

AMERESCO 



SPECIFICATIONS

Central Plant Boiler Replacement



MIDWESTERN STATE UNIVERSITY

Prepared for:

Midwestern State University (MSU);
Facilities Services

July 7, 2023 (Issued for Construction)



**CENTRAL PLANT BOILER REPLACEMENT
MIDWESTERN STATE UNIVERSITY
WICHITA FALLS, TEXAS**

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SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. THIS SECTION INCLUDES THE FOLLOWING:

1. Work covered by the Contract Documents.
2. Work under other Contracts.
3. Owner's Occupancy requirements.
4. Existing Work.
5. Location of underground utilities.
6. Specification formats and conventions.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Contract number: R0022936
- B. Project Location: Midwestern State University, Wichita Falls, Texas
- C. Owner: Midwestern State University (MSU)
3410 Taft Blvd.
Wichita Falls, TX 76308
- D. Engineer: Ameresco, Inc.
111 Speen St, Suite 400
Framingham, MA 01701
- E. The Project is defined by Work Covered by the Contract Documents, The Texas Uniform General Conditions and Supplementary General Conditions and consists of the following scope of work:
- F. **Base Scope:** Replace existing Babcock & Wilcox boiler with new natural gas fired firetube boiler as detailed on the drawings and specifications.

1.3 WORK UNDER OTHER CONTRACTS

- A. General: Cooperate fully with separate subcontractors so Work on those Contracts may be carried out smoothly, without interfering with or delaying Work under this Contract. Coordinate the Work of this Contract with Work performed under separate Contracts.
- B. General: Contractor shall have limited use of premises for construction operations, including use of Project site, during Construction Period. Contractor's use of premises is limited by Owner's security requirements.
- C. Use of site: Limit use of premises to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy of Project site.
2. Driveways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - A) Schedule deliveries to minimize use of driveways and entrances.
 - B) Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.4 OWNER'S OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and Authorities having jurisdiction.

1.5 EXISTING WORK

- A. Contractor shall protection of existing vegetation, structures, equipment, utilities, and improvements.
 1. Remove or alter existing Work in such a manner as to prevent injury or damage to any portions of the existing Work which remain.
 2. 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 shall be in a condition equal to or better than that which existed before new Work started.

1.6 LOCATION OF UNDERGROUND UTILITIES

Prior to any excavation, obtain an excavation permit. Scan the construction site with electromagnetic or sonic equipment and mark the surface of the ground where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other Work to be installed.

- A. Notify the Owner at least 80 hours prior to starting excavation work.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

- A. Division 01: Sections in Division 01 Govern the Execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the section text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011100

SECTION 011400 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 CONTRACTOR ACCESS AND USE OF PREMISES

A. Contractor shall follow all site-specific regulations:

1. Ensure that all Contractor personnel employed on the Owner's site become familiar with and obey the site-specific regulations including safety, fire, traffic and security regulations. Keep within the limits of the Work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

B. WORKING HOURS

1. Regular working hours are Monday through Friday between the hours of 8:00 a.m. -5:00 p.m. After 5:00 p.m., Saturdays, Sundays and holidays are considered outside regular hours.

C. WORK OUTSIDE REGULAR HOURS

1. Work outside regular working hours requires Owner's approval in writing. Make application 15 calendar days prior to such work to allow arrangements to be made by the Owner for inspecting the Work in progress, giving the specific dates, hours, location, type of Work to be performed, Contract Number and Project title. Based on the justification provided, the Owner may approve Work outside regular hours. During periods of darkness, the different parts of the Work shall be lighted in a manner approved by the Owner.

D. UTILITY CUTOVERS AND INTERRUPTIONS

1. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."
2. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.
3. Interruption to water, sanitary sewer, electric service, air conditioning, heating, fire alarm, compressed air, and steam shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

1.2 SECURITY REQUIREMENTS

1. Contractor shall follow site specific security requirements.

A. IDENTIFICATION BADGES

1. The Contractor shall arrange badges for workers.

B. VEHICLE PASSES

1. Vehicle passes will be issued to work vehicles only. Personal vehicles can be parked on site but shall be located in the parking lot due south of Central Plant, north of the Athletic Fields.

C. DELIVERIES

1. A 48-hour written notice to the Owner is required for material deliveries. All delivery trucks will be searched prior to entrance to the site.

D. HOT WORK PERMITS

1. MSU does not currently issue hot work permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011400

SECTION 012000 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

This Section Specifies Administrative and Procedural Requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule. Cost-loaded CPM schedule may serve to satisfy requirements for the Schedule of Values.
1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with continuation sheets submittals schedule and Contractor's Construction Schedule.
 2. Submit the Schedule of Values to the Owner at earliest possible date but no later than seven days before the date Scheduled for Submittal of initial Applications for Payment.
 3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide Subschedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Division 1 table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
- C. Identification: Include the following project identification on the Schedule of Values:
1. Project name and location.
 2. Project number.
 3. Contractor's name and address.
 4. Date of submittal.
- D. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and Progress Reports. Coordinate with the Division 1 table of contents. Provide several line items for principal Subcontract Amounts, where appropriate. Include separate line items under required principal Subcontracts for Operation and Maintenance Manuals, punch list activities, Project Record Documents, and Demonstration and Training in the amount of 5 percent of the Contract Sum.
- E. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- F. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

- G. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
- H. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- I. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - 1. Temporary facilities and other major cost items that are not direct cost of actual Work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
- J. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous Applications and Payments ascertified and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between the Owner and the Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: The period covered by each Application for Payment is one month, ending on the last day of the month.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. The Owner will return incomplete applications without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit an electronic copy of each Application for Payment to Owner. Include waivers of lien and similar attachments if required.
 - 1. Transmit with a transmittal form listing attachments and recording appropriate information about application.

- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of Mechanic's Lien from every entity who is lawfully entitled to file a Mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. The Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to the Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Schedule of unit prices.
 5. Submittals schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project Closeout Requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.

8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012000

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

This Section Specifies Administrative and Procedural Requirements for handling and processing Contract Modifications.

1.2 MINOR CHANGES IN THE WORK

The Owner will issue supplemental instructions authorizing Minor changes in the Work, not involving adjustment to the Contract Sum or the Contract time.

