.2.3.1 Assembly

Complete assembly shall be electrically and mechanically connected and assembled from coordinated subassemblies shipped in complete sections from the manufacturer. Installation shall be aligned, leveled, and secured to the supporting construction in accordance with the manufacturer's recommendations and seismic requirements. All equipment shall be installed as recommended by equipment manufacturer and as directed. Switchboard shall be bolted to the foundation. Welding of the switchboard to the foundation is prohibited.

3.2.4 Panelboards

Panelboards shall be installed so as not to be out of plumb more than 1/4-inch over the full length nor be deformed more than 1/16-inch per linear foot nor more than a total of 1/4-inch in any surface. Panelboards shall be securely mounted so that the top operating handle does not exceed 72-inches above the finished floor. No equipment shall be mounted within 36 inches of the front of the panel. Directory card information shall be printed, complete and legible. Hand-written directory cards will not be accepted.

3.2.5 Raceways

Raceways terminating at the switchboards and panelboards shall comply with the requirements of Section 26 05 00, BASIC ELECTRICAL MATERIAL AND

METHODS.

3.2.6 Wire and Cable

External wire and cable terminating in the switchboards and panelboards shall comply with the requirements of Section 26 05 19, INSULATED WIRE AND CABLE. Wire labels shall be provided at each end of the wire and shall show both destinations.

3.3 FIELD TESTING AND COMMISSIONING

3.3.1 General

After completion of the installation of the equipment and accessories, perform field testing and commissioning to insure proper installation and verify proper operation. Field testing shall include all testing recommended in the NETA ATS and the referenced standards. Submit a field testing and commissioning plan for approval, listing the routine and operational tests to be conducted. The tests shall be witnesses by an OWNER's Representative.

3.3.2 Conductor and Cable Test

Continuity and insulation resistance tests of wiring installed post factory installation. Reference Section 26 05 19, INSULATED WIRE AND CABLE.

3.3.3 Operating Test

After the field testing is performed, conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. At a minimum, the following operational test shall be performed:

a. Manual circuit breaker operation

b. Meter polarity

3.3.4 Test Reports

Submit Field Testing and Commissioning Report for approval. Test report shall include test equipment manufacturer, serial number, range and test equipment calibration certificate. Records of exact test voltage, current, etc. and results shall be recorded. Test data shall include the name of the test engineer and the date the tests were performed.

3.4 ACCEPTANCE

Final acceptance of the equipment will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

3.5 OPERATION AND MAINTENANCE MANUALS

The Contractor shall submit an Operation and Maintenance (O&M) Manual for each switchboard and panelboard provided. Separate manuals for each may be submitted. In addition to meeting the requirements of Section01 78 23 OPERATION AND MAINTENANCE DATA, the following shall be included:

a. Bill of material and spare parts list

b. Product cut sheets

c. Procedures for equipment maintenance.

d. Shop drawings

e. Breaker settings

3.6 TRAINING

The Contractor shall provide three two-hour sessions of instruction on the maintenance of the equipment. One session will focus on equipment maintenance for maintenance crew and two sessions will focus on equipment operation for plant operators. All training manuals, slides, and other materials be submitted 30 days prior to the date training is scheduled to occurs.

-- End of Section --

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M	(2023) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2019; R 2025) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2023) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1008/A1008M	(2024) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM B164	(2003; R 2014) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B633	(2023) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

ILLUMINATING ENGINEERING SOCIETY (IES)

ANSI/IES LM-79	(2019) Approved Method: Electrical and Photometric Measurements of Solid State Lighting Products
ANSI/IES LM-80	(2020) Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
ANSI/IES LS-1	(2020) Lighting Science: Nomenclature and Definitions for Illuminating Engineering
ANSI/IES TM-21	(2021) Technical Memorandum: Projecting Long-Term Luminous, Photon, and Radiant Flux Maintenance of LED Light Sources
ANSI/IES TM-30	(2020) Technical Memorandum: IES Method for Evaluating Light Source Color Rendition

IES Lighting Library	IES Lighting Library
INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)	
IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017) National Electrical Safety Code
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)	
NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2024) Electric Lamps— Specifications for the Chromaticity of Solid State Lighting Products
NEMA C82.77-10	(2020) Harmonic Emission Limits - Related Power Quality Requirements
NEMA SSL 1	(2016) Electronic Drivers for LED Devices, Arrays, or Systems
NEMA SSL 3	(2011) High-Power White LED Binning for General Illumination
NEMA WD 1	(1999; R 2020) Standard for General Color Requirements for Wiring Devices
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 70	(2020) National Electrical Code
NFPA 101	(2024) Life Safety Code
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
47 CFR 15	Radio Frequency Devices
UL SOLUTIONS (UL)	
UL 20	(2025) UL Standard for Safety General-Use Snap Switches
UL 924	(2016; Reprint Feb 2025) UL Standard for Safety Emergency Lighting and Power Equipment
UL 1598	(2021; Reprint Jan 2024) UL Standard for Safety Luminaires
UL 8750	(2020; Reprint Aug 2024) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications and on the drawings, must be as defined in IEEE 100 and ANSI/IES LS-1.

b. For LED luminaire light sources, "Useful Life" is the operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in ANSI/IES LM-80.

c. For LED luminaires, "Luminaire Efficacy" (LE) is the appropriate measure of energy efficiency, measured in lumens/watt. This is gathered from LM-79 data for the luminaire, in which absolute photometry is used to measure the lumen output of the luminaire as one entity, not the source separately and then the source and housing together.

d. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminaire Drawings

SD-03 Product Data

Luminaires;

Light Sources;

LED Drivers;

Luminaire Warranty;

Switches;

Exit Signs;

SD-05 Design Data

Luminaire Design Data;

SD-06 Test Reports

ANSI/IES LM-79 Test Report;

ANSI/IES LM-80 Test Report;

ANSI/IES TM-21 Test Report;

ANSI/IES TM-30 Test Report

SD-10 Operation and Maintenance Data

Lighting System

Lighting Control System

1.4 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the IES Lighting Library as applicable, for the lighting system specified.

1.4.1 Luminaire Drawings

Include dimensions, accessories installation details, and construction details. Photometric data, including CRI, CCT, LED driver type, zonal lumen data, and candlepower distribution data must accompany shop drawings.

1.4.2 Luminaire Design Data

a. Provide safety certification and file number for the luminaire family that must be listed, labeled, or identified in accordance with the NFPA 70. Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratories).

b. Provide long term lumen maintenance projections for each LED luminaire in accordance with ANSI/IES TM-21. Data used for projections must be obtained from testing in accordance with ANSI/IES LM-80.

1.4.3 ANSI/IES LM-79 Test Report

Submit test report on manufacturer's standard production model of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data in IES format as outlined under "14.0 Test Report" in ANSI/IES LM-79.

1.4.4 ANSI/IES LM-80 Test Report

Submit report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data as outlined under "8.0 Test Report" in ANSI/IES LM-80.

1.4.5 ANSI/IES TM-21 Test Report

Submit test report on manufacturer's standard production LED light source (package, array, or module) of specified luminaire. Testing must be performed at the same operating drive current as specified luminaire. Include all applicable and required data, as well as required interpolation information as outlined under "7.0 Report" in ANSI/IES TM-21.

1.4.6 ANSI/IES TM-30 Test Report

Submit color vector graphic in accordance with ANSI/IES TM-30 on manufacturer's standard production LED light source (package, array, or

module) of specified luminaire. Include spectral distribution of test LED light source.

1.4.7 Test Laboratories

Test laboratories for the ANSI/IES LM-79 and ANSI/IES LM-80 test reports must be one of the following:

a. National Voluntary Laboratory Accreditation Program (NVLAP) accredited for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program for both LM-79 and LM-80 testing.

b. One of the qualified labs listed on the Department of Energy - LED Lighting Facts Approved Testing Laboratories List for LM-79 testing.

c. One of the EPA-Recognized Laboratories listed for LM-80 testing.

1.4.8 Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70, unless more stringent requirements are specified or indicated. Provide luminaires and assembled components that are approved by and bear the label of UL for the applicable location and conditions unless otherwise specified.

1.4.9 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products must have been in satisfactory commercial or industrial use for six months prior to bid opening. The six-month period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six-month period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.9.1 Alternative Qualifications

Products having less than a six-month field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.9.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

1.5 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.5.1 Luminaire Warranty

Provide and transfer to the Owner the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

a. Warranty period must begin in accordance with the manufacturer's standard warranty starting date.

b. Provide replacements that are promptly shipped, without charge, to the using Owner's facility point of contact and that are identical to or an improvement upon the original equipment. All replacements must include testing of new components and assembly.

1.6 OPERATION AND MAINTENANCE MANUALS

1.6.1 Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting system for the building. Include the following:

a. Manufacturers' operating and maintenance manuals.

b. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

1.6.2 Lighting Control System

Provide operation and maintenance manuals for the lighting control system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting control system for the building. Include the following:

a. Lighting control system layout and wiring plan.

b. Product data for all devices, including installation and programming instructions.

c. Training materials, such as videos or in-depth manuals, that cover basic operation of the lighting control system and instructions on modifying the lighting control system. Training materials must include calibration, adjustment, troubleshooting, maintenance, repair, and replacement.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

2.2 LUMINAIRES

UL 1598, NEMA C82.77-10. Provide luminaires as indicated in the luminaire schedule or details on project plans, complete with light source, wattage, and lumen output indicated. All luminaires of the same type must be provided by the same manufacturer. Luminaires must be specifically designed for use with the driver and light source provided.

2.2.1 Luminaires

UL 8750, ANSI/IES LM-79, ANSI/IES LM-80. For all luminaires, provide:

a. Complete system with LED drivers and light sources.

b. Housings constructed of non-corrosive materials. All new aluminum housings must be anodized or powder-coated. All new steel housings must be treated to be corrosion resistant.

c. ANSI/IES TM-21, ANSI/IES LM-80. Minimum L70 lumen maintenance value of 50,000 hours unless otherwise indicated in the luminaire schedule. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

d. UL listed for dry or damp location typical of interior installations.

e. LED driver and light source package, array, or module are accessible for service or replacement without removal or destruction of luminaire.

f. Lenses constructed of heat tempered borosilicate glass, UV-resistant acrylic, or silicone.

2.3 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type, delivered lumen output, and wattage as indicated in the luminaire schedule on project plans.

2.3.1 LED Light Sources

Provide LED light sources that meet the following requirements:

a. NEMA ANSLG C78.377. Emit white light and have a nominal CCT of 5000 Kelvin.

b. Minimum Color Rendering Index (CRI) of 80.

2.4 LED DRIVERS

NEMA SSL 1, UL 8750. Provide LED drivers that are electronic, UL Class 1 or Class 2, constant-current type and that comply with the following requirements:

a. The combined driver and LED light source system does not exceed the minimum luminaire efficacy values as listed in the luminaire schedule provided.

b. Operates at a voltage of 120 volts at 50/60 hertz, with input voltage fluctuations of plus/minus 10 percent.

c. Power Factor (PF) greater than or equal to 0.90 at full input power and across specified dimming range.

d. Maximum Total Harmonic Distortion (THD) less than 20 percent at full input power and across specified dimming range.

e. Operates for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.

f. Withstands Category A surges of 2 kV without impairment of performance. Provide surge protection that is integral to the driver.

g. Integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.

h. 47 CFR 15. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

i. Class A sound rating.

2.5 LIGHTING CONTROLS

Provide lighting control systems that do not switch off battery-operated or emergency backup luminaires or exit signs in path of egress. Provide system with override of lighting control devices controlling luminaires in path of egress with activation of fire alarm system.

2.5.1 Devices

2.5.1.1 Toggle Switches

Provide line-voltage toggle switches When used for non-digital loads, devices must be rated at 20 Amps inductive load, and be compatible with the lighting control systems.

NEMA WD 1, UL 20,single pole,totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

Handles: white thermoplastic.

Wiring terminals: screw-type, side-wired. Do not use back-stabbed conductor terminals.

Contacts: silver-cadmium and contact arm - one-piece copper alloy.

Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.6 EXIT AND EMERGENCY LIGHTING EQUIPMENT

2.6.1 Exit Signs

UL 924, NFPA 101. Provide wattage as indicated in the luminaire schedule on project plans. Provide LED Exit Signs that meet the following criteria:

a. UL listed for damp location.

b. Configured for universal mounting.

c. 6 inch high, 3/4 inch stroke red lettering on face of sign with chevrons on either side of lettering to indicate direction.

d. Single or double face as indicated in project plans and luminaire

schedule.

2.6.1.1 Exit Signs with Battery Backup

Equip with automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1-1/2 hours. LEDs must have a minimum rated life of 10 years. Provide self-diagnostic circuitry integral to emergency LED driver. In lieu of battery, can use a nonradioactive photoluminescent plate.

2.6.1.2 Remote-Powered Exit Signs

Provide exit sign that contains provision for 120-277 VAC input from remote source.

2.6.2 Emergency Lighting Unit (ELU)

UL 924, NFPA 101. Provide emergency lighting units (ELUs) completely assembled with wiring and mounting devices, ready for installation at the locations indicated. Provide in painted steel housing with UL damp label as indicated. Emergency lighting units must be rated for 12 volts, except units having no remote-mounted light sources and having no more than two unit-mounted light sources may be rated six volts. Equip units with brown-out sensitive circuit to activate battery when input voltage falls to 75 percent of normal. Equip with two LED light sources, automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 90 minutes. LEDs must have a minimum rated life of 10 years. Provide self-diagnostic circuitry integral to emergency LED driver.

2.6.3 Self-Diagnostic Circuitry for LED Drivers

UL 924, NFPA 101. Provide emergency lighting unit with fully-automatic, integral self-testing/diagnostic electronic circuitry. Circuitry must provide for a one minute diagnostic test every 28 days, and a 30 minute diagnostic test every six months, minimum. Any malfunction of the unit must be indicated by LED(s) visible from the exterior of the luminaire. A manual test switch must also be provided to perform a diagnostic test at any given time.

2.7 LUMINAIRE MOUNTING ACCESSORIES

2.7.1 Suspended Luminaires

a. Provide hangers capable of supporting twice the combined weight of luminaires supported by hangers.

b. Hangers must allow luminaires to swing within an angle of 45 degrees. Brace pendents 4 feet or longer to limit swinging.

c. Single-unit suspended luminaires must have cable hangers. Multiple-unit or continuous row luminaires with a separate power supply cord must have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis,

including one at each end.

d. Provide all linear pendent and surface mounted luminaires with two supports per four-foot section or three per eight-foot section unless otherwise recommended by manufacturer.

2.7.2 Surface Mounted Luminaires

Provide access to light source and LED driver from bottom of luminaire. For surface mounted luminaires with brackets, provide flanged metal stem attached to outlet box, with threaded end suitable for supporting the luminaire rigidly in design position. Flanged part of luminaire stud must be of broad base type, secured to outlet box at not fewer than three points.

2.7.3 Luminaire Support Hardware

2.7.3.1 Wire

ASTM A641/A641M. Galvanized, soft tempered steel, minimum 0.11 inches in diameter, or galvanized, braided steel, minimum 0.08 inches in diameter.

2.7.3.2 Wire for Humid Spaces

ASTM A580/A580M. Composition 302 or 304, annealed stainless steel, minimum 0.11 inches in diameter.

ASTM B164. UNS NO4400, annealed nickel-copper alloy, minimum 0.11 inches in diameter.

2.7.3.3 Threaded Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.7.3.4 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

UL 1598. All luminaires must be clearly marked for operation of specific light sources and LED drivers. The labels must be easy to read when standing next to the equipment, and durable to match the life of the equipment to which they are attached. Note the following light source characteristics in the format "Use Only _____":

a. Correlated Color Temperature (CCT) and Color Rendering Index (CRI) for all luminaires.

b. Driver and dimming protocol.

All markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. LED drivers must have clear markings indicating dimming type and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

NEMA 250. Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of corrosion-resistance testing.

PART 3 EXECUTION

3.1 INSTALLATION

IEEE C2, NFPA 70.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature (CCT), color rendering index (CRI), and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Provide accessories as required for ceiling construction type indicated on Finish Schedule. Luminaire catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a luminaire may be installed. Provide wires, straps, or rods for luminaire support in this section. Install luminaires with vent holes free of air blocking obstacles.

3.1.2.1 Suspended Luminaires

Measure mounting heights from the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain architect approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Support suspended luminaires from structural framework of ceiling or from inserts cast into slab.

a. Provide suspended luminaires with 45 degree swivel hangers so that they hang plumb and level.

b. Locate so that there are no obstructions within the 45 degree range in all directions.

c. The stem, canopy and luminaire must be capable of 45 degree swing.

d. Rigid pendent stem, aircraft cable, rods, or chains 4 feet or longer

excluding luminaire must be braced to prevent swaying using three cables at 120 degree separation.

e. Suspended luminaires in continuous rows must have internal wireway systems for end to end wiring and must be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces.

f. Utilize aligning splines on extruded aluminum luminaires to assure minimal hairline joints.

g. Support steel luminaires to prevent "oil-canning" effects.

h. Match supporting pendents with supported luminaire. Aircraft cable must be stainless steel.

i. Match finish of canopies to match the ceiling, and provide low profile canopies unless otherwise shown.

j. Maximum distance between suspension points must be 10 feet or as recommended by the manufacturer, whichever is less.

3.1.3 LED Drivers

Provide LED drivers integral to luminaire as constructed by the manufacturer.

3.1.4 Exit Signs

NFPA 101. Wire exit signs and emergency lighting units ahead of the local switch, to the normal lighting circuit located in the same room or area.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

3.2.1.1 Emergency Lighting Test

Interrupt power supply to demonstrate proper operation of emergency lighting. If adjustments are made to the lighting system, re-test system to show compliance with standards.

-- End of Section --

SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D698	(2012; R 2021) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
ASTM D2216	(2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D4253	(2016; E 2019) Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	(2016) Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

AK DEPT OF TRANSPORTATION AND PUBLIC FACILITIES (DOT&PF)

1.2 DEFINITIONS

1.2.1 Type A

Existing bulk fill soil material at the switchyard which will be excavated and used to replace excavated soils.

1.2.2 Type C

Existing bulk fill soil material at the powerhouse which will be excavated and used to replace excavated soils.

1.2.3 Switchyard Surface Course

Existing 12-inch thick surficial gravel layer at the switchyard.

1.2.4 Topsoil

Surface layer of primarily organic soil capable of supporting vegetation growth.

1.2.5 Bedding Sand

Fill placed to directly support and encase pipes, conduits, cables, and appurtenant structures. Bedding Sand may also be used to provide a cushion between utilities and bedrock, obstacles, obstructions and other unyielding materials.

1.2.6 Satisfactory Materials

Satisfactory materials for fill, backfill, and/or any in-situ soils to remain in place comprise any materials classified as Type A, Type C, Switchyard Surface Course, Topsoil, Bedding Sand.

1.2.7 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; roots and other organic matter or frozen material. Notify the Geotechnical Engineer when encountering any contaminated materials.

1.2.8 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.9 Degree of Compaction (Proctor)

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698 abbreviated as a percent of laboratory maximum density.

1.2.10 Degree of Compaction (Relative Density)

Degree of compaction required for soils with less than 5 percent passing the No. 200 sieve, is expressed as a relative percentage of the maximum index density/dry unit weight and minimum index density/dry unit weight, obtained by the test procedures in accordance with ASTM D4253 and ASTM D4254, respectively, abbreviated as a percent of laboratory relative density.

1.2.11 Borrow

Soil brought to the project site from an external location for the purposes of project construction.

1.2.12 Subgrade

Earth materials directly below foundations and directly below granular base materials in building slab and pavement areas including shoulders.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Excavation and Trenching Plan;

Dewatering Work Plan;

Disposition of Surplus Materials;

Erosion and Sediment Control Plan

SD-06 Test Reports

Material Test Reports;

1.4 QUALITY CONTROL

1.4.1 Geotechnical Engineer

The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to document site conditions. The Geotechnical Engineer is responsible for preparing and updating the earthwork submittals as necessary during construction to reflect changing conditions and submit an updated plan if necessary.

1.4.2 Qualified Technician

Provide a Qualified Technician to inspect, monitor, sample, and performing field testing. The technician qualifications need to be one of the following: a current National Institute for Certification in Engineering Technologies (NICET) Level II minimum certification in Construction Materials Testing Soils; a Geologist-in-Training with minimum one-year experience; an Engineer-in-Training with minimum one-year experience; a Registered Geologist; or a Professional Engineer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Type A

Materials to be sourced locally from the switchyard excavation areas and match the material characteristics of the Type A fill used in the original construction. Particles larger than 6-inches in diameter should be scalped and removed from the fill.

2.1.2 Type C

Materials to be sourced locally from the powerhouse excavation areas and match the material characteristics of the Type C fill used in the original

construction. Particles larger than 12-inches in diameter should be scalped and removed from the fill.

2.1.3 Switchyard Surface Course

Materials to be sourced locally from the top 12-inches of switchyard surface area and match the material characteristics of Switchyard Surface Course fill used in the original construction. Particles larger than 3-inches in diameter should be scalped and removed from the fill.

2.1.4 Topsoil

Material suitable for topsoil obtained from offsite areas is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth.

2.1.5 Bedding Sand

Except as specified otherwise in the individual piping section, provide bedding for buried piping, conduits, cables, and appurtenant structures. This material is to meet the Alaska DOT&PF Standard Specification for Sand Blanket Material. This material has the following gradation:

Sieve	Percent Passing By Weight
3/8 in.	100
No. 04	95 - 100
No. 200	0 - 6

2.2 BURIED WARNING AND IDENTIFICATION MARKERS

Provide warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes	
Red	Electric
Yellow	Gas, Oil; Dangerous Materials
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems

Warning Tape Color Codes	
White	Steam Systems
Gray	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.2.3 Detection Wire for Non-Metallic Piping

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.3 BORROW

Provide borrow materials from sources located within the property meeting the requirements of paragraph Type A, Type C, Switchyard Surface Course, and Topsoil.

PART 3 EXECUTION

3.1 PROTECTION

Use equipment of type and size appropriate for the site conditions (soil character and moisture content). Maintenance of exposed subgrades and fills is the responsibility of the Contractor. The Contractor is required to prevent damage by ineffective drainage, dewatering, and heavy loads and equipment by implementing precautionary measures. Repair or replace any defects or damage.

3.1.1 Underground Utilities

Location of the existing utilities indicated is approximate. Physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor is responsible for protecting utilities from damage during construction.

3.1.2 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction. Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference

with orderly progress of construction. French drains, sumps, ditches or trenches are not allowed within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Perform control measures by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, maintain the water level continuously below the working level. Submit a Dewatering Work Plan showing compliance with these requirements.

3.1.3 Shoring and Sheeting

Submit an Excavation and Trenching Plan to stabilize features, prevent undermining or unintended horizontal and vertical movement of adjacent structures, and prevent slippage or movement in banks or slopes adjacent to the excavation.

3.1.4 Protection of Graded Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.1.5 Erosion and Sediment Control

Install sediment and erosion control measures to reduce the potential for project-related activities causing erosion and sedimentation. Select measures as shown on the Plans and to meet the requirements of Alaska Dot&PF SS and Alaska Dot&PF BMP Guide. Submit a Erosion and Sediment Control Plan showing compliance with these requirements

3.2 BORROW

Select borrow material to meet the requirements and conditions of the fill or embankment for which it is to be used. Obtain borrow material from within the limits of the project site, selected by the Contractor or from approved private sources.

3.3 SURFACE PREPARATION

3.3.1 Clearing and Grubbing

Remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations. Remove stumps entirely. Grub out matted roots and roots over 3 inches in diameter to at least 18 inches below existing surface.

3.3.2 Stripping

Strip site where indicated on the plans. Strip existing surface materials to a depth of 4 inches below the existing ground surface. Strip in all areas within the planned limits of disturbance. All stripped materials not suitable for reuse as topsoil will be wasted in specified disposal area.

Strip suitable soil from the site where excavation or grading is indicated and stockpile separately from other excavated material. Protect topsoil and keep in segregated piles until needed.

3.3.3 Stockpiling Operations

Place and grade stockpiles as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.4 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Excavate soil disturbed or weakened by Contractor's operations, and soils softened or made unstable for subsequent construction due to exposure to weather. Use material removed from excavations meeting the specified requirements in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes to minimize surplus material and to minimize additional material to brought on site. Do not excavate below indicated depths except to remove unstable material as determined by the Geotechnical Engineer. Remove and replace excavations below the grades shown with appropriate materials as directed by the Geotechnical Engineer.

If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock or as hard/unyielding material, uncover such material, and notify the Geotechnical Engineer. Do not proceed with the excavation of this material until the Geotechnical Engineer has classified the materials as common excavation or rock excavation.

3.4.1 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe or cables to be installed and shown on the Plans. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended by the manufacturer.

3.4.1.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe or cables. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 3 inch or greater in any dimension, or as recommended by the manufacturer, whichever is smaller, to avoid point bearing.

3.4.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, notify the Geotechnical Engineer. Following approval, remove such material 3 inch below the required grade and replaced with suitable materials as provided in paragraph FILLING AND COMPACTION.

3.4.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with suitable material as provided in paragraph FILLING AND COMPACTION.

3.4.1.4 Excavation for Appurtenances

Provide excavation for outlets, catch-basins, inlets, or similar structures sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members.

3.4.2 Underground Utilities

Perform work adjacent to utilities in accordance with procedures outlined by Owner. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Geotechnical Engineer. Report damage to utility lines or subsurface construction immediately to the Geotechnical Engineer.

3.4.3 Structural Excavation

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata.

Concrete placement is not permitted until footing subgrades have been inspected and approved by the Geotechnical Engineer.

3.5 SUBGRADE PREPARATION

3.5.1 General Requirements

Shape subgrade to line, grade, and cross section as indicated. Remove unsatisfactory and unstable material in surfaces to receive fill or in excavated areas, and replace with satisfactory materials. Do not place material on surfaces that are muddy, frozen, contain frost, or otherwise containing unstable material. Scarify the surface to a depth of 4 inches prior to placing fill. Step or bench sloped surfaces steeper than 1 vertical to 4 horizontal prior to scarifying. Place 4 inches of loose fill and blend with scarified material. When subgrade is part fill and part excavation or natural ground, scarify to a depth of 8 inches.

3.5.2 Subgrade for Structures, Spread Footings, and Concrete Slabs

Do not excavate below depth shown for structures, spread footings, and concrete slabs. If over excavation occurs, notify the Geotechnical Engineer and remove, replace, and compact as directed. After final rolling, the surface of the subgrade for buildings and pavements must not show deviations greater than 0.05 foot when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area.

3.6 FILLING AND COMPACTION

Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs for SUBGRADE PREPARATION. Do not place

material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to plus or minus 2 percent of optimum moisture. Fill and backfill to contours, elevations, and dimensions indicated. Compact and test each lift before placing overlaying lift.

3.6.1 Trench Backfill

Backfill trenches to the grade shown. For pipes and cables, leave the joints and couplings uncovered during pressure tests. Do not backfill the trench until all specified tests are performed.

3.6.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with satisfactory material or initial backfill material.

3.6.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with satisfactory material placed in layers not exceeding 6 inches loose thickness.

3.6.1.3 Initial Backfill

Provide fills of the type and thickness shown on the Plans. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the buried component. Bring up the backfill evenly on both sides of the component for the full length of the component. Take care to ensure thorough compaction of the fill under the haunches of the component.

3.6.1.4 Final Backfill

Do not begin backfill until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, and the excavation cleaned of trash and debris. Bring backfill to indicated finish grade. Heavy equipment for spreading and compacting backfill are not to be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; compact remaining area in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Place backfill carefully around pipes or tanks to avoid damage to coatings, wrappings, or the structures themselves.

Fill the remainder of the trench. Place backfill material and compact as follows:

3.6.1.5 Buried Tape And Detection Wire

3.6.1.5.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.6.1.5.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.6.2 Type A Placement

Place fill and backfill in successive horizontal layers of loose material not more than 12 inches in depth, or in loose layers not more than 6 inches in depth when using hand-operated compaction equipment. Remove all material particles greater than 6-inches in diameter. Do not place over wet or frozen materials. Compact to at least 70 percent of relative density, except as otherwise specified. Perform compaction in such a manner as to prevent wedging action or eccentric loading upon or other damage to the structure. Moisture condition fill and backfill material to within range of plus 2 or minus 2 percent of optimum moisture content at the time of compaction. Compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.6.3 Type C Placement

Place fill and backfill in successive horizontal layers of loose material not more than 12 inches in depth, or in loose layers not more than 6 inches in depth when using hand-operated compaction equipment. Remove all material particles greater than 12-inches in diameter. Do not place over wet or frozen materials. Compact to at least 70 percent of relative density, except as otherwise specified. Perform compaction in such a manner as to prevent wedging action or eccentric loading upon or other damage to the structure. Moisture condition fill and backfill material to within range of plus 2 or minus 2 percent of optimum moisture content at the time of compaction. Compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.6.4 Switchyard Surface Course Placement

Place fill and backfill in successive horizontal layers of loose material not more than 12 inches in depth, or in loose layers not more than 6 inches in depth when using hand-operated compaction equipment. Do not place over wet or frozen materials. Compact to at least 70 percent of relative density, except as otherwise specified. Compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.6.5 Bedding Sand Placement

Place fill and backfill in successive horizontal layers of loose material not more than 12 inches in depth, or in loose layers not more than 6 inches in depth when using hand-operated compaction equipment. Do not place over wet or frozen materials. Compact to at least 95 percent of maximum dry density (standard proctor), except as otherwise specified. Place in a single lift and compact with a minimum of four passes of a hand-operated plate-type vibratory compactor.

3.7 FINISHING/FINISH OPERATIONS

During construction, keep excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, frozen or otherwise unstable subgrade.

Finish the surface of excavations and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except as indicated for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.7.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.8 DISPOSITION OF SURPLUS MATERIAL

Remove from property all surplus or other soil material not required or not suitable for filling or backfilling, along with brush, refuse, stumps, roots, and timber. Properly disposed of in accordance with all applicable laws and regulations. Prepare plan for Disposition of Surplus Materials to include permissions document to dispose of nonsalable products.

3.9 TESTING

Perform testing, using a Qualified Technician, as indicated in the following table. Submit Material Test Reports showing compliance with these requirements.

Material Type	Location of Material	Test Method	Test Frequency
Bedding Sand	Switchyard and Powerhouse	Density - ASTM D698	One test per 2000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines. Double testing frequency for areas compacted by hand-operated machines.

Material Type	Location of Material	Test Method	Test Frequency
Type A Type C Switchyard Surface Course	Switchyard and Powerhouse	Relative Density - ASTM D4253 ASTM D4254	One test per 2000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines. Double testing frequency for areas compacted by hand-operated machines.
All Fills	Switchyard and Powerhouse	Moisture Content - ASTM D2216	One representative test per 2000 cubic yards of fill and backfill. Sample taken immediately prior to compaction after moisture conditioning.
All Fills	Switchyard and Powerhouse	Compaction - ASTM D6938	One representative test per 2000 cubic yards of fill and backfill. For low fines material which cannot develop a reliable proctor curve or cannot be measured with a nuclear density gauge, visual observation and compliance verification by the Geotechnical Engineer is acceptable.
Bedding Sand	Switchyard and Powerhouse	Gradation - ASTM C136/C136M	One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the density.