1.3 PROPOSAL REQUESTS

A. OWNER-INITIATED PROPOSAL REQUESTS

1. The Owner will issue a detailed description of proposed Changes in the Work that may require adjustment to the Contract Sum or the Contract time. If necessary, the description will include supplemental or revised Drawings and Specifications.
2. Proposal requests issued by the Owner are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
3. Within time specified in proposal request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract time necessary to execute the change.
 - A. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - B. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - C. Include costs of labor and supervision directly attributable to the change.
 - D. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. CONTRACTOR-INITIATED PROPOSALS:

If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to the Owner.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Owner will issue a Change Order for signatures of Owner and Contractor.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. WORK CHANGE DIRECTIVE

1. The Owner may issue a Work Change Directive. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. DOCUMENTATION

1. Maintain detailed records on a time and material basis of work required by the Work Change Directive.

After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 01 30 00 - ADMINISTRATIVE AND COORDINATION REQUIREMENTS

PART 1 - GENERAL

1.1 SUBMITTALS

Owner's Representative approval is required for submittals as indicated on the submittal register. The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:

SD-01 Preconstruction Submittals

List of contact personnel

Certificates of Insurance

1.2 MINIMUM INSURANCE REQUIREMENTS

- A. Prior to the start of the Contractor's work, the Contractor shall procure and maintain in force for the duration of the project Workers' Compensation Insurance, Employer's Liability Insurance, Commercial General Liability Insurance, and Automobile Liability Insurance on allowed, non-owned, and hired vehicles.
- B. The Contractor's Commercial General Liability, Automobile Liability Insurance, and Workers' Compensation shall be written with limits of liability not less than the following:
1. Commercial General Liability coverage (including Premises/Operation Liability, Products/Completed Operation Liability, Contractual Liability, Contractors Protective Independent Contractors coverage in all cases where sub-Contractors are to perform any of the Work to be done under this contract, and Broad Form property Damage coverage):
 2. Bodily Injury (including death): \$2,000,000 Per Person Per Occurrence
 3. Property Damage: 2,000,000 Per Person Per Occurrence
 4. General Aggregate: 2,000,000 Shall apply specifically to this Contract
- C. Comprehensive Automobile Liability coverage (including owned, hired, and non-ownervehicles)
1. Bodily Injury (including death) \$1,000,000 Per Person Per Occurrence
 2. Property Damage \$1,000,000 Per Person Per Occurrence
 3. General Aggregate \$2,000,000 Shall apply specifically to this Contract
- D. Workers' Compensation: Statutory coverage in accordance with the laws of the state and/or states in which the work is to be performed. The certificate must show the state where the project is located as a covered state for the statutory benefits of that state. Any applicable Federal or Maritime coverage (e.g., Longshoremen's and Jones Act) that may be required due to Contractor's work shall be included in Contractor's coverage. A waiver of subrogation in favor of the Owner is required from the Workers' Compensation carrier.
- E. EMPLOYERS' LIABILITY:

\$1,000,000 Per Accident
\$1,000,000 Disease Policy Limit
\$1,000,000 Disease Each Employee

- F. Watercraft Liability: \$1,000,000 If applicable
- G. Aircraft Liability: \$1,000,000 If Applicable
- H. Umbrella Liability: \$5,000,000 Minimum
- I. Others as Required by State Law.
- J. See also the General and Technical Specifications in the Bid Documents.

1.3 CONTRACTOR PERSONNEL REQUIREMENTS

A. IDENTIFICATION BADGES

Identification badges will not be required for this project.

1.4 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, if a Quality Control (QC) representative is required on the Contract, then that individual shall also have fluent English communication skills.

1.5 PROJECT MEETINGS

A. GENERAL

Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, within three days of the meeting.

B. PRECONSTRUCTION CONFERENCE

Participate in a preconstruction conference before the start of construction. The conference will be held at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

Attendees: Authorized Representatives of Owner, and their Consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

Agenda: Discuss items of significance that could affect progress, including the following:

1. Tentative construction schedule.
2. Phasing.
3. Critical work sequencing and long-lead items.
4. Designation of key personnel and their duties.
5. Procedures for processing field decisions and Change Orders.
6. Procedures for RFIs.
7. Procedures for testing and inspecting.
8. Procedures for processing Applications for Payment.
9. Distribution of the Contract Documents.
10. Submittal procedures.
11. Preparation of Record Documents.
12. Use of the premises.
13. Work restrictions.
14. Owner's occupancy requirements.
15. Responsibility for temporary facilities and controls.
16. Construction waste management and recycling.
17. Parking availability.
18. Office, work, and storage areas.
19. Equipment deliveries and priorities.
20. First aid.
21. Security.
22. Progress cleaning.
23. Working hours.

Minutes: Record And Distribute Meeting Minutes.

C. PREINSTALLATION CONFERENCES

Conduct a pre-installation conference at project site before each construction activity that requires coordination with other construction.

1. Attendees:

Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Owner of scheduled meeting dates.

2. Agenda:

Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

- 1) The Contract Documents.
 - 2) Options.
 - 3) Related RFIs.
 - 4) Related Change Orders.
 - 5) Purchases.
 - 6) Deliveries.
 - 7) Submittals.
 - 8) Review of mockups.
 - 9) Possible conflicts.
 - 10) Compatibility problems.
 - 11) Time schedules.
 - 12) Weather limitations.
 - 13) Manufacturer's written recommendations.
 - 14) Warranty requirements.
 - 15) Compatibility of materials.
 - 16) Acceptability of substrates.
 - 17) Temporary facilities and controls.
 - 18) Space and access limitations.
 - 19) Regulations of authorities having jurisdiction.
 - 20) Testing and inspecting requirements.
 - 21) Installation procedures.
 - 22) Coordination with other work.
 - 23) Required performance results.
 - 24) Protection of adjacent work.
 - 25) Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: distribute minutes of the meeting to each party present and to parties who should have been present.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the work and reconvene the conference at earliest feasible date.

D. PROGRESS MEETINGS

Conduct progress meetings at regular intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees

In addition to representatives of Owner, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda

Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

Contractor's Construction Schedule:

Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

Review schedule for next period.

Review present and future needs of each entity present, including the following:

- 1) Interface requirements.
- 2) Sequence of operations.
- 3) Status of submittals.
- 4) Deliveries.
- 5) Off-site fabrication.
- 6) Access.
- 7) Site utilization.
- 8) Temporary facilities and controls.
- 9) Work hours.
- 10) Hazards and risks.
- 11) Progress cleaning.
- 12) Quality and work standards.
- 13) Status of correction of deficient items.
- 14) Field observations.
- 15) RFIs.
- 16) Status of proposal requests.
- 17) Pending changes.
- 18) Status of Change Orders.
- 19) Pending claims and disputes.
- 20) Documentation of information for payment requests.

Minutes: Record the meeting minutes.

3. Reporting

Distribute minutes of the meeting to each party present and to parties who should have been present.

Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.6 COORDINATION OF GENERAL INSTALLATION AND FIELD-ENGINEERING SERVICES

See Division 01 Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.7 COORDINATION

Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

A. PREPARE MEMORANDA

Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

B. ADMINISTRATIVE PROCEDURES

Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

1.8 SUBMITTALS

SD-02: Shop Drawings

A. SHOP DRAWINGS

Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

B. CONTENT

Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

1. Indicate functional and spatial relationships of components of project's architectural, structural, civil, mechanical, and electrical systems.
2. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Owner for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

C. SHEET SIZE

At least 8-1/2 by 11 inches but no larger than 24 by 36 inches.

D. NUMBER OF COPIES

1. Submit two opaque copies of each submittal. Owner will return one copy.
2. Refer to individual Specification Sections for Coordination Drawing requirements for Work in those sections.

1.9 REQUESTS FOR INFORMATION (RFI)

A. PROCEDURE

Immediately on discovery of the need for information related to the Contract Documents, and if not possible to request information at Project meeting, prepare and submit an RFI in the form specified.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's Work or Work of subcontractors.

B. CONTENT OF THE RFI

Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Construction Manager.
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

C. ENGINEER'S ACTION

Owner will review each RFI, determine action required, and return it. Allow seven working days for Engineer's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. Engineer's action may include a request for additional information, in which case Engineer's time for response will start again.
2. Engineer's or Owner's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures." If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Owner in writing within 10 days of receipt of the RFI response.
3. On receipt of RFI response, Contractor shall update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Owner within seven days if Contractor disagrees with response.

D. RFI LOG

Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number.

1. Project name.
2. Name and address of Contractor.
3. RFI number including RFIs that were dropped and not submitted.
4. RFI description.
5. Date the RFI was submitted.
6. Date RFI response was received.

7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013000

SECTION 013216 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Submittals Schedule.
 - 3. Daily Construction reports.
 - 4. Field condition reports.
- B. See Division 01 11 00 Section "Work Under Other Contracts" for preparing a combined Contractor's Construction Schedule.
- C. See Division 01 section "Payment Procedures" for submitting the Schedule of Values.

1.2 DEFINITIONS

A. ACTIVITY

A discrete part of a Project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

- 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
- 2. Predecessor Activity: An activity that precedes another activity in the network.
- 3. Successor Activity: An activity that follows another activity in the network.

B. CRITICAL PATH METHOD

Critical Path Method (CPM), which is a method of planning and scheduling a construction Project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. CRITICAL PATH

The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall project duration and contains no float.

D. FLOAT

The measure of leeway in starting and completing an activity. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

E. MAJOR AREA

A story of construction, a separate building, or a similar significant construction element.

1.3 SUBMITTALS

SD-01 Submittal Schedule

Contractors Construction Schedule

A. SUBMITTALS SCHEDULE

Submit electronic copy of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of Contractor.
5. Description of the Work covered.
6. Scheduled date for Owner's final release or approval.

B. DAILY CONSTRUCTION REPORTS

Not required for this project.

C. FIELD CONDITION REPORTS

Submit two copies at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate preparation and processing of Schedules and Reports with performance of construction activities and with scheduling and reporting of separate subcontractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, Progress Reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from parties involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Submit a Schedule of Submittals, arranged in chronological order by dates required by Construction Schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Submit concurrently with the first complete submittal of Subcontractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. TIME FRAME

Extend schedule from date established for the Notice to Proceed to date of Final Completion. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. ACTIVITIES

Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 working days unless specifically allowed by Owner.
2. Procurement Activities: Include procurement activities for long lead items requiring a cycle of more than 20 working days as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Include the following information as part of each activity: Activity ID, Activity Description, Original Duration in Work Days, Remaining Duration, Percent Complete, Early Start Date, Early Finish Date, and Total Float.
4. With the exception of the Contract Award and Completion dates, no activity should be open ended. All other activities must have at least one predecessor and one successor.
5. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
6. Startup and Testing Time: Include not less than two days for startup and testing.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Owner's administrative procedures necessary for certification of Substantial Completion.

C. MILESTONES

Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. GANTT-CHART SCHEDULE

Submit a Time-Scaled Logic Diagram with Gantt-Chart including activity details listed in 2.2.B.3 using the Critical Path Method within one week of Notice of Award. Once approved by the Owner, this version of the schedule will become the Baseline Schedule.

B. CRITICAL PATH

A Critical Path layout of the schedule will be submitted with each Time-Scaled Logic Diagram. Activity details listed in 2.2.B.3 will be included in this report.

C. PREPARATION

1. Indicate each significant construction activity separately.
2. Unless otherwise specified, the default project calendar will reflect a standard 5 day, Mon-Fri, 40 hour work week. Block all Federal Holidays as non-work days.
3. Schedule calculations and Out-of-Sequence progress shall be handled through retained logic, not progress override. All activity durations and float values will be shown in working days. Activity progress will be shown using Remaining Duration.

2.4 REPORTS

A. DAILY CONSTRUCTION REPORTS

Prepare a daily construction report recording the following information concerning events at Project site:

1. List of Contractor's and subcontractor's personnel at Project site.
2. Equipment at Project site.
3. Material deliveries.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Stoppages, delays, shortages, and losses.
7. Meter readings and similar recordings.
8. Orders and requests of authorities having jurisdiction.
9. Services connected and disconnected.
10. Equipment or system tests and startups.

B. FIELD CONDITION REPORTS

Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. CONTRACTOR'S CONSTRUCTION SCHEDULE UPDATING

1. Starting with the Baseline schedule, the schedule will be updated monthly by the tenth calendar day using the last day of the preceding month as the new data date. Completed activities will be shown as such, and activities not yet started by the data date will be re-forecasted with new projected start and finish dates.

2. For activities not yet started, the original / remaining durations will remain unchanged unless approved by the Owner.
3. As the Work progresses, indicate actual completion percentage for each activity.

B. DISTRIBUTION

Distribute copies of approved schedule to the Owner, separate subcontractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know scheduleresponsibility.

1. Post copies in project meeting rooms and temporary field offices.
2. Submit all schedules in pdf form to the Midwestern State University Representative (Name TBD at Project Award).

END OF SECTION 013216

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. ENGINEER-FURNISHED INFORMATION

Submittal register will be delivered to the Contractor, by the Owner. The Register will have the following fields completed, to the extent that will be required by the Owner during subsequent usage.

Lists specification section in which submittal is required.

Lists each Submittal Description (SD No. and type, e.g. SD-04 Drawings) required in each specification section.

Lists one principal paragraph in Specification Section where a material or product is specified. This listing is only to facilitate locating submittal requirements. Do not consider entries here as limiting project requirements.

Indicate approving authority for each submittal.

1.2 DEFINITIONS

A. SUBMITTAL

Shop Drawings, Product Data, samples, Operation and Maintenance Data, and administrative submittals presented for review and Owner approval.

B. TYPES OF SUBMITTALS

All submittals are classified as indicated in paragraph "Submittal Descriptions (SD)". Submittals also are grouped as follows:

1. Shop Drawings: As used in this section, drawings, design calculations, schedules, diagrams, and other data prepared specifically for this Contract, by Contractor or through Subcontractor by way of manufacturer, supplier, distributor, or other lower tier contractor, to illustrate portion of Work. Submittal of pre-engineered metal building shop drawings shall bear a Registered Engineers seal for the State in which Project is located. The submittal will be rejected if the drawings do not bear the seal.
2. Product Data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate portion of Work, but not prepared exclusively for this Contract.
3. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to portion of work, illustrating portion of Work or establishing standards for evaluating appearance of finished Work or both.

4. Operation and Maintenance (O&M) Data: Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

The data is required when the item is delivered to the Project site.

5. Administrative Submittals: Data presented for reviews and approval to ensure that administrative requirements of Project are adequately met but not to ensure directly that work is in accordance with design concept and in compliance with Contract Documents.

1.3 SUBMITTAL IDENTIFICATION (SD)

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

- Certificates of Insurance.
- Surety Bonds.
- List of proposed subcontractors.
- List of proposed products.
- Construction Progress Schedule.
- Submittal Register.
- Schedule of Values.
- Health and Safety plan.
- Work plan.
- Quality Control 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 subcontractor for integrating the product or system into the Project.

Drawings prepared by or for the subcontractor 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 or equipment for some portion of the Work.

Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.

Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information which is not applicable.

Provide manufacturer's preparation, assembly, and installation instructions.

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 by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which 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.

Design submittals, design substantiation submittals and extensions of design submittals.