-- End of Section --

SECTION 33 71 02

HIGH-VOLTAGE SWITCHGEAR AND PROTECTION DEVICES

PART 1 GENERAL

1.1 SCOPE

This specification covers the design, manufacture, and testing of three pole, gang operated, vertical interrupter outdoor circuit switchers with an integral disconnect switch (center break or double-end break design).

1.2 SERVICE CONDITIONS

The circuit switcher shall be suitable for outdoor installation in electric power substations under the following conditions:

1.2.1 Temperature

The circuit switcher shall perform in an ambient temperature range of -40°C through +50°C.

1.2.2 Altitude

The circuit switcher shall perform at elevations up to 3,300 feet (1,005.8 meters).

1.2.3 Seismic

The circuit switcher and disconnect shall be capable of withstanding seismic loading of 0.2 g ground acceleration in any direction when installed on the manufacturer's furnished support structure and anchor bolts, and with flexible connections to the terminal pads. The circuit switcher shall perform its specified functions during and after the seismic event.

1.2.4 Wind Loading

The circuit switcher and disconnect shall be capable of withstanding wind loads up to 90 mph without loss of function.

1.3 CIRCUIT SWITCHER DESIGN

1.3.1 Electrical

a. Electrical Ratings:

Maximum voltage rating (kV)	69
Interrupter/blade minimum BIL (kV)	350
Continuous current	2000 A

Maximum voltage rating (kV)	69
Power frequency	60 Hz
Short-time withstand	50 kA (3 sec)
Peak withstand	130 kA
Insulator design	Porcelain
Ambient temperature range	-40C to +50C standard (-50C to +50C optional)

b. Circuit Switcher Ratings:

Primary fault interrupting	25 kA
Secondary thru-fault interrupting	4 kA
Interrupting time	3 cycles
Short-circuit making	50 kA

* Consult factory for 4000 A ratings

1.3.2 Rated Duty Cycle

Rated Duty Cycle: O-0.3 sec-CO-15 sec-CO

1.3.3 Source Supply Voltage

a. Motor Voltage: 125 VDC

b. Auxiliary Voltage: 120 VAC

c. Control Voltage: 125 VDC

1.3.4 Interrupter

The circuit switcher shall use SF6 single gap interrupters. Each interrupter shall be provided with an overpressure relief device and shall be field refillable. Hermetically sealed interrupters are not acceptable due to the inherent dangers to purchaser's personnel associated with handling fully pressurized SF6 devices during installation and due to potential hazards encountered during transportation and offloading.

1.3.5 Insulators

The support insulators and the interrupter insulators shall be ANSI 70 gray in color and either porcelain or composite in construction.

1.3.6 SF6 Gas System

a. The circuit switcher shall have a gas system constructed of rigid copper piping or a combination of rigid copper piping and flexible stainless steel tubing that allows each interrupter to be pressurized

through a fill port.

b. The gas system shall include the insulator and a color coded, temperature compensated density gauge that is visible from the ground and which is furnished with low-pressure alarm and lockout contacts. The density gauge must be at ground potential. Battery powered gas density monitors are not acceptable.

c. The system shall be constructed such that the density gauge can be isolated from the interrupter to allow the low-pressure alarm and lockout contact set points to be verified. A means for refilling the system in the field without disassembling the circuit switcher must be provided. The device shall have a leak rate of less than 0.5% per year.

1.3.7 Terminal Pads

Terminal pads shall be unplated aluminum with a 4-hole NEMA drilling pattern for use with purchaser-furnished terminal connectors. The terminal pads shall be reversible for mounting at the top, bottom, or either side of the interrupter.

1.3.8 Circuit Switcher Operating Mechanism

1.3.8.1 Spring Operating Mechanism

Each circuit switcher shall be provided with a spring open-spring close mechanism capable of a duty cycle of O-0.3 seconds-CO-15 seconds-CO. The spring shall be charged via an electric motor in 15 seconds or less. Pneumatic, hydraulic, or combination pneumatic/hydraulic mechanisms are not acceptable. Devices utilizing multiple mechanisms are not acceptable.

1.3.8.2 Mechanism Housing and Control Components

a. An ANSI 70 gray painted steel mechanism housing shall be furnished and shall be provided with the following accessories:

1. Electric spring charging motor

2. Color coded, temperature compensated gas density gauge with low pressure alarm contact and low-pressure lockout contact

3. Trip-close pistol grip switch

4. Close coil

5. Dual trip coils

6. Anti-pump relay

7. Local-remote selector switch

8. A minimum of 10 spare non-adjustable auxiliary switch contacts that are factory set as 5 normally open (NO) and 5 normally closed (NC) contacts

9. Thermostatically controlled cabinet heater

10. Molded case circuit breakers for protection of motor circuit, control circuit, and heater circuit

11. Spring charged-discharged indicator

12. Manual closing spring charging handle

13. Open-Close position indicator

14. Position indicating lights (green=open, red=closed)

15. Manual trip lever

16. Operations counter

17. 120 VAC cabinet light with door actuated switch

18. View window in cabinet door

19. 120 VAC duplex receptacle with GFCI

20. Hinged cabinet door with 3-point latch, open position door stop, and padlocking provisions

1.3.8.3 Ground Pads

Two NEMA 2-hole ground pads shall be supplied for grounding the structure to the station ground grid.

1.4 MANUFACTURING REQUIREMENTS

1.4.1 Wiring

Wiring Shall be the following:

a. Point-to-point without splices or tee connections

b. Bundled using cable ties

c. Clearly identified with permanently affixed markers

d. Sized per NFPA-70 except being No. 14 AWG

1.4.2 Base Frame

Each circuit switcher shall be provided with a manufacturer furnished base frame which houses the gas piping for the three support/interrupter insulators which form the gas system while also housing the interpole linkage that connects the three interrupters to the spring operating mechanism. Phase spacing shall be as shown in the following table:

Maximum kV Rating	Phase Spacing Options (inches)
69	51

1.5 DESIGN TESTS

A. The circuit switcher shall be design tested in accordance with ANSI C37.09-2001. The testing shall include a dielectric test, a power test, a

continuous current test, and a mechanical endurance test. The dielectric test shall include 60 Hz power frequency, lighting impulse withstand, and visual corona. The power test shall include short circuit interrupting, fault closing, and short-time withstand.

1.6 PRODUCTION TESTS

Each circuit switcher shall be fully assembled as a three-phase unit at the factory that is adjusted, tested, and timed per ANSI C37.09 section 5. The tests shall include the following:

a. Mechanical Operation:

1. There shall be at least 50 mechanical operations performed at the factory. Timing tests, opening and closing operations at minimum and maximum operating voltage, and spring recharge time shall be recorded.

b. Leak Test:

1. An SF6 leak test shall be performed to confirm the leak rate is less than 0.5% per year.

c. Resistance Tests:

1. Current Path Resistance Test: A terminal-to-terminal micro-ohm resistance check shall be performed on each interrupter using a 100 A DC source, and the values shall be recorded.

2. Heater, Coil, and Relay Resistance Test: The resistance of each heater, coil, and relay shall be confirmed to be within specifications, and the value(s) shall be recorded.

d. Dielectric Tests:

1. Control Circuit Dielectric Test: The completely assembled and wired operator control circuit shall pass a dielectric test of 1500 V for 1 minute.

2. Interrupter Dielectric Test: Each interrupter shall pass a power frequency withstand test at 60 Hz for one minute. The required test value shall be at least three times rated line-to-ground voltage.

1.7 SWITCH DESIGN

1.7.1 Electrical

a. Center Break Disconnects* (Types EC-1 and EC-2)

b. Double End Break Disconnects (Type RDA-1)

c. Electrical Switch Design Requirements:

Maximum voltage	69 kV
BIL	350 kV

Maximum voltage	69 kV
Continuous current	2000 A
Rated short-time RMS symmetrical	63 kA (3 sec), 164 kA peak
Ambient temperature range	-40C to +50C
Number of mechanical operations	1000 for all kV ratings

* Ratings vary slightly for center break disconnects depending on style selected (EC-1 or EC-2).

1.7.2 Operating Mechanism

The operating mechanism will be as specified on the request for quotation and will be either a swing handle operator, a worm gear operator, or a motor operator. The maximum operating force to open or close the switch when using a swing handle operator shall be 50 lbs force exerted at the end of a 3-foot effective length handle. The maximum operating force to open or close the switch when using a worm gear operator shall be 35 lbs force exerted at the end of the crank handle. The operating mechanism shall be capable of being padlocked in both the open and the closed position. To prevent the disconnect from being opened or closed when the circuit switcher is closed, interlocking, either electrical or mechanical, or both should be provided.

1.7.3 Production Tests

Each disconnect switch shall be assembled as a single-phase unit at the factory, with insulators (as specified) adjusted and final test completed. The minimal tests shall include the following:

a. Mechanical Operation

1. Open and Close checks shall be performed.

b. Resistance Tests

1. A terminal-to-terminal micro-ohm resistance check shall be performed on each interrupter using a 100 A DC source, and the values shall be recorded.

c. Motor Operator Electrical Interlock Test

1. If there is an electrical interlock between the circuit switcher and a disconnect motor operator, the operation sequence should be shown on the drawings and tested in the factory prior to shipment.

1.8 SUPPORT STRUCTURE

Each circuit switcher with integral disconnect shall be provided with a manufacturer supplied support structure consisting of a minimum of two vertical support columns. The structure shall be capable of supporting both the circuit switcher and disconnect along with associated control and operator enclosures. The mounting pedestal shall be hot-dipped galvanized steel, and shall allow convenient ground level access to the control components. The height of the pedestal will be a standard manufacturer

height of at least 12 feed. Unless otherwise specified in the quotation request, anchor bolts will be provided by the purchaser. All anchor bolts shall be sized as required for the operational loads generated by the circuit switcher. The manufacturer shall determine anchor bolt sizing and anchor bolt plan details when providing the anchor bolts.

1.9 SPARE PARTS

Anchor bolts shall be required to be purchased at the time of circuit switcher purchase. Stock shall be maintained at the manufacturer available for rush shipment in the event of an emergency need.

1.10 DOCUMENTATION REQUIREMENTS

1.10.1 Approval Drawings

The manufacturer shall furnish approval drawings in AutoCAD.DWG format via email. The purchase order will designate the name and e-mail address of the individual where the drawings should be forwarded. If there are no comments to the approval drawings, purchaser will respond via e-mail that drawings are approved as submitted with no changes. If comments are required, then one copy of the drawings will be returned to the manufacturer within 10 days from the date of transmittal marked "approved with comments as noted".

1.10.2 Final Drawings

The manufacturer shall furnish final drawings in AutoCAD.DWG format via e-mail. Unless otherwise specified in the purchase order, the final drawings will be forwarded to the same individual that the approval drawings were sent to.

1.10.3 Instruction Books

The manufacturer shall furnish an electronic copy of each applicable instruction book in Adobe Acrobat.PDF format via e-mail. Unless otherwise specified in the purchase order, the instruction book(s) will be forwarded to the same individual that the approval drawings were sent to.

1.10.4 Additional Documentation

The manufacturer shall provide one complete set of final drawings and one copy of each applicable instruction book shall be shipped in a weatherproof envelope with each circuit switcher.

1.11 SHIPPING AND DELIVERY

The circuit switcher shall be match-marked and disassembled as necessary to accommodate shipping dimensional clearance restrictions. Each interrupter shall be shipped with a positive pressure of 5-10 psi of SF6, eliminating the need to pull a vacuum on the interrupters in the field. An SF6 fill kit shall be provided to fill the interrupters to rated pressure during installation.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 40 05 13

PIPELINES, LIQUID PROCESS PIPING

PART 1 GENERAL

1.1 APPLICABILITY

This specification section is intended to apply to the supply and/or installation of piping and appurtenances associated with: the oil-water separator inlet and outlet piping, the sump interconnection and cooling water piping used when Unit 3 is operated in synchronous condensing mode, the turbine air vent piping, and those portions of the OWNER-furnished cooling water piping that are indicated to be fabricated, assembled, or installed in the field.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2023) Scheme for the Identification of Piping Systems
ASME B1.1	(2024) Unified Inch Screw Threads (UN, UNR, and UNJ Thread Form)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2024) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2021) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B31.3	(2024) Process Piping
ASME B36.19M	(2022; Errata 2023) Welded and Seamless Wrought Stainless Steel Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C111/A21.11	(2023) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C210	(2024) Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of

	Steel Water Pipelines
AWWA C213	(2022) Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
AWWA C217	(2023) Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings
AWWA C219	(2023) Bolted Sleeve-Type Couplings for Plain-End Pipe
AWWA C504	(2023) Standard for Rubber-Seated Butterfly Valves
AWWA C508	(2017) Swing-Check Valves for Waterworks Service, 2 In. Through 48-In. (50-mm Through 1,200-mm) NPS
AWWA C515	(2020) Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	(2024) Protective Interior Coatings for Valves and Hydrants

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105/A105M	(2023) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A126	(2004; R 2023) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A182/A182M	(2024) Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

ASTM A193/A193M	(2025) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2024) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A240/A240M	(2025a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A269/A269M	(2024) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A312/A312M	(2022a) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A403/A403M	(2025) Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A479/A479M	(2024) Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A536	(2024) Standard Specification for Ductile Iron Castings
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2021) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2467	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2774	(2021a) Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	(2020) Standard Practice for the Two-Step

	(Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3892	(2015) Standard Practice for Packaging/Packing of Plastics
ASTM E814	(2024) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM F402	(2018) Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F656	(2021) Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 704	(2022) Standard System for the Identification of the Hazards of Materials for Emergency Response

PLASTICS PIPE INSTITUTE (PPI)

PPI Handbook	(2008) PPI Handbook Of PE Pipe

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards

1.3 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL

PROCEDURES:

SD-02 Shop Drawings

Materials and Equipment

Equipment Shop Drawings; O

Support System Detail Drawings; O

SD-03 Product Data

Qualifications

Welders

Waste Water Disposal

Manufacturer's Field Services

Delivery, Storage and Handling

Materials and Equipment; O

Valve Schedule; O

Pump; O

SD-06 Test Reports

Pipe Leakage Tests

Hydrostatic Tests

Valve Testing

SD-07 Certificates

Plastic Piping System

Plastic Pipe Installation

1.4 QUALIFICATIONS

1.4.1 Experience

Submit a statement certifying that the Contractor has the specified experience. Ensure Contractor has successfully completed at least three projects of the same scope and size or larger within the last six years. Demonstrate specific experience in regard to the system installation to be performed.

1.4.2 Welders

Submit the names of all qualified welders, their identifying symbols, and the qualifying procedures for each welder including support data such as test procedures used, standards tested to, etc. Weld pressure piping systems in accordance with qualifying procedures using performance qualified welders and operators. Use procedures and welders in accordance

with Section 40 17 26.00 20 WELDING PROCESS PIPING. Weld structural members in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials delivered and placed in storage must be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged must be replaced at the Contractor's expense. During installation, piping must be capped to keep out dirt and other foreign matter. A Safety Data Sheet in conformance with 29 CFR 1910 Section 1200(g) must accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling must be in accordance with ASTM F402. Storage facilities must be classified and marked in accordance with NFPA 704. Materials must be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings must be handled and stored in accordance with the manufacturer's recommendation. Plastic pipe must be packed, packaged and marked in accordance with ASTM D3892.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Existing Conditions

Verify existing piping and penetrations. Prior to ordering materials, expose all existing pipes which are to be connected to new pipelines. Verify the size, material, joint types, elevation, horizontal location, and pipe service of existing pipes, and inspect size and location of structure penetrations to verify adequacy of wall sleeves, and other openings before installing connecting pipes.