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. (Testing must have been within three years of date of Contract Award for the Project.)

Report which includes findings of a test required to be performed by the Subcontractor on an actual portion of the Work or prototype prepared for the Project before shipment to jobsite.

Report which 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 checklists

Final Acceptance test and Operational Test procedure

SD-07 Certificates

Statements signed by responsible officials of manufacturer of product, system or material attesting that 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 lower tier contractor the purpose of which is to further quality of orderly progression of a portion of the Work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS) 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 must state the test results; and indicate whether the material, product, or system has passed or failed the test.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

SD-11 Closeout Submittals

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

A. APPROVING AUTHORITY

Person authorized to approve Submittal shall be Owner or Owner Representative unless otherwise specified.

B. WORK

As used in this section, on- 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.

1.4 SUBMITTALS

Submit the following in accordance with the requirements of this Section.

SD-01 Preconstruction Submittals

Submittal Register

Shop Drawings, where indicated in individual Specification Sections

Product Data, where indicated in individual Specification Sections

Samples, where indicated in individual Specification Sections

1.5 USE OF SUBMITTAL REGISTER

Prepare and maintain Submittal Register, as the Work progresses. Do not change data which was originally filled in by Engineer.

A. SUBMITTAL REGISTER

Submit Submittal Register. Submit with Quality Control Plan and Project Schedule required by section 01 45 00, "Quality Control" and section 01 32 16, "Construction Progress Documentation." Verify that all Submittals required for Project are listed and add missing Submittals. Complete the following on the register:

Activity Number: Activity Number from the Project Schedule.

Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Contractor Approval Date: Date Contractor needs approval of Submittal.

Contractor Material: Date that Contractor needs material delivered to Contractor Control.

B. CONTRACTOR USE OF SUBMITTAL REGISTER

Update the Following Fields.

Transmittal Number: Contractor assigned list of consecutive numbers.

Action Code: Date of action used to record Contractor's review when forwarding submittals to Owner.

List date of submittal transmission.

List date approval received.

C. APPROVING AUTHORITY USE OF SUBMITTAL REGISTER

Update the Following Fields.

List date of submittal receipt.

List date returned to Contractor.

D. ACTION CODE

Entries used will be as follows (others may be prescribed by Transmittal

Form):NR - Not Received

AN - Approved as

NotedA - Approved

RR - Disapproved, Revise, and Resubmit

E. COPIES DELIVERED TO MSU

Submit an electronic copy of Submitted Register updated by Contractor to Owner with each invoice request.

1.6 PROCEDURES FOR SUBMITTALS

A. REVIEWING, CERTIFYING, APPROVING AUTHORITY

Contractor's QC organization shall be responsible for reviewing and certifying that submittals are in compliance with Contract Requirements. Approving authority on submittals is the Owner unless otherwise Specified for specific Submittal. At each "Submittal" paragraph in individual Specification Sections, indicates Owner approval is required for that submittal. "Action Submittals" designates Owner approval required.

B. CONSTRAINTS

1. Submittals listed or Specified in this Contract shall conform to provisions of this Section, unless explicitly stated otherwise. Submittals shall be complete for each definable feature of Work; components of definable feature interrelated as a system shall be submitted at same time.
2. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without Engineer or Owner review.
3. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

C. SCHEDULING

1. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of Work so that Work will not be delayed by submittal processing. Allow for potential requirements to resubmit.
2. Except as specified otherwise, allow review period, beginning with receipt by approving authority that includes at least 10 working days for submittals for Owner approval. Period of review for submittals with Engineer approval begins when Engineer receives submittal from Owner. Period of review for each resubmittal is the same as for initial submittal.

3. For submittals requiring review by Fire Protection Engineer or Authorities having Jurisdiction, allow review period, beginning when Engineer receives submittal from Owner, of 20 working days for return of submittal to the Contractor. Period of review for each resubmittal is the same as for initial submittal.

D. VARIATIONS

Variations from Contract requirements require Owner's approval and will be considered where advantageous to the Owner.

1. Considering variations

Discussion with Owner prior to submission will help ensure functional and quality requirements are met and minimize rejections and resubmittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

2. Proposing variations

When proposing variation, deliver written request to the Owner, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Owner. If lower cost is a benefit, also include an estimate of the cost saving. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

3. Warranting that variations are compatible

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

4. Review Schedule is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Owner of submittals with variations.

E. CONTRACTOR'S RESPONSIBILITIES

1. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the Work and Contract Documents.
2. Transmit submittals to QC.
3. Organize in accordance with Schedule on approved submittal register, and to prevent delays in the Work, delays to the Owner, or delays to separate subcontractors.
4. Advise Owner of variation, as required by paragraph entitled "Variations."
5. Correct and resubmit submittal as directed by approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the Contractor shall provide copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct specific attention in writing or on resubmitted submittal, to revisions not requested by approving authority on previous submissions.

6. Furnish additional electronic copies of submittal when requested by MSU representative.
7. Complete Work which must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.
8. Ensure no Work has begun until submittals for that Work have been returned as "Approved," or "Approved as Noted", except to the extent that a portion of Work must be accomplished as basis of submittal.

F. CONTRACTOR'S QC ORGANIZATION RESPONSIBILITIES

1. Note date on which submittal was received by Contractor on each submittal.
2. Review each submittal; and check and coordinate each submittal with requirements of Work and Contract Documents.
3. Review submittals for conformance with Project design concepts and compliance with Contract Documents.
4. Ensure that material is clearly legible.
5. Stamp each sheet of each submittal with Contractor QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.
6. Contractor QC organization will certify submittals forwarded to Owner with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number: TBD, is in compliance with the Contract Drawings and Specification, can be installed in the allocated spaces, and is submitted for Owner approval.

Certified by Submittal Reviewer _____, Date _____ (Signature when applicable)

Certified by QC Manager _____, Date _____ (Signature)

7. Sign certifying statement or approval statement. The person signing certifying statements shall be Contractor's QC organization member designated in the approved Contractor QC Plan. The signatures shall be in original ink. Stamped signatures are not acceptable.
8. Update submittal register as submittal actions occur and maintain the submittal register at Project site until Final Acceptance of all Work by the Owner.
9. Retain a copy of approved submittals at Project site, including Contractor's copy of approved samples.

G. ENGINEER'S RESPONSIBILITIES

1. Note date on which submittal was received from Owner, on each submittal.

2. Review submittals within scheduling period specified and only for conformance with Project design concepts and compliance with Contract Documents.
3. Identify returned submittals with one of the actions defined in paragraph entitled "Actions Possible" and with markings appropriate for action indicated.

H. ACTIONS POSSIBLE

Submittals will be returned with one of the following notations:

1. Submittals marked "Not Reviewed" will indicate 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.
2. Submittals marked "Approved" "Approved as Submitted" authorize Contractor to proceed with Work covered.
3. Submittals marked "Approved as Noted" or "Approval Except as Noted; resubmission not required" authorize Contractor to proceed with work as noted provided Contractor takes no exception to the notations.
4. Submittals marked "Revise and Resubmit" or "Disapproved" indicate submittal is incomplete or does not comply with design concept or requirements of the Contract Documents and shall be resubmitted with appropriate changes. No Work shall proceed for this item until resubmittal is approved.

1.7 FORMAT OF SUBMITTALS

A. TRANSMITTAL FORM

Transmit each submittal, except sample installations and sample panels, to office of Owner's Representative. Transmit submittals with transmittal form prescribed by Owner and standard for Project. The transmittal form shall identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals" Process transmittal forms to record actions regarding sample panels and sample installations.

B. IDENTIFYING SUBMITTALS

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

1. Project title and location.
2. Construction Contract Number.
3. Section Number of the Specification Section by which submittal is required.
4. Submittal Description (SD) number of each component of submittal.

5. When a resubmission, add alphabetic suffix on submittal description, for example, SD-10A, to indicate resubmission.
6. Name, address, and telephone number of Contractor, supplier, manufacturer and anyother lower tier contractor associated with submittal.
7. Product identification and location in Project.

C. FORMAT FOR SHOP DRAWINGS

1. Shop Drawings shall not be less than 8 1/2 by 11 inches nor more than "D" size 34 by 22inches.
2. Present 8 1/2 by 11 inches sized Shop Drawings as part of the bound volume forsubmittals required by section. Present larger drawings in sets.
3. Include on each drawing the drawing title, number, date, and revision numbers and dates,in addition to information required in paragraph entitled "Identifying Submittals."
4. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Shop Drawing dimensions shall be thesame unit of measure as indicated on the Contract Drawings. Identify materials and products for Work shown.

D. FORMAT OF PRODUCT DATA

1. Present product data submittals for each section as a complete, bound volume. Includetable of contents, listing page and catalog item numbers for product data.
2. Indicate, by prominent notation, each product which is being submitted; indicatespecification section number and paragraph number to which it pertains.
3. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developedspecifically for Project.

E. FORMAT OF SAMPLES

1. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer hasprepackaged samples of approximately 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 inchesand adequate to indicate color, texture, and material variations.
 - D. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, ifless than 10 inches. Examples of Linear Devices or Materials are conduit and handrails.
 - E. Sample of Non-Solid Materials: Pint. Examples of Non-Solid Materials are

sand and paint.

- F. Color Selection Samples: 2 by 4 inches.
- G. Sample Panel: 4 by 4 feet.
- H. Sample Installation: 100 square feet.

- 2. Samples Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range.
- 3. Reusable Samples: Incorporate returned samples into Work only if so specified or indicated. Incorporated samples shall be in undamaged condition at time of use.
- 4. Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final cleanup of Project.
- 5. When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

F. FORMAT OF OPERATION AND MAINTENANCE (O&M) DATA

- 1. O&M Data format shall comply with the requirements specified in Section 01 78 23, "Operation and Maintenance Data".

G. FORMAT OF ADMINISTRATIVE SUBMITTALS

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

1.8 QUANTITY OF SUBMITTALS

A. NUMBER OF COPIES OF SHOP DRAWINGS

Submit an electronic copy of submittals of Shop Drawings in PDF format.

B. NUMBER OF COPIES OF PRODUCT DATA

Submit Product Data in compliance with quantity and format requirements specified for Shop Drawings.

C. NUMBER OF COPIES OF OPERATION AND MAINTENANCE DATA

Submit an electronic copy in PDF format of O&M Data to the Owner's Representative for review and approval.

D. NUMBER OF COPIES OF ADMINISTRATIVE SUBMITTALS

Unless otherwise specified, submit administrative submittals in compliance with quantity and format requirements specified for Shop Drawings.

1.9 FORWARDING SUBMITTALS

A. SUBMITTALS REQUIRED FROM THE CONTRACTOR

As soon as practicable after Award of Contract, and before procurement of fabrication, forward to the Owner's Representative submittals required in the technical sections of this specification, including Shop Drawings, product data and samples. One copy of the transmittal form for all submittals shall be forwarded to the Owner's Representative.

O&M Data

The Owner's Representative will review and approve O&M Data to verify the submittals comply with the Contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

1. In the event the Contractor fails to deliver O&M Data within the time limits specified, the Owner may withhold from Progress Payments 50 percent of the price of the item with which such O&M Data are applicable.

1.10 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

A. OWNER APPROVED

Owner approval is required for extensions of design, critical materials, any deviations from the solicitation, the accepted proposal, or the completed design, equipment whose compatibility with the entire system must be checked, and other items as designated by the Owner.

B. ENGINEER APPROVED

Engineer approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Owner. Generally, design submittals should be identified as SD-05 Design Data submittals.

C. ENGINEER REVIEWED DESIGN OR EXTENSION OF DESIGN

Engineer review is required for extension of design construction submittals, used to define Contract conformity, and for deviation from the completed design. Review will be only for conformance with the Contract requirements. Included are only those Construction Submittals for which the Designer of Record Design Documents does not include enough detail to ascertain Contract compliance.

D. INFORMATION ONLY

All submittals not requiring Engineer or Owner approval will be for information only. They are not considered to be "Shop Drawings" within the terms of the Contract Clause referred to above.

1.11 APPROVED SUBMITTALS

The Owner or Engineer's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this Contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all Work. After submittals have been approved, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.12 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the Owner/Engineer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. The Contractor shall make all corrections required by the Owner/Engineer and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. Any "Information Only" submittal found to contain errors or unapproved deviations from the Solicitation or Accepted Proposal shall be resubmitted as one requiring "Approval" action, requiring Owner. If the Contractor considers any correction indicated on the submittals to constitute a change to the Contract, a notice in accordance with the Contract Clause "Changes" shall be given promptly to the Owner.

1.13 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the Work will not be made if required approvals have not been obtained. No payment for materials incorporated in the work will be made if all required Owner or Engineer approvals have not been obtained. No payment will be made for any materials incorporated into the Work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

1.14 GENERAL

The Contractor shall make submittals as required by the specifications. The Owner may request submittals in addition to those specified when deemed necessary to adequately describe the Work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the Contract Drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager, and each item shall be stamped, signed, and dated by the CQC System Manager indicating action taken. Proposed deviations from the Contract requirements shall be clearly identified. Submittals shall include items such as: subcontractor'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. Submittals requiring Engineer approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the Work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.15 SUBMITTAL REGISTER

The Engineer shall 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 Contractor shall maintain a Submittal Register for the Project.

The Engineer shall develop a complete list of submittals during design. The Engineer shall identify required submittals in the Specifications and use the list to prepare the Submittal Register. The list may not be all inclusive and additional submittals may be required by other parts of the Contract. The Contractor is required to complete the Submittal Register and submit it to the Owner for approval within 30 calendar days after Notice to Proceed. The approved Submittal Register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the Contract period. The "submit" dates and "need" dates used in the Submittal Register shall be coordinated with dates in the Contractor prepared progress schedule. Updates to the Submittal Register showing the Contractor action codes and actual dates with reviewer (Engineer or Owner) action codes and actual dates shall be submitted monthly or until all submittals have been satisfactorily completed. When the progress schedule is revised, the submittal register shall also be revised and both submitted for approval.

1.16 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of 20 working days exclusive of mailing time) shall be allowed and shown on the register for review and approval. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 10 working days shall be allowed and shown on the register for review and approval of submittals for control systems.