1.7 SEQUENCING AND SCHEDULING

For slab, floor, wall, and roof penetrations, keep on site pertinent wall pipes and sleeves before they are required for placement in concrete forms. Verify and coordinate the size and location of building and structure pipe penetrations before forming and placing concrete.

1.8 MAINTENANCE

1.8.1 Extra Materials

Submit the manufacturer's installation recommendations or instructions for each material or procedure to be utilized, including materials preparation. Concurrent with delivery and installation of the specified piping systems and appurtenances, furnish spare parts for each different item of material and equipment specified that is recommended by the manufacturer to be replaced any time up to 3 years of service. For each type and size of valve, provide the following extra materials: lubricator, lubricant (with appropriate temperature rating), lubricator/isolating valve; galvanized operating wrench, 4 feet long, for T-handled operators. Extra materials include 2 of the following spare parts for each type and size of valve: gaskets; O-ring seals; all elastomer parts; stem packing; seat rings and seat ring pulling tool.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

This specification covers the requirements for above and below grade liquid process pipe, pipe supports, fittings, equipment and accessories located both inside and outside of the powerhouse.

2.1.1 Design Requirements

Select and design support systems in accordance with MSS SP-58 within the specified spans and component requirements. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing supports throughout facility. The structural design, selection, fabrication and erection of piping support system components must satisfy the seismic requirements in accordance with Section 13 48 73 SEISMIC CONTROL FOR MISCELLANEOUS EQUIPMENT.

2.1.2 Performance Requirements

The pressure ratings and materials specified represent minimum acceptable standards for piping systems. Provide piping systems suitable for the services specified and intended. Coordinate each piping system to function as a unit. Provide flanges, valves, fittings and appurtenances with a pressure rating no less than that required for the system in which they are installed.

2.1.2.1 Buried Piping Systems

Provide piping systems suitable for design conditions, considering the piping both with and without internal pressure. Give consideration to all operating and service conditions both internal and external to the piping systems. Ensure buried ferrous piping has cathodic protection.

2.1.2.2 Above Grade Piping Systems

Provide piping systems suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Give consideration to all operating and service conditions both internal and external to the piping systems.

2.2 MATERIALS AND EQUIPMENT

Submit manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings; thermal characteristics (coefficient of expansion and thermal conductivity); and chemical resistance to each chemical and chemical mixture in the liquid stream. Provide piping materials and appurtenances as specified and as shown on the drawings, and suitable for the service intended. Ensure piping materials, appurtenances, and equipment supplied as part of this contract are of equal material and ratings as the connecting pipe, new and unused except for testing equipment. Ensure components that serve the same function and are the same size are identical products of the same manufacturer. Provide general materials to be used for the piping systems in accordance with the contract drawings. Submit a list of piping systems, pressure ratings and source of supply for each piping system broken out by material, size and application as

indicated on the contract drawings. A list of any special tools necessary for each piping system and appurtenances furnished for adjustment, operation, maintenance and disassembly of the system. Provide pipe fittings compatible with the applicable pipe materials.

2.2.1 Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacturing of the products and that essentially duplicate items that have been in satisfactory use for at least 10 years prior to bid opening. Submit the following: Equipment shop drawings and support system detail drawings showing piping systems and appurtenances, such as mechanical joints, valves, local indicators and hangers, including a complete list of equipment and materials. As-built drawings showing pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. As-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, vents, drains, and all other inline devices; if the contract drawings contained P&IDs, revise the P&IDs found in the contract drawings to reflect the constructed process system, as directed by the OWNER. Use nominal sizes for standardized products. Provide pipe, valves, fittings and appurtenances supported by a service organization that is, in the opinion of the OWNER, reasonably convenient to the site.

2.2.2 Identification and Tagging

Each piece of pipe must bear the ASTM designation and all other markings required for that designation. Mark valves in accordance with MSS SP-25 and securely attach an identification tag using stainless steel wire. Identification tags must be 1.375 inch inches minimum diameter, made of brass, engraved laminated plastic, engraved anodized aluminum, or stamped stainless steel. Use black indentations for reading clarity. Display service, valve identification number shown on the Valve Schedule in the contract drawings, the manufacturer's name, and the valve model number.

2.3 DUCTILE IRON PIPING SYSTEM

2.3.1 Ductile Iron Joints

Connect the existing ductile iron transformer containment area drain outfall pipe to the new oil-water separator inlet piping by means of a bolted sleeve type coupling per AWWA C219. The coupling must be suitable for use on both PVC and ductile iron piping. After installation and prior to backfill, wrap the coupling with a wax tape wrap per AWWA C217.

2.4 CARBON STEEL PIPING SYSTEM

2.4.1 Carbon Steel Pipe

2.4.1.1 General Service

Provide carbon steel pipe meeting the requirements of ASTM A53/A53M seamless or electric-resistance welded, Grade B and in accordance with Pipe Schedule.

2.4.2 Carbon Steel Joints

Join carbon steel piping by welding fittings or flanges. Provide

dielectric fittings or isolation joints between all dissimilar metals.

2.4.3 Carbon Steel Fittings

Fittings must be carbon steel. Where cast fittings are not available, fabricate segmental welded steel fittings, ASTM A53/A53M, Grade B, meeting the requirements of manufacturer's recommended wall thicknesses.

2.4.3.1 Welding Fittings

Provide butt-welding or socket-welding welding fittings. Provide welding fittings consisting of forged steel, ASTM A105/A105M Class 150 conforming to ASME B16.9, or ASME B16.11.

2.4.3.2 Flanged Fittings

Ensure the internal diameter bores of flanges and flanged fittings are the same as that of the associated pipe. The flanges must be welding neck, slip-on, or socket welding type. Flanges and flanged fittings must be forged steel, ASTM A105/A105M, faced and drilled to ASME B16.5 Class 150 with a 0.0625 inch raised face or flat face in order to maintain compatibility with the mating valve or fitting. For tie-in to existing flanges, field check existing flanges for non-standard bolt hole configurations and design as required to assure new pipe and flange mate properly. Provide bolting consisting of alloy-steel ASTM A193/A193M Grade B7 hex head bolts and ASTM A194/A194M Grade 2H hex head nuts and hardened steel washers. When mating flange on valves or equipment is cast iron, use ASTM A193/A193M Grade B8 Class 1 bolts and ASTM A194/A194M Grade 8 heavy hex head nuts. Provide bolts with washers of the same material as the bolts. Provide gaskets meeting the requirements of ASME B16.5.

2.4.4 Carbon Steel Coatings

Coat the interior and exterior of carbon steel piping and components with a liquid epoxy per AWWA C210or fusion bonded epoxy coating per AWWA C213. Ensure coatings and finishes are 100 percent holiday free.

2.5 STAINLESS STEEL PIPING SYSTEM

2.5.1 Austenitic Piping

2.5.1.1 Stainless Steel Pipe

Stainless steel pipe intended for general corrosive service must meet the requirements of ASTM A312/A312M, seamless, Grade TP304, Schedule 40S in accordance with Pipe Schedule with dimensions conforming to ASME B36.19M.

2.5.1.2 Stainless Steel Tubing

Provide stainless steel tubing meeting the requirements of ASTM A269/A269M, seamless welded, Grade TP304, or TP316.

2.5.1.3 Stainless Steel Joints

Join stainless steel piping by welded fittings, or flanges. Join tubing using compression fittings. Provide dielectric fittings or isolation joints between all dissimilar metals.

2.5.1.4 Stainless Steel Welding Fittings

Provide butt-welding or socket-welding welding fittings. Provide welding fittings consisting of forged austenitic stainless steel, ASTM A403/A403M Grade TP304L.

2.5.1.5 Stainless Steel Flanged Fittings

Provide internal diameter bores of flanges and flanged fittings that are the same as that of the associated pipe. Ensure flanges are welding neck, slip-on, or socket welding type. Provide flanges and flanged fittings consisting of forged austenitic stainless steel, ASTM A182/A182M Grade TP304L, Class 150, drilled to ASME B16.5 with a 0.0625 inch raised face. For tie-in to existing flanges, field check existing flanges for non-standard bolt hole configurations and design as required to assure new pipe and flange mate properly. Bolting must be alloy-steel ASTM A193/A193M Grade B8 hex head bolts and ASTM A194/A194M Grade 8 hex head nuts. When mating flange on valves or equipment is cast iron, use ASTM A193/A193M Grade B8 Class 1 bolts and ASTM A194/A194M Grade 8 heavy hex head nuts. Provide bolts with washers of the same material as the bolts. Provide gaskets meeting the requirements of ASME B16.5.

2.5.1.6 Compression Fittings for Tubing

Provide compression fittings consisting of ASTM A479/A479M stainless steel, Grade TP316, nuts, ferrules and bodies rated to a minimum 2000 psig. Provide straight threads conforming to ASME B1.1.

2.6 PLASTIC PIPING SYSTEM

Submit documentation certifying that the manufacturer of each thermoplastic piping system is listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture each of the respective thermoplastic pipe systems.

2.6.1 PVC Pipe

PVC, ASTM D1784, minimum cell classification 12454, pipe must be Schedule 80 conforming to ASTM D1785 or gravity sewer pipe per ASTM D3034, SDR 35 as indicated in the Contract Drawings.

2.6.2 PVC Joints

Join piping system by socket-weld, flanged, or bell and spigot connections.

2.6.3 PVC Fittings

Ensure the schedule rating for the fittings is not less than that for the associated pipe. Fittings must be ASTM D1784, minimum cell classification 12454, PVC conforming to the requirements of ASTM D2467, socket type.

2.6.3.1 Push-on Joints

Seal push-on type joints with ethylene propylene rubber (EPR) gaskets in accordance with ASTM F477.

2.6.3.2 Flanged Fittings

Provide flanges and flanged fittings that are Class 125, one piece, molded hub type, flat faced, and conform to ASME B16.1ASTM A240/A240M, TP304 stainless steel backing flanges with ASME B16.1 drilling. Provide flanges complete with one-piece, molded PVC stub ends. Ensure flanged connections have the same pressure rating as the pipe or greater. Bolting must be stainless steel, ASTM A193/A193M, Grade B8 hex head bolts and ASTM A194/A194M, Grade 8 hex head nuts. Provide bolts with washers of the same material as the bolts. Gaskets must be full-faced, maximum 1/8 inch thick, fabricated from chloroprene rubber in accordance with ASME B16.21. When the mating flange has a raised face, use a flat ring gasket and provide a filler gasket between outer diameter of the raised face and the flange outer diameter to protect the PVC flange from bolting moment.

2.6.4 PVC Solvent Cement

Join socket connections with PVC solvent cement conforming to ASTM D2564. Ensure manufacture and viscosity is as recommended by the pipe and fitting manufacturer to assure compatibility. Prepare joints with primers conforming to ASTM F656 prior to cementing and assembly.

2.7 ISOLATION JOINTS AND COUPLINGS

2.7.1 Dielectric Fittings

Provide dielectric fittings between threaded ferrous and nonferrous metallic pipe, fittings and valves. Provide dielectric fittings, suitable for the required working pressure, temperature and corrosive application, to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.7.2 Isolation Joints

Provide isolation joints between nonthreaded ferrous and nonferrous metallic pipe fittings and valves. Provide isolation joints consisting of an isolation gasket of the dielectric type, isolation washers and isolation sleeves for flange bolts. Provide full faced isolation gaskets with an outside diameter equal to the flange outside diameter. Bolt isolation sleeves must be full length. Units must be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.7.3 Metallic Piping Couplings

Provide thrust ties where shown on the contract drawings and where required to restrain the force developed by 1.5 times the maximum allowable operating pressures specified. For metallic pipe other than ductile iron, attach thrust ties with fabricated lugs. For ductile iron pipe, attach thrust ties with socket clamps against a grooved joint coupling or flange. For exposed installations, use zinc-plated nuts and bolts. However, high-strength, low-alloy steel, in accordance with AWWA C111/A21.11, may be substituted for use on cast iron and ductile iron couplings. For buried and submerged installations, provide TP304 stainless steel bolts and nuts. Use steel middle rings and followers that are fusion bonded epoxy-lined and coated in accordance with AWWA C550.

2.7.3.1 Sleeve-Type Couplings

Use sleeve-type couplings for joining plain end pipe sections in a flexible manner with a diameter to properly fit the pipe. A coupling

consists of one steel or ductile iron middle ring, two steel or ductile iron followers, two elastomeric wedge section gaskets and elliptic-neck, track-head steel bolts designed to properly compress the gaskets. Gaskets must be ethylene propylene diene monomer (EPDM). Sleeve type couplings must comply with AWWA C219. Split sleeve-type couplings may be used in aboveground installations under special situations and when approved in advance by the OWNER.

2.8 PUMPS

The pump that supplies cooling water to the Unit 3 tailrace while the unit is operating in synchronous condensing mode shall be a vertical pump with performance characteristics as shown on the drawings. The pump shall be designed and manufactured for lubrication of the lineshaft bearings by the water being pumped. The pumping unit shall be designed and manufactured in accordance with the latest Hydraulic Institute standards and AWWA specifications for lineshaft turbine pumps. Submit pump product data showing materials of construction and performance curves for approval.

2.9 VALVES

2.9.1 General Requirements For Valves

Valves include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and all other accessories required for a complete operation. Ensure valves are suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Provide valves that are the same size as adjoining pipe. Ensure valve ends are compatible with adjacent piping system. Size an operator to operate the associated valve for the full range of pressures and velocities. Valves will open by turning counterclockwise. Provide factory mounted operators, actuators, and accessories.

2.9.2 Valve Schedule

Submit a list of valve materials, pressure ratings, valve operator's materials, location, source of supply, and reference identification as indicated in the contract drawings. Provide a list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly. Requirements relative to this paragraph are shown on the Valve Schedule located in the contract drawings.

2.9.3 Factory Finishing

Provide valves with an epoxy lining and coating in accordance with AWWA C550 unless otherwise specified. Ensure the epoxy is either a two-part liquid material or a heat-activated (fusion) material except that only a heat-activated material applies if a valve coating is specified as "fusion" or "fusion bonded" epoxy. Provide epoxy lining and coating with a minimum 7.0 mils dry film thickness except where it is limited by valve operating tolerances.

2.9.4 Check Valves

2.9.4.1 Swing Check Valves

Provide swing check valves conforming to the following:

a. Provide swing check valves, 2 inch through 48 inch, conforming to AWWA C508, and have ASME B16.1 Class 125 flanged end connections. Provide valves with a ductile iron body, and Buna-N with alloy steel and Nylon reinforcement -mounted disc. Provide valves 2 inch through 48 inch rated for 250 psig service . Coat the interior and exterior of the valve with a fusion bonded epoxy coating. Provide the valve with a mechanical indicator that is in constant contact with the disc that provides visual position indication of the disc. Basis of design for the swing check valve is the Valmatic Surgebuster line of swing check valves.

2.9.5 Gate Valves

2.9.5.1 General Service Gate Valves

Provide general service gate valves conforming to the following:

a. Provide gate valves, 2.5 inch and larger, with ductile iron bodies with stainless steel trim. Provide valves meeting the requirements of AWWA C515 and have Class 125 flanged end connections. Provide a NRS Bolted type bonnet. Discs must be wedge type of rubber coated ductile iron construction, and have nonrising stems. Gate valves must be coated with a fusion bonded epoxy coating meeting the requirements of AWWA C550. Gate valves to be installed outdoors in the vicinity of the switchyard must be top coated with a compatible UV-resistant polyurethane coating. Equip the valves installed outdoors in the vicinity of the switchyard with handwheel operators. Equipment the valve installed on the sump interconnection pipe with 2-inch square operating nut, extension stems, stem guides, and all fittings needed to re-use the existing floor box such that the valve can be opened and closed by means of a T-handle wrench from the floor level.

2.9.6 Butterfly Valves

2.9.6.1 Standard Service Butterfly Valve

Provide butterfly valves, 2 inch and larger, with ASTM A126 cast iron or ASTM A536 Grade 65-45-12 ductile iron bodies, with ASME B16.1 flanged end connections. Provide valves conforming to AWWA C504 Class 150B. Discs must be contoured ASTM A536 Grade 65-45-12 ductile iron. Provide stainless steel valve shafts with self-lubricating, corrosion-resistant sleeve type bearings. Provide resilient valve seats, constructed of EPDM or Buna-N, for 24 inch and smaller valves and attach to the disc. Hold valve seats in place by means of a stainless steel retaining ring. Valves must be lined and coated with a fusion bonded epoxy coating meeting the requirements of AWWA C550. Provide valves with manual hand wheel operators, or 2-inch square operating nut, shaft extensions, and fittings as needed to re-use existing floor box as indicated.

2.9.7 Valve Accessories

2.9.7.1 Extension Bonnet for Valve Operator

Provide all extension bonnets as necessary, complete with stem and accessories applicable to the specific valve and operator.

2.9.7.2 Floor Box and Stem

Reuse existing floor boxes above Sump 4 if possible. Otherwise, provide

the plain type floor box and stem for support of nonrising type stem; complete with stem, operating nut, and stem guide brackets. Space stem guide such that stem L/R ratio does not exceed 200. Supply anchors as required.

2.10 MISCELLANEOUS PIPING COMPONENTS

2.10.1 Expansion Joints

Provide all structural work and equipment required to control expansion and contraction of piping. Verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems.

2.10.1.1 Expansion Joint for Metallic Pipe

The expansion joint must be a bellows type with EPDM wetted materials of construction. Size expansion joint to match the associated piping. The maximum allowable working pressure is 150 psig at 120 degrees F. Size expansion joint for a maximum axial deflection of 0.375 inches, a lateral movement of 0.5 inches, and an angular rotation of 15 degrees. End connections must be ASME B16.5 Class 150 flanged. Provide required accessories for a complete assembly including: limit stops, and control rods.

2.11 PIPE SUPPORTS AND PENETRATIONS

Provide auxiliary steel where the support of piping systems and equipment is required between building structural elements. Provide light gauge and structural steel shapes conforming to the requirements of ASTM A36/A36M. The Contractor has the option to use pre-engineered support systems of electrogalvanized steel products. However, a mixture of support system manufacturers products is not permitted. Where auxiliary steel is indicated as stainless steel, provide TP304 stainless steel conforming to ASTM A167, No. 1 Finish.

2.11.1 Pipe Supports

Provide pipe supports conforming to the requirements of MSS SP-58 and as shown in the Contract Drawings. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material so that neither has a deteriorating action on the other.

2.11.1.1 Riser Clamps

Support vertical runs of piping at each floor, or closer where required, with ASTM A36/A36M carbon steel clamps bolted around pipes and attach to the building construction. Use two bolt-type clamps designed for installation under insulation on insulated pipe runs.

2.11.2 Wall Penetrations

2.11.2.1 Above Grade Wall Penetrations

Provide piping which passes through fire-rated or smoke-rated walls, floors, or ceilings with insulated and encased pipe sleeves. Seal penetrations through an existing fire or fire barrier wall with a fire stop system that has an "F" rating no less than the required fire resistance rating of the penetrated wall. The fire stopping sealant for metal piping systems must be vibration resistant, polysiloxane (also known

as silicone) based, nonslumping, premixed sealant with intumescent properties, that is rated for 3 hours pursuant to ASTM E814 and UL requirements. The fire stopping sealant for plastic and insulated piping systems must be a polysiloxane (also known as silicone) based, nonslumping, premixed sealant with intumescent properties , that is vibration and moisture resistant, and is rated for 3 hours pursuant to ASTM E814 and UL requirements with metal collars. Fit vented plastic pipe penetrations with galvanized steel collars that have intumescent inlays.

2.11.2.2 Below Grade Wall Penetrations

Provide below-grade wall penetrations with hydrostatic seals designed to seal opening between pipe or conduit and a through-structure opening. The seals must be modular mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening or polysiloxane (also known as silicone) based, nonslumping, vibration and water resistant sealant with intumescent properties.

2.11.2.3 Galvanizing

Galvanizing must be hot-dip applied and meet the requirements of ASTM A153/A153M. Stainless steel components may be substituted where galvanizing is specified.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the OWNER of any discrepancy before performing the work.

3.2 PREPARATION

3.2.1 Protection

Close pipe and equipment openings with caps or plugs during installation. Protect equipment from dirt, water, and chemical or mechanical damage.

3.2.2 System Preparation

3.2.2.1 Pipe and Fittings

Inspect pipe and fittings before exposed piping is installed or buried piping is lowered into the trench. Clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.2.2.2 Damaged Coatings

Repair damaged coating areas in the field with material equal to the original coating, except promptly remove damaged glass-lined pipe from the site. Do not install damaged piping materials. Field repair damaged and uncoated areas of galvanized piping conforming to ASTM A780/A780M.

3.2.2.3 Field Fabrication

Notify the OWNER at least 2 weeks prior to the field fabrication of pipe

or fittings and at least 3 days prior to the start of any surface preparation or coating application work. Perform field welding in accordance with Section 40 17 26.00 20 WELDING PRESSURE PIPING. Provide welding electrodes in accordance with Table 3.1 of AWS D1.1/D1.1M as required for the applicable base metals and welding process. Fabricate fittings in accordance with the manufacturer's instructions.

3.3 EXPOSED PIPING INSTALLATION

Run exposed piping as straight as practical along the alignment shown on the contract drawings and with a minimum of joints. Install piping and appurtenances in conformance with reviewed shop drawings, manufacturer's instructions and ASME B31.3. Install piping without springing or forcing the pipe.

3.3.1 Anchors and Fasteners

Impact expansion (hammer and explosive charge drive-type) anchors and fastener systems are not acceptable. Lead shields, plastic or fiber inserts, and drilled-in plastic sleeve/nail drive systems are also not acceptable.

3.3.1.1 Drilled-In Expansion Anchors and Fasteners

Design anchors to accept both machine bolts and/or threaded rods. Such anchors must consist of an expansion shield and expander nut contained inside the shield. Fabricate and design the expander nut to climb the bolt or rod thread and simultaneously expand the shield as soon as the threaded item, while being tightened, reaches, and bears against the shield bottom. Provide shield body consisting of four legs,taper the inside of each toward shield bottom (or nut end). Elongate the end of one leg and turn across shield bottom. Rib the outer surface of shield body for grip-action. The expander nut must be of square design with sides tapered inward from bottom to top. The anchor materials of construction must be TP304 stainless steel. Provide fasteners consisting of machine bolts for use with above anchors; provide nuts and washers conforming to ASTM A194/A194M. Ensure the anchor length, diameter, and embedment depth meet the manufacturer's requirements for the maximum allowable working load of the application.

3.3.1.2 Drilled-In Adhesive Anchors

Do not use drilled-in adhesive anchors for overhead applications. Compose anchors of an anchor rod assembly and an anchor rod adhesive cartridge. Provide anchor rod assembly composed of a chamfered and threaded stud rod of TP304 stainless steel with a nut and washer of TP316 stainless steel. Use anchor length, diameter, and embedment depth meeting the manufacturer's requirements for the maximum allowable working load of the application. Ensure the adhesive cartridge is a sealed capsule containing premeasured amounts of resin, quartz sand aggregate, and a hardener contained in a separate vial within the capsule. Activate the capsule ingredients by the insertion procedure of the anchor rod assembly.

3.3.2 Piping Expansion and Contraction Provisions

Install piping to allow for thermal expansion and contraction resulting from the difference between installation and operating temperatures. Design for installation of plastic pipe exposed to ambient conditions or in which the temperature variation of the contents is substantial must

have provisions for movement due to thermal expansion and contraction documented to be in accordance with PPI Handbook. Install anchors as shown in the contract drawings to withstand expansion thrust loads and to direct and control thermal expansion. Install an intermediate pipe guide for every pipe at each metal channel framing support not carrying an anchor or alignment guide. Where pipe expansion joints are required, install pipe alignment guides adjacent to the expansion device and within four pipe diameters. Install expansion devices in accordance with the manufacturer's instructions.

3.3.3 Piping Flexibility Provisions

Provide thrust protection as required. Install flexible couplings and expansion joints at connections to equipment, and where shown on the contract drawings. Provide additional pipe anchors and flexible couplings, beyond those shown on the contract drawings, to facilitate piping installation, in accordance with reviewed shop drawings.

3.3.4 Couplings, Adapters and Service Saddles

Thoroughly clean pipes of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Wipe gaskets clean prior to installation. Lubricate flexible couplings and flanged coupling adapter gaskets with the manufacturer's standard lubricant before installation on the pipe ends. Install couplings, service saddles, and anchor studs in accordance with manufacturer's instructions. Tighten bolts progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Use torque-limiting wrenches to tighten bolts.

3.3.5 Piping Equipment/Component Installation

Install piping components and indicators in accordance with manufacturer's instructions. Provide required upstream and downstream clearances, isolation valves, and miscellaneous devices for an operable installation.

3.3.5.1 Local Indicators

Install all direct-reading indicator devices, thermometers, and pressure gauges so that they can be easily read from floor level, and are readily accessible for maintenance and service. Coat all temperature sensing bulbs with a silver base heat transfer grease prior to insertion into the thermowell. Install pressure gauges and thermometers where indicated in the contract drawings.

3.3.6 Pipe Flanges

Pipe flanges must be set level, plumb, and aligned. Install flanged fittings true and perpendicular to the axis of the pipe. Ensure bolt holes are concentric to the centerline of the pipe and straddle the vertical centerline of the pipe.

3.3.7 Valve Locations

Locate valves in accordance with the contract drawings where actuators are shown. Where actuators are not shown, locate and orient valves to permit easy access to the valve operator, and to avoid interferences.

3.3.8 Plastic Pipe Installation

Submit a statement signed by the plastic pipe manufacturer's representative certifying that the Contractor's personnel are capable of properly installing the piping system on the project. Cut, make up, and install all plastic pipe in accordance with the pipe manufacturer's recommendations.

a. Do not lay pipe when the temperature is below 40.1 degrees F, nor above 90 degrees F when exposed to direct sunlight. Ensure any plastic pipe installed above grade and outdoors is ultraviolet (UV) protected or UV resistant.

b. Shield pipe ends that are to be joined from direct sunlight prior to and during the laying operation. Provide adequate ventilation when working with pipe joint solvent cement and handle solvent cements, primers and cleaners in accordance with ASTM F402.

c. Provide and install supports and hangers in accordance with the manufacturer's recommendations. Where plastic pipe is subjected to severe temperature fluctuations, provisions for expansion and contraction must be provided. Accomplish this with the use of expansion joints and offset piping arrangements. Hydrostatically test all lines at the maximum operating pressures.

3.3.8.1 PVC Piping

Construct solvent-cemented joints in accordance with ASTM D2855.

3.4 BURIED PIPE PLACEMENT

Install thermoplastic piping systems underground in accordance with ASTM D2774.

3.4.1 Excavation and Backfilling

Perform earthwork as specified in Section 31 00 00 EARTHWORK. Accomplish backfilling after inspection by the OWNER. Exercise care when lowering pipe into the trench to prevent damage or twisting of the pipe.

3.4.2 Fittings

Make press connections in accordance with manufacturer's installation instructions using tools approved by the manufacturer. Insert tubing fully into the fitting and then mark at the shoulder of the fitting. Check fitting alignment against the mark on the tubing to ensure the tubing is fully inserted before the joint is pressed. At valves and connections, dig out the trench bottom with sufficient length, width, and depth to ensure clearance between the undisturbed trench bottom and the valves and such connections.

3.4.3 Thrust Restraint

Thrust restraint devices are generally not shown in the contract drawings; their absence will not relieve Contractor of the responsibility for providing them as required to provide complete systems for the use intended. Provide thrust blocks and ties where required, whether or not shown on the contract drawings. At a minimum, provide thrust restraint at pipeline tees, plugs, caps, bends, and other locations where unbalanced

forces exist.

3.4.3.1 Thrust Blocks

Thrust blocking must be concrete of a mix not leaner than 1 part cement, 2.5 parts sand and 5 parts gravel, and have a compressive strength of not less than 2000 psi after 28 days. Place blocking between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, pour the base and thrust bearing sides of the thrust blocks against undisturbed earth. The sides of thrust blocks not subject to thrusts may be poured against forms. Provide area of bearing as shown or directed. Place blocking so that fitting joints are accessible for repair. Use steel rods and clamps, protected by galvanizing or a coating of bituminous paint, to anchor vertical down bends into gravity thrust blocks.

3.4.4 Marking Tape

Provide and install pipe marking tape in accordance with the requirements of Section 31 00 00 EARTHWORK.

3.4.5 Plastic Pipe Installation

Cut, fabricate, and install plastic pipe in strict conformance with the pipe manufacturer's recommendations. Provide offset loops from the trench centerline as recommended by the manufacturer for the maximum temperature variation between the pipe temperature at the time of solvent welding and operating temperature. Design for installation of plastic pipe exposed to ambient conditions or in which the temperature variation of the contents is substantial must have provisions for movement due to thermal expansion and contraction documented to be in accordance with PPI Handbook. Support flexible plastic pipe connected to heavy fittings, manholes, and rigid structures in such a manner that no subsequent relative movement between the plastic pipe at the flanged joint and the rigid structures is possible. Do not use thrust blocking for flexible plastic piping. Design and install piping to withstand the compression and expansion forces imposed by the trench conditions.

3.5 CONNECTING DISSIMILAR PIPE

Install flexible transition couplings, dielectric fittings and isolation joints in accordance with the manufacturer's instructions.

3.6 EXTERNAL CORROSION PROTECTION

Protect all pipe and piping accessories from corrosion and adverse environmental conditions.

3.6.1 Above Grade Metallic Piping

Do not paint nonferrous and stainless steel piping except for aluminum alloy piping. Where dissimilar metals are joined, use isolation joints.

3.6.1.1 Ferrous Piping

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed. Clean surfaces that contain loose rust, mill scale or other foreign substances mechanically by power wire brushing and prime with a ferrous metal primer. Finish primed surfaces with two coats of exterior epoxy paint in accordance with

AWWA C210.

3.7 PENETRATIONS

Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations. Coatings must be as specified in Section 09 90 00 PAINTS AND COATINGS. Support wall pipes securely by form work to prevent contact with reinforcing steel and tie-wires. Ensure joints are caulked with rubber sealant or sealed with a wall penetration seal. For existing concrete walls, rotary drilled holes may be provided in lieu of sleeves.

3.8 VALVE INSTALLATION

Install flanged valve bolt holes so as to straddle the vertical centerline of pipe. Clean flanged faces prior to inserting the gasket and bolts, and then tighten the nuts progressively and uniformly. Clean threads of threaded ends by wire brushing or swabbing prior to installation.

3.8.1 Valve Orientation

Install operating stem of a manual valve in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on contract drawings. Install operating stem of a manual valve in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown on contract drawings.

3.8.1.1 Butterfly Valves

Orientation of butterfly valves must take into account changes in pipe direction. Orient valve shafts so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of the disc.

3.8.2 Operator Extension Stems

Where the depth of the valve is such that its centerline is more than 1 foo t below grade, furnish an operator extension stem with a 2 inch operating nut to bring the operating nut to a point 5.9 inches below the surface of the ground and/or box cover. Locate operating nut in a floor box.

3.8.3 Torque Tube

Where the operator for quarter-turn valve is located on a floor stand, furnish an extension stem torque tube, properly sized for the maximum torque capacity of the valve.