1.17 SUBMITTAL PROCEDURES

Submittals Shall Be Made as Follows:

A. PROCEDURES

Owner will further discuss detailed submittal procedures with the Contractor at the Preconstruction Conference.

B. DEVIATIONS

For submittals which include proposed deviations requested by the Contractor, "Variation" shall be clearly noted. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Owner and Engineer reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.18 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

1.19 OWNER/ENGINEER APPROVED SUBMITTALS

Upon completion of review of submittals requiring the Owner or Engineer to approve, the submittals will be identified as having received approval by being so stamped and dated. Six copies of the submittal will be retained and one electronic copy of the submittal will be returned to the Contractor.

1.20 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Owner or Engineer is not required on information only submittals. The Owner reserves the right to 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 to the Owner for testing in those instances where the technical specifications so prescribe. Four copies of information only submittals shall be retained.

END OF SECTION 013300

SECTION 013540 - ENVIRONMENTAL MANAGEMENT

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 basic designation only.

U.S. AIR FORCE (USAF)

AFI 32-1053 Pest Management Program

U.S. ARMY (DA)

AR 200-5 Pest Management

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

NPDES (1972; R 2005) National Pollutant Discharge Elimination System

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (1996) U.S. Army Corps of Engineers
Safety And Health Requirements Manual

WETLAND MANUAL Corps of Engineers Wetlands Delineation
Manual Technical Report Y-87-1

1.2 DEFINITIONS

A. ENVIRONMENTAL POLLUTION AND DAMAGE

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

B. ENVIRONMENTAL PROTECTION

Environmental Protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

C. CONTRACTOR GENERATED HAZARDOUS WASTE

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute Work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

D. SURFACE DISCHARGE

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

E. WATERS OF THE UNITED STATES

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

F. WETLANDS

Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with Wetland Manual.

1.3 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the Project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and Local Laws and Regulations. The Contractor shall be responsible for any delays and fines or penalties resulting from failure to comply with environmental laws and regulations.

1.4 LOWER TIER CONTRACTORS

The Contractor shall ensure compliance with this section by lower tier subcontractors.

1.5 PAYMENT

No separate payment will be made for Work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the Contract Price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and Local Laws and Regulations.

1.6 SUBMITTALS

Owner or Engineer approval is required for submittals as indicated on the submittal register. The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:

SD-01 PRECONSTRUCTION SUBMITTALS

Environmental Protection Plan:

The Environmental Protection Plan.

1.7 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Owner. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this Section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this Section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this Section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Owner for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's environmental plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

A. COMPLIANCE

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and Local Environmental Protection Laws and Regulations. During construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

B. CONTENTS

The Environmental Protection Plan shall include, but shall not be limited to, the following:

1. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
2. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.
3. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
4. Description of the Contractor's environmental protection personnel training program.

5. The spill control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local Laws and Regulations. The spill control plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:
 - A. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Owner and the local fire department in addition to the legally required Federal, State, and local reporting channels (including the national response center (1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.
 - B. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.
 - C. Training requirements for Contractor's personnel and methods of accomplishing the training.
 - D. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.
 - E. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.
 - F. The methods and procedures to be used for expeditious contaminant cleanup.

A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any lower tier contractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the non-hazardous solid waste diversion reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. The first working day of January, April, July, and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

6. An Air Pollution Control Plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

7. A Contaminant Prevention Plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and Local Laws and Regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any giventime shall be included in the Contaminant Prevention Plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

C. APPENDIX

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached as an appendix, to the Environmental Protection Plan.

1.8 PROTECTION FEATURES

This paragraph supplements the Contract Clause "Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements". Prior to start of any onsite construction activities, the Contractor and the Owner shall make a joint condition survey.

Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of Work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and Owner upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's Work under the Contract.

1.9 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the Drawings, Plans and Specifications which may have an environmental impact will be subject to approval by the Owner and may require an extended review, processing, and approval time. The Owner reserves the right to disapprove alternate methods, even if they are more cost effective, if determined that the proposed alternate method will have an adverse environmental impact.

1.10 NOTIFICATION

The Owner will notify the Contractor in writing of any observed noncompliance with Federal, State or Local Environmental Laws or Regulations, Permits, and other elements of the Contractor's Environmental Protection Plan. The Contractor shall, after receipt of such notice, inform the Owner of the proposed corrective action and take such action when approved by the Owner. The Owner may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Owner may take under the Contract, or in accordance with the State or Federal Law.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local Environmental Laws and Regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the Drawings and Specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the Work area. The Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

A. LANDSCAPE

The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved Work area.

B. CONTRACTOR FACILITIES AND WORK AREAS

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the Drawings or as directed by the Owner. Temporary movement or relocation of Contractor facilities shall be made only when approved. If excavation work becomes necessary, erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

If excavation work becomes necessary, the Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal and State air emission and performance laws and standards.

A. PARTICULATES

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials; shall be controlled at all times, including weekends, holidays and hours when Work is not in progress. The Contractor shall maintain Work areas within or outside the Project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance.

Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the Work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

B. ODORS

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State Regulations and/or local Ordinances.

C. SOUND INTRUSIONS

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State of Texas rules.

D. BURNING

Burning shall be prohibited on the Owner's premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise Specified in other Sections and/or shown on the Drawings.

A. SOLID WASTES

Solid wastes shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Owner's property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

B. CHEMICALS AND CHEMICAL WASTES

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Owner. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and Local Laws and Regulations.

C. CONTRACTOR GENERATED HAZARDOUS WASTES/EXCESS HAZARDOUS MATERIALS

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and Local Regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and Local Laws and Regulations. The Contractor shall transport Contractor generated hazardous waste off Owner's property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation Laws and Regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and Local Laws and Regulations. Spills of hazardous or toxic materials shall be immediately reported to the Owner. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility.

D. FUEL AND LUBRICANTS

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and Local Laws and Regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and Local Laws and Regulations.

E. WASTEWATER

Disposal of waste water shall be as specified below:

1. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. Shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off Owner's property in accordance with all Federal, State, Regional and Local Laws and Regulations.

3.6 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Owner so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.7 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and Local Laws and Regulations.

3.8 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the Project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.9 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.10 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities.

Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.11 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Owner, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

END OF SECTION 013540

SECTION 014200 - 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.

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. Documents listed in the Specifications with numbers which were not assigned by the standardsproducing organization should be ordered from the source by title rather than by number.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club
Drive Farmington Hills,
MI 48331PH: 248-848-
3700
FAX: 248-848-3701
E-MAIL: BKSTORE@CONCRETE.ORG
INTERNET: [HTTP://WWW.CONCRETE.ORG](http://WWW.CONCRETE.ORG)

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)
2111 Wilson Blvd, Suite 500
Arlington, VA 22201
PH: 703-524-8800
FAX: 703-528-3816
E-MAIL: FDIETZ@AHRINET.ORG
INTERNET: [HTTP://WWW.AHRINET.ORG](http://WWW.AHRINET.ORG)

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
1827 Walden Office
SquareSuite 550
Schaumburg, IL 60173-5774
PH: 847-303-5664
FAX: 847-303-5774
E-MAIL: WEBMASTER@AAMANET.ORG
INTERNET: [HTTP://WWW.AAMANET.ORG](http://WWW.AAMANET.ORG)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION
OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite
249 Washington, DC 20001
PH: 202-624-5800
FAX: 202-624-5806
E-MAIL: INFO@AASHTO.ORG
INTERNET: [HTTP://WWW.AASHTO.ORG](http://WWW.AASHTO.ORG)

AMERICAN BOILER MANUFACTURERS ASSOCIATION (ABMA)
8221 Old Courthouse Road Suite 207
Vienna, VA 22182
PH: 703-356-7171
FAX: 703-356-4543
INTERNET: [HTTP://WWW.ABMA.COM](http://WWW.ABMA.COM)

AMERICAN GAS ASSOCIATION (AGA)
400 North Capitol Street
N.W. Suite 450
Washington, D.C. 20001
PH: 202-824-7000
FAX: 202-824-7115
E-MAIL: WEBSITE@AGA.ORG
INTERNET: [HTTP://WWW.AGA.ORG](http://WWW.AGA.ORG)

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)
2700 Prosperity Ave., Suite 250
Fairfax, VA 22031
TEL: 703-849-8888
FAX: 703-207-3561
E-MAIL: INFONET@AIHA.ORG
INTERNET [HTTP://WWW.AIHA.ORG](http://WWW.AIHA.ORG)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite
700 Chicago, IL 60601-1802
PH: 312-670-2400
FAX: 312-670-5403
PUBLICATIONS: 800-644-2400
E-MAIL: PUBS@AISC.ORG
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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

SECTION 014500 - QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

This Section includes administrative and procedural requirements for Quality Assurance and Quality Control.

Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other Quality-Assurance and -Control Procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide Quality-Assurance and -Control Services required by Owner, or authorities having jurisdiction are not limited by provisions of this Section.

See Divisions 02 through 49 Sections for Specific Test and Inspection Requirements

1.2 DEFINITIONS

A. QUALITY-ASSURANCE SERVICES

Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. QUALITY-CONTROL SERVICES

Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include Contract enforcement activities performed by Owner.

C. PRECONSTRUCTION TESTING

Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. PRODUCT TESTING

Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. SOURCE QUALITY-CONTROL TESTING

Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. FIELD QUALITY-CONTROL TESTING

Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. TESTING AGENCY

An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. INSTALLER/APPLICATOR/ERECTOR

Contractor or another entity engaged by Contractor as an Employee, Subcontractor, or Sub-Subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

Using a term such as "Carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "Carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

I. EXPERIENCED

When used with an entity, "Experienced" means having successfully completed a minimum of three previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. GENERAL

If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Owner for a decision before proceeding.

B. MINIMUM QUANTITY OR QUALITY LEVELS

The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Owner for a decision before proceeding.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-01 Qualification Data

SD-07 Reports

A. QUALIFICATION DATA

For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. REPORTS

Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and re-inspecting.

C. PERMITS, LICENSES, AND CERTIFICATES

For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

A. GENERAL

Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. INSTALLER QUALIFICATIONS

A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this project, whose work has resulted in construction with a record of successful in-service performance.

C. MANUFACTURER QUALIFICATIONS

A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. FABRICATOR QUALIFICATIONS

A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. PROFESSIONAL ENGINEER QUALIFICATIONS

A Professional Engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

Engineering services are defined as those performed for installations of the system, assembly, or product(s) that are similar to those indicated for this Project in material, design, and extent.

F. SPECIALISTS

Certain Sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

Requirement for specialists shall not supersede Building Codes and Regulations Governing the Work.

G. TESTING AGENCY QUALIFICATIONS

An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

NVLAP: A testing agency accredited according to NIST'S National Voluntary Laboratory Accreditation Program.

H. FACTORY-AUTHORIZED SERVICE REPRESENTATIVE QUALIFICATIONS

An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this project.

1.6 QUALITY CONTROL

A. OWNER RESPONSIBILITIES

None

B. REFERENCE TO TESTS AND INSPECTIONS

Where the individual specification sections, or notes on the drawings, refer to tests and inspections to be done by Owner, these will be the responsibility of the Contractor. All tests and inspections are the Contractor's responsibility to have performed and to pay for. Provide Quality-Control services specified and those required by authorities having jurisdiction.

1. Engage a qualified testing agency to perform these Quality-Control services.
2. Notify testing agencies at least 24 hours in advance of time when work that require testing or inspecting will be performed.
3. Where Quality-Control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each Quality-Control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction when they so direct.

C. MANUFACTURER'S FIELD SERVICES

Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. RETESTING/REINSPECTING

Provide Quality-Control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. TESTING AGENCY RESPONSIBILITIES

Cooperate with Owner and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Owner and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar Quality-Control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. ASSOCIATED SERVICES

Cooperate with agencies performing required tests, inspections, and similar Quality-Control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. COORDINATION

Coordinate sequence of activities to accommodate required Quality-Assurance and -Control Services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

Schedule times for tests, inspections, obtaining samples, and similar activities.

1.7 SPECIAL TESTS AND INSPECTIONS

A. Special tests and inspections.

B. Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual specification sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and Quality-Control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Owner and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar Quality-Control service to Owner with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at substantial completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and re-inspecting corrected Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. GENERAL

On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. PROTECT EXPOSED CONSTRUCTION

Protect construction exposed by or for Quality-Control Service activities.

C. CONTRACTOR'S REPAIR AND PROTECTION RESPONSIBILITY

Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for Quality-Control services.

END OF SECTION 014500

SECTION 015000 - TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

See Division 01 Section "Execution" for progress cleaning requirements.

1.2 DEFINITIONS

Permanent Enclosure: As determined by Owner, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

A. GENERAL

Allow other entities to use temporary services and facilities without cost.

B. WATER SERVICE

Water from Owner's existing water system is available through standard hose bibbs without need to meter usage.

ELECTRIC POWER SERVICE

Electric power from Owner's existing system is available for use without metering and without payment of use charges. Also include the removal of temporary services.

1.4 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal Procedures."

SD-01 Traffic Control Plan

SD-01 Site Plan

A. SITE PLAN

Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

A. ELECTRIC SERVICE

Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70 and OSHA.

B. TESTS AND INSPECTIONS

Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. TEMPORARY USE OF PERMANENT FACILITIES

Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. FIELD OFFICES, GENERAL

If applicable, Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Tie downs shall be furnished to meet codes. Appearance is important and is subject to Owner's approval.

B. STORAGE AND FABRICATION SHEDS

Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Appearance is important and is subject to Owner's approval.

2.2 EQUIPMENT

A. FIRE EXTINGUISHER

Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures, to be furnished by each Contractor/Subcontractor.

B. HVAC EQUIPMENT

Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control, by each Contractor/Subcontractor as needed to protect their work.

Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

Locate facilities to limit site disturbance.

Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. GENERAL

Install temporary service or connect to existing service.

Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. SEWERS AND DRAINAGE

Provide temporary utilities to remove effluent lawfully.

C. WATER SERVICE

Install water service and distribution piping in sizes and pressures adequate for construction.

D. WATER SERVICE FACILITIES

Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

E. SANITARY FACILITY

Contractor shall provide their own temporary toilets. Drinking water for use of construction personnel will be provided by each Contractor.