3.9 AIR RELEASE, DRAINS AND SAMPLE PORTS

Provide sample ports where indicated on the contract drawings. Install specified vents at piping high points for entrapped air release and install drains in the low points of pipelines regardless of whether shown on contract drawings.

3.10 PIPING SUPPORT SYSTEMS INSTALLATION

The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing supports

throughout plant.

3.10.1 General Support Requirements

Provide pipe support systems meeting the requirements of MSS SP-58. Install Contractor-designed and selected support systems in accordance with MSS SP-58, and as specified herein. Support piping connections to equipment by pipe supports and not off the equipment. Support large or heavy valves, fittings, and/or equipment independently of associated piping. Do not support pipes off other pipes. Provide supports at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the contract drawings. Do not install pipe supports and hangers in equipment access areas or bridge crane runs. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing. At each channel type support, provide every pipe with an intermediate pipe guide, except where pipe anchors are required. Existing support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Provide pedestal type pipe supports under base flanges adjacent to rotating equipment and where required to isolate vibration. Brace piping 2.5 inch in diameter and larger for seismic forces. Install lateral supports for seismic loads at all changes in direction.

3.10.2 Support of Insulated Piping

Install oversized supports to fit the insulation inserts. Provide supports with galvanized or stainless steel protection shields and oversized rollers.

3.10.3 Dielectric Barriers

Install dielectric barriers between supports and copper or stainless steel piping, and between stainless steel supports and non-stainless steel ferrous piping.

3.10.4 Support Methods

Provide piping support as specified and as shown in the contract drawings. Support single or multiple horizontal suspended piping by trapeze hangers with channel type supports. Provide horizontal pedestal mounted piping with saddle type supports. Provide horizontal wall mounted piping with wall brackets. Support vertical piping by wall brackets,or riser clamps on floor penetrations.

3.10.5 Supports and Hangers for Stainless Steel Piping

Provide all hanger-pipe contact surfaces with a dielectric barrier consisting of chloroprene rubber wrapping . The load rating of universal concrete inserts is not allowed to be less than that of the hanger rods they support.

3.11 PIPE IDENTIFICATION, PAINTING AND COLOR CODING

Ensure color, coating, and lettering requirements for exposed piping are in accordance with ASME A13.1.

3.12 FIELD QUALITY CONTROL

3.12.1 Hydrostatic Tests

Where any section of a pipeline is provided with concrete thrust blocking for fitting, do not make the hydrostatic tests until at least 5 days after the installation of the concrete thrust blocking, unless otherwise approved by the OWNER.

3.12.1.1 Buried Piping

After the pipe is laid, the joints completed and the trench partially backfilled leaving the joints exposed for examination, subject the newly laid piping or any valved section of piping, unless otherwise specified, for 1 hour to a hydrostatic test pressure as listed in the Pipe Schedule in the contract drawings. Open and close each valve several times during the test. Carefully examine exposed pipe, joints, fittings, and valves during the partially open trench test. Replace joints showing visible leakage as necessary. Remove defective pipe, joints, fittings, and valves found during the pressure test and replace with new material, and repeat the test until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the OWNER when one or more of the following conditions are encountered: (1) wet or unstable soil conditions in the trench; (2) compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions; or (3) maintaining the trench in an open condition would delay completion of the Contract. The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the hydrostatic tests. Place backfill placed prior to the tests in accordance with the requirements of Section 31 00 00 EARTHWORK.

3.12.1.2 Exposed Piping

Conduct hydrostatic testing in accordance with ASME B31.3. Test piping systems under normal service conditions (as indicated in the Pipe Schedule in the contract drawings) to demonstrate compliance. Use water as the hydrostatic test fluid. Provide clean test water of such quality to prevent corrosion of the piping system materials. Open air release vents at all high points of the piping system in order to purge air pockets while the piping system is filling.

3.12.1.2.1 Rigid Piping

For rigid piping hydrostatic testing, calculate the maximum test pressure according to ASME B31.3, but do not exceed the yield strength of the piping system. The maximum velocity during filling is 0.25 fps applied over full area of pipe. Venting during filling may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents. Test all parts of the piping system. Maintain hydrostatic test pressure continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage. Examine all joints and connections for leakage. Ensure piping system, exclusive of possible localized instances at pump or valve packing, shows no visual evidence of leaking. Correct visible leakage and retest. Unless otherwise directed by the OWNER, leave the piping system full of water after leaks are repaired.

3.12.1.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a delay, underground piping jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Conduct tests for above ground pressure piping after the piping has been completely installed, including all supports, hangers, and anchors, and inspected for proper installation but prior to installation of insulation.

3.12.2 Pipe Leakage Tests

Unless approved by the OWNER, conduct leakage testing after the pressure tests have been satisfactorily completed. The duration of each leakage test is at least 2 hours. Leakage is defined as the quantity of the test liquid, water, that is supplied to the piping system, or any valved or approved section thereof, in order to maintain pressure within 5 psi of the specified leakage test pressure after the piping has been filled with the test liquid and all air is expelled. No piping installation will be accepted if leakage exceeds the values listed in the Pipe Schedule in the contract drawings.

Should any test disclose leakage greater than that allowed, locate the leaks and repair until the leakage is within the specified allowance, without additional cost.

3.12.3 Valve Testing

Submit copies of all field test reports within 24 hours of the completion of the test. Valves may either be tested while testing pipelines, or as a separate step. Demonstrate that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. Count and record the number of turns required to open and close each valve, and account for any discrepancies with manufacturer's data. Examine air and vacuum relief valves as the associated pipe is being filled to verify venting and seating is fully functional. Set, verify, and record set pressures for all relief and regulating valves. Test self-contained automatic valves at both maximum and minimum operating ranges, and reset upon completion of test to the design value.

3.13 FINAL CLEANING

3.13.1 Interim Cleaning

Prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping sections during fabrication. Examine the piping to assure removal of these and other foreign objects prior to assembly and installation.

3.13.2 Flushing

Following assembly and testing, and prior to final acceptance, flush piping systems with water to remove accumulated construction debris and other foreign matter. Flush piping until all foreign matter is removed from the pipeline. Provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water without damage to adjacent properties. The minimum flushing velocity is 2.5 fps. For

large diameter pipe where it is impractical to flush the pipe at the minimum flushing velocity, clean the pipeline in-place from the inside by brushing and sweeping, then flushing the pipeline at a lower velocity. Install cone strainers in the flushing connections of attached equipment and leave in place until cleaning is completed. Remove accumulated debris through drains, or by removing spools or valves.

3.14 WASTE WATER DISPOSAL

Submit the method proposed for disposal of waste water from hydrostatic tests and disinfection, and all required permits, prior to performing hydrostatic tests. Dispose of water used for testing, cleaning, flushing and/or disinfection in accordance with all applicable regulations. Disposal is solely the responsibility of the Contractor. Provide the method proposed for disposal of waste water to the OWNER for approval prior to performing any testing, cleaning, flushing and disinfection activities.

3.15 MANUFACTURER'S FIELD SERVICES

Submit a signed statement certifying that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance. Obtain manufacturer's technical assistance for Contractor training, installation inspection, start up, and owner operating and maintenance training. Follow manufacturer's instructions for installation.

-- End of Section --

SECTION 40 17 26.00 20

WELDING PRESSURE PIPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC V	(2017) BPVC Section V-Nondestructive Examination

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS Z49.1	(2021) Safety in Welding, Cutting and Allied Processes

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction

1.2 PROJECT SPECIFIC SCOPE

Work under this Section is limited to field welding associated with installation of the Unit 3 Pelton turbine distributor, turbine housing vent piping, and cooling water piping. The distributor will be shipped in three (3) sections that will be aligned, bolted into final position, and then field welded together. Vent piping for the turbine housing will be supplied and field welded on site at locations shown on the Supplier drawings. Cooling water piping consists of both steel piping and stainless steel piping and will require field welding of certain pipe flanges and other joints.No other pressure piping systems are included under this Section unless explicitly shown on the Contract Drawings.

1.3 SUBMITTALS

OWNER approval is required for submittals with an "O" classification. Submittals not having an "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Field Weld Map; O
Include location, length, weld type, weld ID numbering, and NDE method(s) for each field weld.

Weld Identifications

SD-07 Certificates

Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR); O
Submit WPS/PQR for distributor section welds and vent piping welds qualified in accordance with ASME BPVC Section IX.

Welder and Welding Operator Performance Qualification; O
Submit WPQ records for each welder/welding operator for the processes/positions to be used.

Nondestructive Examination (NDE) Procedures; O
Submit VT/PT/MT/UT procedures (as applicable) in accordance with ASME BPVC Section V.

NDE Personnel Certification; O
Submit NDE personnel certifications and the Contractor written practice meeting ANSI/ASNT CP-189.

Inspector Certification

SD-11 Closeout Submittals

Final Weld Log and NDE Reports O
Submit final weld log keyed to weld IDs and include all NDE reports and repair documentation.

1.4 QUALITY ASSURANCE

1.4.1 Welding Pressure Piping

Provide a field weld map identifying each distributor section weld, each vent piping weld, and each cooling water piping weld, including weld ID, weld type, weld length, base material identification (if known), proposed WPS, and required NDE method(s). Include hold points for Owner/Supplier coordination prior to welding and prior to any pressure testing.

1.4.2 Procedures

Develop and qualify procedures for welding metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified. Perform qualification testing by an approved testing laboratory, or by the Contractor if approved by the Owner in accordance with the qualified procedures. Notify the Owner at least 24

hours in advance of the time and place of the tests. When practicable, perform the qualification tests at or near the work site. Maintain current records of the test results obtained in welding procedure, welding operator/welder performance qualifications, and nondestructive examination (NDE) procedures. These records must be readily available at the site for examination by the Owner.

For distributor section welds, cooling water piping, and turbine housing vent piping welds furnished as part of the turbine package, comply with the Supplier’s welding and NDE requirements. Where this Section and the Supplier requirements differ, the more stringent requirement governs. Welding process selection must be consistent with the qualified WPS submitted for approval.

1.4.2.1 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification provided that the following conditions are fulfilled:

a. Copies of welding procedures, procedure qualification test records, and welder and welding operator performance qualification test records are submitted and approved in accordance with the paragraph SUBMITTALS.

b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality control organization.

c. The welding procedures, welders, and welding operators were qualified in accordance with ASME BPVC Section IX; and base materials, filler materials, electrodes, equipment, and processes conform to the applicable requirements of this specification and the approved WPS.

d. The requirements of paragraph WELDER AND WELDING OPERATOR PERFORMANCE QUALIFICATION for renewal of qualification were met, and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.4.2.2 Performance

The Contractor must be responsible for the quality of joint preparation, welding, and examination. Clearly identify and record materials used in the welding operations. The examination and testing defined in this specification are minimum requirements. Provide additional examination and testing as necessary to achieve the quality required.

1.4.3 Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR)

Qualification of the welding procedures for each group of materials to be welded is required as indicated in ASME BPVC SEC IX. Record in detail and qualify the "Welding Procedure Specifications" for every welding procedure proposed. Qualification for each welding procedure must conform to the requirements of ANSI Standards and to this specification. The welding procedures must specify end preparation for welds, including cleaning, alignments, and root openings. Preheat, interpass temperature control, and any postweld heat treatment requirements shall be as required by the approved WPS and the Supplier’s requirements for the turbine package. Where requirements differ, the more stringent requirement governs.

1.4.4 Welder and Welding Operator Performance Qualification

Qualify each welder and welding operator assigned to work covered by this specification by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires from the same specification, classification, or group number that will be encountered on his assignment. Welders or welding operators who make acceptable procedure qualification tests will be considered performance-qualified for the welding procedure used. Determine performance qualification in accordance with ASME BPVC SEC IX, and as specified.

1.4.5 Renewal of Qualification

Requalification of a welder or welding operator must be required under one or any combination of the following conditions:

a. When a welder or welding operator has not used the specific welding process for a period of 3 months. The period may be extended to 6 months if the welder has been employed on another welding process.

b. There is specific reason to question the welder's ability to make welds that will meet the requirements of the specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract and a qualification test has not been taken within the preceding 12 months. Renewal of qualification under this condition need be made on only a single test joint or pipe of any thickness, position, or material to reestablish qualification for any thickness, position, or material for which the welder or welding operator had qualified previously.

1.4.6 Qualification of Inspection and (NDE) Personnel

Qualification of Inspection and Nondestructive Examination (NDE) Personnel: Qualify inspection and nondestructive examination personnel in accordance with the following requirements:

1.4.6.1 Inspector Certification

Provide welding inspection by personnel qualified as AWS Certified Welding Inspector (CWI) qualified as an AWS Certified Welding Inspector (CWI) or by personnel qualified to perform VT in accordance with the Contractor’s written practice meeting ANSI/ASNT CP-189. VT personnel shall be qualified for the applicable method(s) and documented.

1.4.6.2 NDE Personnel Certification

Certify NDE personnel and establish a written procedure for the control and administration of NDE personnel training, examination, and certification. Base procedures on appropriate specific and general guidelines of training and experience recommended by ANSI/ASNT CP-189.

1.4.6.3 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedure specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable

welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified. Do not start welding work prior to procedure qualification. The certification must state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.4.7 Symbols

Conform to AWS A2.4.

1.4.7.1 Weld Identifications

Submit a list of the welders' names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.

1.4.8 Safety

Conform to AWS Z49.1, 29 CFR 1910-SUBPART Q, "Welding, Cutting, and Brazing," 29 CFR 1926-SUBPART J, "Welding and Cutting."

1.5 ENVIRONMENTAL

Do not perform welding when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Owner will determine when weather or working conditions are unsuitable for welding.

1.6 DELIVERY AND STORAGE

Deliver filler metals, electrodes, fluxes and other welding materials to the site in manufacturers' original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

PART 2 PRODUCTS

2.1 WELDING MATERIALS

Provide electrodes, filler metals, shielding gases, and consumables as required by the approved WPS for distributor section welds and vent piping welds. Materials shall be compatible with the base materials and shall produce sound welds when used by qualified personnel in accordance with qualified procedures.

PART 3 EXECUTION

3.1 WELDING

Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the Owner. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification unless otherwise specified. Assign each welder or welding operator an identifying number, letter, or symbol that must be used to identify his

welds. Each welder or welding operator must apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at 3 foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.

3.1.1 Distributor Welding Sequence

Install distributor sections sequentially, aligning and bolting flanged and nozzle connections per Supplier installation requirements. Do not perform distributor section field welding until final fit-up and alignment are complete and accepted. After welding, perform required examinations and testing prior to placing the distributor into service. Field weld housing vent piping and cooling water piping at locations shown on the Supplier drawings; vent welding may occur before or after distributor pressure testing where permitted by Supplier requirements and the approved test procedure.

3.2 WELDING OPERATORS

Perform welding in accordance with qualified procedures using qualified welders and welding operators.

3.3 EXAMINATIONS AND TESTS

Perform examinations and NDE for distributor section welds and vent piping welds as follows:

a. Visual Examination (VT): 100 percent VT of all field welds before, during, and after welding in accordance with this Section and ASME BPVC Section V.

b. Liquid Penetrant (PT): 100 percent PT of completed distributor section welds, cooling water piping welds, and vent piping welds unless otherwise indicated by the Supplier drawings or approved WPS.

c. Magnetic Particle (MT) and Ultrasonic (UT): Perform MT and/or UT when required by Supplier drawings, Supplier procedures, or when directed due to VT/PT indications or repair welding.

d. Timing: Perform PT/MT/UT after final surface conditioning and any required hold time per the approved NDE procedures.

e. Repairs: Evaluate, repair, and re-examine welds in accordance with paragraph CORRECTIONS AND REPAIRS.

3.3.1 Visual Examination

Visually examine welds as follows:

a. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.

b. During welding -- for conformance to the qualified welding procedure.

c. After welding -- for cracks, contour and finish, bead reinforcement,

undercutting, overlap, and size of fillet welds.

3.3.2 Nondestructive Examination

NDE must be in accordance with written procedures. Procedures for liquid penetrant, magnetic particle, and ultrasonic tests and methods must conform to ASME BPVC SEC V. The approved procedure must be demonstrated to the satisfaction of the Owner's QA personnel. In addition to the information required in ASME BPVC SEC V, the written procedures must include:

a. Timing of the nondestructive examination in relation to the welding operations.

b. Safety precautions.

3.3.3 Examinations and Tests by the OWNER

Examinations and tests will conform to paragraphs "Visual Examination" and "Nondestructive Examination" of this section, except that destructive tests may be required also. When destructive tests are made, qualified welders or welding operators must make repairs using welding procedures which will develop the full strength of the members cut. Welding must be subject to examination and tests in the mill, shop, and field.

3.4 ACCEPTANCE STANDARDS

3.4.1 Visual

The following are unacceptable for field welds under this Section:

a. Any cracks

b. Lack of fusion or incomplete fusion visible at the surface.

c. Incomplete penetration where the inside surface is accessible and examination indicates incomplete penetration.

d. Undercut greater than 1/32 inch deep.

e. Overlap, excessive convexity, excessive concavity, or other weld profile conditions that prevent required NDE or that create sharp notches or stress risers.

f. Any other surface condition that, in the Owner’s judgment, could impair integrity of the distributor assembly or vent piping.

3.4.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

a. Any cracks and linear indications.

b. Rounded indications with dimensions greater than 3/16 inch.

c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.

d. Ten or more rounded indications in any 6 square inches of surface,

with the major dimension of this area not to exceed 6 inches, with the area taken in the most unfavorable location relative to the indications being evaluated.

3.4.3 Liquid Penetrant Examination

Indications whose major dimensions are greater than 1/16 inch must be considered relevant. The following relevant indications are unacceptable:

a. Any cracks or linear indications.

b. Rounded indications with dimensions greater than 3/16 inch.

c. Four or more rounded indications in a line separated by 1/16 inch or less edge-to-edge.

d. Ten or more rounded indications in any 6 square inches of surface, with the major dimension of this area not to exceed 6 inches, with the area taken in the most unfavorable location relative to the indications being evaluated.

3.4.4 Ultrasonic Examination

When UT is performed, linear-type discontinuities interpreted as cracks, lack of fusion, or incomplete penetration are unacceptable regardless of length. Additional acceptance criteria shall be as defined in the approved UT procedure in accordance with ASME BPVC Section V and the Supplier’s requirements.

3.5 CORRECTIONS AND REPAIRS

Repair defects discovered between weld passes before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area must be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, reexamine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination must be the same as required for butt welds. Indication of a defect must be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

-- End of Section --

SECTION 46 25 14

COALESCING OIL-WATER SEPARATORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2017) Standard Methods for the Examination of Water and Wastewater

ASTM INTERNATIONAL (ASTM)

ASTM C990	(2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

1.2 SYSTEM DESCRIPTION

1.2.1 Applications

The separator shall remove free oil and suspended solids from oil-in-water mixtures of freshwater originating from switchyard operations. The influent oil-in-water mixture will flow by gravity to the unit which will not be located in an area with a corrosive atmosphere.

1.2.2 Influent Characteristics

Provide oil-water separator designed for a maximum flow of 140 gallons per minute. Operating temperatures of the influent oil-in-water mixture will range from 32 to 60 degrees F and ambient air temperatures will range from 10 to 80 degrees F. The specific gravity of the oil at operating oil-water temperatures will range from 0.84 to 0.90. The specific gravity of the freshwater at operating temperatures will range from 0.98 to 1.05. The average specific gravity of the suspended solids is 2.65. The influent is further characterized as follows:

Oil-in-Water Mixture	Minimum	TO	Maximum
Total solids	0	to	20 mg/L
Total suspended solids	0	to	20 mg/L
Petroleum hydrocarbons	90	to	110 mg/L
pH	6	to	8
Oil Droplet Size	Greater than 60 microns		

1.2.3 Performance Requirements

The petroleum hydrocarbon concentration in the effluent from the oil-water separator shall not exceed the following limitations:

Contaminants	Maximum
Petroleum hydrocarbon, daily maximum	10 mg/L

To achieve this goal, it will be necessary to remove all free oil droplets equal to or greater than 60 microns.

1.3 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Separator; O

Accessories; O

Submit shop drawings for separator and accessory equipment including principal dimensions, location of fittings and unit foundation. Include data to verify center of gravity with the unit empty and filled with water.

SD-05 Design Data

Separator; O

Accessories; O

Submit analysis, signed by a registered professional engineer, which indicates that at the calculated overflow rate, the separator will be provided with the required square feet of projected plate separation area to achieve the specified performance under laminar flow (i.e. Reynolds number of less than 500) conditions. Calculations shall take into account the rate of

flow, potential surge flow, influent concentrations, particle characteristics, fluid temperature, fluid specific gravities, and pH.

SD-06 Test Reports

Shop hydrostatic test; O

Submit results of hydrostatic and dynamic testing.

Inspection

Field hydrostatic test

Preoperational test

In-service test

SD-07 Certificates

Separator corrosion protection; O

Submit written verification on the fabricator's letterhead that surface preparation and coating application were performed in accordance with the manufacturer's printed recommendations for the coating system.

SD-08 Manufacturer's Instructions

Separator system; O

SD-10 Operation and Maintenance Data

Separator system, Data Package 3; O

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Protect materials not suitable for outdoor storage to prevent damage during periods of inclement weather, such as subfreezing temperatures, precipitation, and high winds. Store materials susceptible to deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. If special precautions are required, prominently and legibly stencil instructions for such precautions on outside of equipment or its crating.

1.4.2 Handling

Handle separator in such a manner as to ensure delivery to final location in sound, undamaged condition. Take special care not to damage interior and exterior surfaces of separator, coalescing plates, and associated supports and pipe coatings or linings. Make satisfactory repairs to damaged materials at no cost to OWNER. Carry and do not drag materials.

PART 2 PRODUCTS

2.1 MATERIALS

Construct the oil water separator using precast concrete base, top, and riser sections. Provide riser sections as needed to result in the top of the oil water separator being approximately 6 inches above the finished grade elevation in the switchyard. Sediment weir and oil retaining baffle installed inside the base section are also to be made of precast concrete. Seal joints between the base, riser, and top sections using a butyl resin sealant to provide watertight joints. Design the oil water separator for buried service.

2.1.1 Separator Corrosion Protection

2.1.1.1 Precast Concrete Separator

After shop conducted hydrostatic tests and have been successfully completed, provide a concrete sealant or coating system which will protect the separator from the oil-in-water mixture, and in situ soil conditions specified herein as recommended by the precast oil water separator manufacturer.

2.1.2 Substitutions

Separators constructed of reinforced fiberglass or reinforced glass fiber resin laminates over a rigid urethane foam core may be provided in lieu of precast concrete provided they are designed for underground service and are provided with provisions to prevent floatation when subject to high ground water levels. Provide fiber glass separator with lifting straps. Glass fiber reinforced plastic weirs may be accepted as a suitable weir and baffle material provided that necessary requirements for anchorage of these items include provisions for contraction and expansion. Surfaces shall be seamless, chemically resistant to oil-in-water mixture, and resistant to ultraviolet deterioration.

2.1.3 External Surfaces

External surfaces and appurtenances shall be resistant to corrosion from the in situ soil, backfill material, groundwater, and surface runoff .

2.1.4 Internal Surfaces

Parallel plate material and orientation shall enhance oil coalescence and solids removal, and be corrosion and chemically resistant to the oil-in-water mixture as specified in paragraph entitled "SYSTEM DESCRIPTION."

2.1.5 Hardware

Bolts, stiffeners, washers, nuts, screws, pins, and fittings as required shall be corrosion resistant. Provide materials that are inherently corrosion resistant and not merely treated with a corrosion-resistant coating, such as provided by the galvanizing process.

2.1.6 Accessibility

Do not bury tops of separators. Make the entire top area of the separator

visible from ground surface. Separators below grade with access manholes and extension tubes to the surface will not be permitted. Use open top separators with spring assisted galvanized diamond plate hatches with locking latches. As a minimum provide access hatches over the following areas: parallel plates, oil storage compartments, Influent sampling area, effluent sampling area, and weirs. Parts subject to wear or requiring adjustment, inspection, cleaning or repair shall be accessible and capable of convenient removal when required.

2.2 SEPARATION CHAMBER

Provide below ground separator to withstand hydraulic and soil loadings under static and dynamic conditions while empty and during operating conditions. Provide adequate support for additional loadings from separator appurtenances including weirs, hoppers, internal supports, parallel plate oil coalescers, equipment transportation, and rapid lowering and braking of load during handling operations. Bolt separator and accessories to weld-fabricated, structural steel skid base, or mount on manufacturer's standard base.

2.2.1 Lifting Mechanism

Fit separator with lifting lugs for handling and installation. Each lug shall carry the total dry weight of the separator and attendant appurtenances. Prominently display lifting instructions on an anodized aluminum plate located on top of separator.

2.2.2 Flanges

Use only flat face flanges and drill 150 pound ANSI Standard bolt circle and remove burrs. Use flanged piping connections that conform to ASME B16.5, welding neck type.

2.2.3 Weirs

Attach stationary weirs and adjustable weir supports to separator side walls to provide a watertight seal between adjoining compartments and trough to prevent hydraulic short-circuiting. Use precast concrete for weir plates and baffles. Provide sharp crested weirs of size and section specified by manufacture. Provide slotted holes in weir plates and baffles or supports to permit horizontal and vertical adjustment of weir or baffle. Use nondeteriorating sealant or gaskets for mounting weir plates. Fill voids between separator wall and weir plate with sealant to make watertight.

2.2.4 Identification Plates

Provide anodized aluminum identification and instruction plates and stamp necessary data. Securely affix plates on top of the separator, in prominent location, with nonferrous screws or bolts of not less than 1/8 inch in diameter. Nomenclature shall include design flow rate, oil holding volume, coalescing media make, model, and quantity, and separator component weights at a minimum.

2.2.5 Instruction Plates

Instruction plates shall describe special or required procedures to operate and service equipment, and shall include warnings of hazardous procedures and notice of safety and health requirements. Plates shall be

durable and legible throughout equipment life.

2.2.6 Warning Sign

On entrances to the separator (and entrances to the vault) place a permanent sign which states the following: "DO NOT ENTER separator (OR VAULT) OR PERFORM HOT WORK ON OR IN separator UNTIL THE ATMOSPHERE HAS BEEN TESTED AND CERTIFIED GAS FREE AND SAFE."

2.3 INLET COMPARTMENT

Provide inlet compartment of sufficient volume to effectively reduce influent suspended and settleable solids and dissipate energy. Use inlet compartment that provides a minimum of 2 minutes detention ahead of the oil coalescing compartment. Provide nonclogging flow distributor and energy dissipater device. Locate sample ports as recommended by the manufacturer.

2.4 OIL SEPARATION COMPARTMENT

2.4.1 General

The separator will also provide a minimum detention time within the oil separation compartment of 8 minutes at design flow. Detention time will recomputed by calculating the volume of the separation zone within the separator and dividing this volume by the design flow rate. For computing detention time, total volume shall be reduced by 20 percent for the space occupied by settled solids (sediment) and accumulated oil at the surface. The parallel plate coalescing media shall be designed to occupy the full width of the oil separation compartment and must extent above the standing water depth in the separator.

2.4.2 Parallel Plates

Provide parallel, corrugated plates spaced not less than 3/4 inch apart for removal of free oil and settleable solids. Configuration used shall not promote solids buildup on plates which would increase velocities to point of discharging an effluent of unacceptable quality. Maintain laminar flow at maximum design flow rate throughout plate packs including entrance and exit so as to prevent re-entrainment of oil(s) with water. Flow through plate packs shall be in a cross-flow perpendicular to plate corrugations, so that the oil collects and coalesces at high point of corrugations and rises to top of pack without clogging from oil or settleable solids. Make plates out of a corrosion resistant, oleophilic material. Make minimum effective projected surface area 592 square feet.

2.4.3 Supports

Brace and support plate packs to withstand loads associated with transportation and operation of units, including cleaning. Equip each plate pack with lifting lugs or other attachments for handling and installation. Each lug shall carry total weight of plate pack.

2.4.4 Baffles

Provide oil retention baffle and stationary underflow baffle. Position underflow baffle to prevent resuspension of solids that have accumulated in oil separation compartment.

2.5 OUTLET COMPARTMENT

Provide outlet compartment of at least 19 cubic feet, an oil retaining baffle, and a sampling port.

2.6 ACCESSORIES

Provide bolts, stiffeners, washers, nuts, screws, pins, gaskets, and fittings as required for weirs, separator covers and parallel plate packs.

2.6.1 High Level Alarm

Provide the oil water separator with an adjustable float style high level alarm for the purpose of alerting operators when the fluid level is approaching the top of the oil retaining baffle. When activated, the high level alarm must trigger a flashing light that is installed above ground in the switchyard near the location of the oil water separator.

2.7 FABRICATION

Provide shop fabricated, skid mounted oil-water separator, or other shop fabricated unit approved by the OWNER, which is comprised of a separator containing an inlet compartment, parallel plate oil coalescing compartment, outlet compartment and the following accessories:

Separator Cover spring assisted 180 degree opening capability

Riser sections as required to bring the top of the separator above finish grade elevation

2.7.1 Shop Hydrostatic Test

Prior to applying coatings, perform hydrostatic test at atmospheric pressure by filling base section of the separator with water in the shop for a minimum of 4 hours. Testing shall be conducted after concrete has fully cured. Acceptance criteria, for the hydrostatic test, is no leakage after 4 hours using a thorough visual inspection for the leaks.

2.7.2 Reduction of Solids

Inlet compartment shall reduce suspended and settleable solids to nonclogging level for parallel plates and provide a uniform oily wastewater hydraulic loading across inlet face of oil coalescing compartment, under laminar flow conditions. Equip compartment with an inlet nozzle with wastewater sampling port, nonclogging flow distributor and energy dissipater device (sediment weir).

2.7.3 Oil Coalescing Compartment

Equip oil coalescing compartment with easily removable and reinstallable, parallel, corrugated coalescing media plates arranged to optimize separation of free oil from liquid carrier. Use parallel plates that are easily removable without dismantling packs and without confined space entry. Provide oil retention baffle positioned to prevent discharge of free oil that has been separated from the carrier liquid in inlet and oil coalescing compartments. Provide access to each plate pack from top. Each bundle shall be equipped with handles or lifting rings. Plate designs that permit cleaning of plate packs in place are not acceptable.

2.7.4 Wastewater Sampling Port

Equip inlet and outlet pipes with wastewater sampling tees permitting easy access for obtaining isokinetic influent and effluent samples.

2.7.5 Connections

Connect the separator at the inlet and outlet pipe invert elevations indicated. Follow equipment manufacturer's recommendation for setting and adjusting top of weir elevations throughout unit. Inlet and outlet pipe penetrations through the separator wall must be sealed to be watertight. Connect the oil water separator discharge pipe to an appropriately sized Petro-Pipe by Solidification Products International, inc. The effluent from the oil water separator must pass through the Petro-Pipe prior to final discharge from the switchyard.

PART 3 EXECUTION

3.1 INSPECTION

Inspect each component of separator for compliance with requirements specified in PART 2 PRODUCTS. Redesign or modification of equipment to comply with specified requirements, or necessary redesign or modification following failure to meet specified requirements, shall receive particular attention for adequacy and suitability. This element of inspection shall encompass visual examinations and dimensional measurements. Noncompliance with specified requirements, or presence of one or more defects preventing or lessening maximum efficiency of separator operation, shall constitute cause for rejection.

3.2 INSTALLATION

Lift separator as required without parallel plate packs in place onto level foundation using lifting mechanism provided. Level separator and bolt to supports to prevent hydrostatic uplift and ensure unit stability. Use a lifting bar through lugs to insert plate packs into separator and place on supports. Caulk around packs and pack supports with sealing compound conforming to ASTM C990 to prevent hydraulic short-circuiting. Avoid abrupt contact between the packs and the separator walls and pack supports to avoid damage. Separator system installation shall be conducted in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

3.3.1 Field Hydrostatic Test

After separator has been leveled and secured to foundation and parallel plate packs are in place, level effluent overflow weir at elevation specified by manufacturer and hydrostatically test unit at atmospheric or operational pressure (for no leakage) for an additional 8 hours by filling with water. Perform the hydrostatic test prior to backfilling below ground or partially below ground installations.

3.3.2 Preoperational Test

The manufacturer's service representative shall inspect, operate, and test unit before in-service testing by the Contractor.

3.3.2.1 Tests

Tests shall include but not be limited to the following:

a. Soundness (without cracked or otherwise damaged parts).

b. Completeness in all details, as specified.

c. Correctness of setting, alignment, and relative arrangement of each component.

d. Verification of proper operation for all system components.

3.3.2.2 Preoperational Investigation and Test Report

Submit manufacturer's service representative's preoperational test report. Document inspections, operations, adjustments, and tests performed and indicate whether they were acceptable or not. For unacceptable items, describe corrective action taken or recommended. Include detailed descriptions of points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. Include the manufacturer's certificate that equipment conforms to specified requirements and is ready for permanent operation and that nothing in installation will render manufacturer's warranty null and void.

3.3.3 In-Service Test

After hydrostatic test and preoperational test have been successfully completed and unit has been properly connected to influent and effluent piping, allow influent oil-in-water mixture previously described in paragraph entitled "SYSTEM DESCRIPTION" to flow into separator filled with water. Adjust and level surface oil overflow weirs to optimize oil skimming and minimize water overflow to oil recovery. Optimize operation of unit within 5 working days. Operate unit for a minimum of ten separator volume changes prior to testing for removal of contaminants and document testing results.

3.3.3.1 Analytical Methods

Test and sample preservation methods for test contaminants shall be in accordance with the latest revisions of AWWA 10084, APHA Standard Methods for the Examination of Water and Wastewater, EPA 600/4-79/020, EPA Methods for Chemical Analysis of Water and Wastes, or those substitute methods approved by the governing regulatory agencies having jurisdiction.

3.3.3.2 Test for Contaminants

Verify the separator efficiency by testing influent and effluent for contaminants described in paragraph entitled "Performance Requirements." If effluent quality is found to be unacceptable, then verify influent to effluent performance in particle size removal at the site. Tests shall be performed by an independent certified testing laboratory.

3.3.3.3 Sampling Procedures

Within an 8 hour period and at regular intervals collect a minimum of 10 influent and effluent samples from sampling ports provided as part of the separator. Purge each sampling port to remove built-up solids or other

material prior to collecting sample. Collect wastewater samples isokinetically in clean glass containers with polytetrafluoroethylene lined caps. Collect duplicate wastewater samples in separate glass containers. Do not attempt to split sample. Use containers for other contaminants as recommended in references listed in paragraph entitled "Analytical Methods."

3.3.3.4 Acceptance Criteria

90 percent of the effluent samples taken shall not exceed the specified daily maximum limit for petroleum hydrocarbon contaminants. The remaining samples shall not exceed 15 mg/L for petroleum hydrocarbon contaminants. If the separator does not meet requirements of this specification, due to poor workmanship and wrong fabrication dimensions, the unit may be rejected. If the unit is not operating at design efficiency 5 days after installation, OWNER may reject system. In the event OWNER rejects unit, Contractor shall remove separator or defective components and replace with acceptable unit or components and test as specified above.

-- End of Section --

SECTION 48 13 01

INSTALLATION OF OWNER-FURNISHED TURBINE-GENERATOR EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

1.1.1 This section includes the following requirements for installation of the owner-furnished turbine-generator equipment:

Provide labor, supervision, rigging, temporary supports, tools, and incidentals required to receive, offload, handle, store, preserve, assemble, install, align, interconnect, and support commissioning of OWNER-furnished turbine-generator (T/G) equipment and associated auxiliary systems for Unit 3.

Work includes, but is not limited to, the following:

1. Receiving, inspection, documentation of condition, handling, indoor storage, preservation, and protection of OWNER-furnished equipment.

2. Setting, leveling, alignment, anchorage, and installation in accordance with SUPPLIER/OEM instructions and the Contract Drawings.

3. Mechanical and electrical interconnections between OWNER-furnished equipment and the CONTRACTOR-furnished interface work shown on the Drawings.

4. System cleaning and flushing (where specified), pre-start checks, functional checks, and support of commissioning, startup, and performance testing.

5. Protection of existing equipment, systems, and finishes; coordination with OWNER for access, outages, tie-ins, and activities that may affect operations.

1.1.2 OWNER-Furnished Equipment

OWNER has procured the major Unit 3 turbine-generator package and certain auxiliary systems under a separate procurement contract. These items will be turned over to CONTRACTOR as OWNER-furnished equipment for installation.
OWNER-furnished equipment includes, but is not limited to, the following:

1. Hydraulic turbine and turbine accessories as provided by the equipment SUPPLIER.

2. Generator and generator accessories as provided by the equipment SUPPLIER.

3. Switchgear and control cabinets as provided by the equipment SUPPLIER.

4. Generator Step-up transformer as provided by the equipment SUPPLIER.

5. Turbine inlet valve and accessories as provided by the equipment SUPPLIER.

6. Hydraulic power system (HPU) and accessories as provided by the equipment SUPPLIER.

7. Cooling water system and accessories as provided by the equipment SUPPLIER.

1.1.3 Installation-Only Scope

a. This Section defines CONTRACTOR responsibilities for installation and interconnection only. Procurement, fabrication, and factory testing of OWNER-furnished equipment are not part of this Contract.

b. Install OWNER-furnished equipment under the supervision and direction of the equipment SUPPLIER as required by the Contract Documents.

1.2 DEFINITIONS

a. OWNER-Furnished Equipment (OFE): Equipment procured by OWNER under separate contract(s) and provided to CONTRACTOR for installation.

b. SUPPLIER/OEM: The manufacturer(s) or integrator(s) providing OFE and associated field service for erection supervision and commissioning support.

c. Interconnections: CONTRACTOR-furnished piping, tubing, fittings, supports, conduit, cable tray, wiring, terminations, and appurtenances required to connect OFE into a complete operating unit as shown on the Drawings and required by SUPPLIER/OEM.

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Pre-Installation Meeting

Conduct a pre-installation meeting prior to receipt of the first major OFE shipment. Include OWNER, CONTRACTOR, and SUPPLIER/OEM field service personnel. Review delivery logistics, offload and handling, storage and preservation, access and rigging routes, installation sequencing, hold points, and coordination requirements with powerhouse operations.

1.3.2 Sequencing

Sequence Work to maintain safe access and to avoid impacts to ongoing powerhouse operations. Do not perform tie-ins, outages, or activities that may affect operations without OWNER coordination and approval.

1.3.3 Scheduling

Include OFE delivery, offload, storage, installation, and SUPPLIER/OEM field service windows in the CONTRACTOR schedule in accordance with Section 01 32 01 PROJECT SCHEDULE.

1.4 SUBMITTALS

OWNER approval is required for submittals with a "O" classification. Submittals not having a "O" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
T/G Installation Plan; O
Rigging, Lift, and Handling Plan; O
Receiving, Storage, Preservation, and Protection Plan; O
Outage and Access Coordination Plan; O

SD-02 Shop Drawings
Installation and Interconnection Drawings; O
Temporary Supports and Handling Fixtures; O

SD-03 Product Data
Installation Consumables; O

SD-06 Test Reports
Flushing and Cleanliness Reports; O
Pre-Commissioning Check Sheets; O

SD-07 Certificates
Installation Completion Certificate; O

SD-08 Manufacturer's Instructions
SUPPLIER/OEM Installation Instructions

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualifications

a. Provide personnel experienced in installation and alignment of hydroelectric turbine-generator equipment of similar size and complexity.

b. Provide a qualified supervisor on site with authority to coordinate installation with OWNER and SUPPLIER/OEM field service personnel.

1.5.2 SUPPLIER/OEM Field Service

SUPPLIER/OEM will provide field service personnel under separate contract for erection supervision, alignment guidance, and commissioning support. CONTRACTOR shall coordinate activities and provide labor and assistance required for complete installation.

1.6 DELIVERY, STORAGE, AND HANDLING

a. Coordinate delivery windows, offloading, and staging with OWNER.

b. Provide all equipment, labor, and procedures required to offload OWNER-furnished equipment from delivery conveyance and transport to the powerhouse.

c. Inspect equipment at receipt. Document shipping damage, missing items, and nonconformances. Notify OWNER and SUPPLIER/OEM immediately.

d. Store, protect, and preserve equipment strictly in accordance with SUPPLIER/OEM requirements.

e.Maintain heaters, desiccants, protective coatings, and covers as required.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Existing Conditions and Operations

a. Work will occur within an operating powerhouse and switchyard.

b. CONTRACTOR shall protect all existing equipment, systems, and finishes from damage during construction.

c. Coordination with OWNER is required for access, outages, tie-ins, and activities that may affect operations.

1.7.2 Site Access and Remote Logistics

a. The work is located at the Tyee Lake Powerhouse in Southeast Alaska. Practical access is by wheeled charter aircraft for landing on a private airstrip, helicopter, or by shallow draft vessels at high tide.

b. Coordinate mobilization, delivery logistics, and staging with OWNER.

1.7.3 Temporary Utilities and Facilities

a. Temporary power and potable water will be provided by OWNER as described in Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS.

b. Provide all other temporary facilities and services required for installation and testing, including housing, sanitary facilities, and fuel containment measures, in accordance with Section 01 50 00.

PART 2 PRODUCTS

2.1 MATERIALS AND CONSUMABLES

a. Provide installation materials and consumables required for a complete installation, unless explicitly furnished with OWNER-furnished equipment.

b. Materials include, but are not limited to, the following:

1. Nonshrink grout and related formwork and accessories where required by the Drawings or SUPPLIER/OEM instructions.

2. Steel shims, leveling plates, and temporary supports.

3. Cleaning agents, solvents, lint-free wipes, preservatives, rust inhibitors, and desiccants.

4. Gaskets, sealants, thread compounds, anti-seize, and touch-up coatings compatible with SUPPLIER/OEM requirements.

5. Hardware, fasteners, and anchorage not furnished with OWNER-furnished equipment.

PART 3 EXECUTION

3.1 EXAMINATION

a. Verify foundations, embedded items, anchor bolt locations, blockouts, sole plates, and alignment datums prior to setting equipment.

b. Verify access routes, laydown areas, and rigging paths are suitable for installation.

c. Do not proceed until deficiencies are corrected and accepted by OWNER.

3.2 PREPARATION

3.2.1 Protection

a. Provide protection of surrounding areas and surfaces.

b. Maintain cleanliness and prevent debris from entering bearings, hydraulic systems, cooling systems, and electrical enclosures.

c. Cap and seal openings when work is not actively in progress.

3.2.2 Surface Preparation

a. Prepare equipment foundations and mounting surfaces in accordance with the Drawings and SUPPLIER/OEM instructions.

b. Remove laitance, oil, debris, and loose materials prior to grouting or setting equipment.

3.3 INSTALLATION

3.3.1 General

a. Perform installation under supervision of SUPPLIER/OEM field service personnel.

b. Install equipment in accordance with SUPPLIER/OEM printed instructions and approved submittals.

c. Provide special tools, rigging, temporary supports, and materials required for installation except for items furnished by SUPPLIER/OEM with the OWNER-furnished package.

d. Maintain written alignment and measurement logs. Provide copies to OWNER.

3.3.2 Turbine and Generator Installation

a. Set, level, align, and secure turbine and generator components in accordance with SUPPLIER/OEM procedures and the Drawings.

b. Provide grouting, shimming, and anchorage as required.

3.3.3 Turbine Inlet Valve Installation

Install turbine inlet valve and accessories in accordance with SUPPLIER/OEM instructions and the Drawings. Provide supports, alignment, actuator hookups, and required tie-ins.

3.3.4 Generator Step-Up Transformer Installation

Set, level, align, assemble and secure the generator step-up transformer components in accordance with SUPPLIER/OEM procedures and the Drawings.

Fill with insulating oil in accordance with SUPPLIER/OEM instructions. Provide anchorage as required.

3.3.5 Hydraulic Power System Installation

Install hydraulic power unit and hydraulic piping, tubing, fittings, supports, and appurtenances required to connect to turbine nozzle servomotors, deflectors, inlet valve actuation, and other hydraulic loads as indicated and required by SUPPLIER/OEM.

3.3.6 Cooling Water System Installation

Install cooling water system components provided as OWNER-furnished equipment and all CONTRACTOR-furnished interconnecting piping, valves, fittings, supports, and appurtenances required for complete operation as indicated and required by SUPPLIER/OEM.

3.3.7 Interconnections

a. Provide mechanical and electrical interconnections required for a complete operating unit, including piping, tubing, conduit, cable tray, wiring, and terminations between package components and interface points shown on the Drawings.

b. Coordinate exact interface points, terminations, and responsibilities with SUPPLIER/OEM submittals and OWNER.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

a. Perform and document specified installation checks, flushing, and functional tests required prior to commissioning.

b. Provide test reports in accordance with the Submittals Article of this Section.

3.4.2 Manufacturer Field Service

Coordinate with SUPPLIER/OEM field service for installation oversight, alignment verification, and commissioning support. Provide labor and assistance as required.

3.5 SYSTEM STARTUP

Provide labor, tools, and assistance to OWNER and SUPPLIER/OEM during commissioning, startup, and performance testing.

Correct installation deficiencies identified during startup and testing.

3.6 ADJUSTING AND CLEANING

Upon completion of installation and testing support activities, remove temporary supports and temporary installation materials, clean work areas, and prepare equipment and spaces for OWNER acceptance.

3.7 CLOSEOUT ACTIVITIES

Submit installation records, alignment logs, flushing records, and the

SEAPA

Southeast Alaska Power Agency

Tyee Lake 3rd Unit Installation

Construction Specifications

Issued for Construction

McMillen

May 18, 2026

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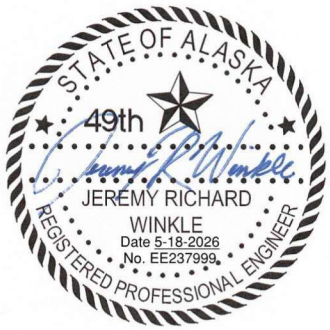
Professional Engineer Stamps

Jay Dallas, P.E.
PM & Mechanical Engineer
Date: 5/18/2026

Cyrus Niamir, P.E.
Civil Engineer
Date: 5/15/2026

Mark Merklein, P.E.
Structural Engineer
Date: 5/18/2026

Chris Curtis, P.E.
Fire Protection
Date: 5/18/2026



Jeremy Winkle, P.E.
Electrical & Controls
Date: 5/18/2026

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Installation Completion Certificate in accordance with the Submittals Article of this Section.

3.8 PROTECTION

Protect installed equipment from damage prior to acceptance. Provide temporary covers, heaters, and preservation measures required by SUPPLIER/OEM.

-- End of Section --