F. HEATING AND COOLING

Each Contractor, as needed, shall provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

G. VENTILATION CONTROL

Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

H. ELECTRIC POWER SERVICE

Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

1. Electrical Contractor will provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
2. Install electric power service overhead, unless otherwise indicated.
3. Connect temporary service to Owner's existing power source, as directed by Owner.

I. LIGHTING

Electrical Contractor will provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

A. GENERAL

Comply with the following:

Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.

Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. TRAFFIC CONTROLS

Comply with requirements of authorities having jurisdiction.

Protect existing site improvements to remain including curbs, pavement, and utilities. Maintain access for fire-fighting equipment and access to fire hydrants.

C. PARKING

Use designated areas of Owner's site for construction personnel.

D. DEWATERING FACILITIES AND DRAINS

Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.

Remove snow and ice as required to minimize accumulations.

E. TEMPORARY SIGNS

Provide temporary, warning, safety and directional signs for construction personnel and visitors. Maintain and touchup signs so they are legible at all times.

F. WASTE DISPOSAL FACILITIES

Contractor will provide their own roll-off waste-collection container. Each Contractor is responsible for their own clean up.

G. LIFTS AND HOISTS

Provide facilities necessary for hoisting materials and personnel.

Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. ENVIRONMENTAL PROTECTION

Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. TEMPORARY EROSION AND SEDIMENTATION CONTROL

Each Contractor, as required, will provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

C. STORMWATER CONTROL

Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. TREE AND PLANT PROTECTION

Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. PEST CONTROL

Keep the jobsite clean and free from left-over food, etc.

F. BARRICADES, WARNING SIGNS, AND LIGHTS

Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

G. TEMPORARY ENCLOSURES

Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

H. TEMPORARY PARTITIONS

Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.

Construct dustproof partitions with 2 layers of 3-mil polyethylene sheet on each side. Cover floor with 2 layers of 3-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.

Provide walk-off mats at each entrance through temporary partition.

I. TEMPORARY FIRE PROTECTION

Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

Prohibit smoking in construction areas.

Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. SUPERVISION

Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. MAINTENANCE

Maintain facilities in good operating condition until removal.

Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. TERMINATION AND REMOVAL

Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 01 57 50 - TEMPORARY ENVIRONMENTAL 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 in the text by the basic designation only.

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

29 CFR 1910	OCCUPATIONAL SAFETY AND HEALTH STANDARDS
29 CFR 1910.1200	HAZARD COMMUNICATION
40 CFR 112	OIL POLLUTION PREVENTION
40 CFR 122.26	EPA NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT REGULATIONS
40 CFR 173	PROCEDURES GOVERNING THE RESCISSION OF STATE PRIMARY ENFORCEMENT RESPONSIBILITY FOR PESTICIDE USE VIOLATIONS
40 CFR 241	GUIDELINES FOR DISPOSAL OF SOLID WASTE
40 CFR 243	GUIDELINES FOR THE STORAGE AND COLLECTION OF RESIDENTIAL, COMMERCIAL, AND INSTITUTIONAL SOLID WASTE
40 CFR 258	SUBTITLE D LANDFILL REQUIREMENTS
40 CFR 260	HAZARDOUS WASTE MANAGEMENT SYSTEMS: GENERAL
40 CFR 261	IDENTIFICATION AND LISTING OF HAZARDOUS WASTE
40 CFR 262	GENERATORS OF HAZARDOUS WASTE
40 CFR 263	TRANSPORTERS OF HAZARDOUS WASTE
40 CFR 264	OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES
40 CFR 265	INTERIM STATUS STANDARD FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

40 CFR 266	MANAGEMENT OF SPECIFIC HAZARDOUS WASTES AND SPECIFIC TYPES OF HAZARDOUS WASTE MANAGEMENT FACILITIES
40 CFR 268	LAND DISPOSAL RESTRICTIONS
40 CFR 270	EPA ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT PROGRAM
40 CFR 271	REQUIREMENTS FOR AUTHORIZATION OF STATE HAZARDOUS WASTE PROGRAMS
40 CFR 272	APPROVED STATE HAZARDOUS WASTE MANAGEMENT PROGRAMS
40 CFR 273	UNIVERSAL WASTE MANAGEMENT
40 CFR 279	USED OIL REGULATIONS
40 CFR 280	OWNERS AND OPERATORS OF UNDERGROUND STORAGE TANKS
40 CFR 300	NATIONAL OIL AND HAZARDOUS SUBSTANCE POLLUTION CONTINGENCY PLAN
40 CFR 355	EMERGENCY PLANNING AND NOTIFICATION
40 CFR 372-SUBPART D	EPA TOXIC CHEMICAL RELEASE REPORTING REGULATIONS
40 CFR 716	HEALTH AND SAFETY DATA REPORTING
40 CFR 761	POLYCHLORINATED BIPHENYLS (PCBS) MANUFACTURING, PROCESSING, DISTRIBUTION IN COMMERCE, AND USE PROHIBITIONS
49 CFR 173	SHIPMENTS AND PACKAGINGS
49 CFR 178	PACKAGINGS
U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)	
EPA SW-846	(1996) EVALUATING SOLID WASTE (PHYSICAL/CHEMICAL METHODS)
EPA 832-R-92-005	STORM WATER MANAGEMENT FOR CONSTRUCTION ACTIVITIES

1.2 DEFINITIONS

A. SEDIMENT

Soil and other debris that have eroded and have been transported by runoff water or wind.

B. SOLID WASTE

Garbage, refuse, debris, sludge, or other discharged material (except hazardous waste as defined in paragraph entitled "Hazardous Waste" or Hazardous Debris as defined in paragraph entitled "Hazardous Debris"), including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

1. Green Waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.
2. Surplus Soil: Existing soil that is in excess of what is required for this Work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.
3. Inert construction and demolition debris: broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may be re-enforced with or contain ferrous wire, rods, accessories and weldments.
4. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.
5. Scrap Metal: Scrap and excess ferrous and non-ferrous metals such as re-inforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.
6. Paint Cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.
7. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may be included as recyclable if sold to a scrap metal company.

C. DEBRIS

Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders). A mixture of debris

and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

D. HAZARDOUS DEBRIS

As defined in paragraph entitled "Debris" of this Section, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

E. CHEMICAL WASTES

This includes salts, acids, alkalies, herbicides, pesticides, and organic chemicals.

F. GARBAGE

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

G. HAZARDOUS WASTE

Hazardous waste as defined in 40 CFR 261 or as defined by applicable State and Local Regulations.

H. OILY WASTE

Petroleum products and bituminous materials.

I. REGULATED WASTE

Those solid waste that have specific additional Federal, State, or Local Controls for handling, storage, or disposal.

J. CLASS I OZONE DEPLETING SUBSTANCE (ODS)

Class I ODS is defined in section 602(a) of the Clean Air Act and includes the following chemicals:

CHLOROFLUOROCARBON-11 (CFC-11) CHLOROFLUOROCARBON-213 (CFC-213)
CHLOROFLUOROCARBON-12 (CFC-12) CHLOROFLUOROCARBON-214 (CFC-214)
CHLOROFLUOROCARBON-13 (CFC-13) CHLOROFLUOROCARBON-215 (CFC-215)
CHLOROFLUOROCARBON-111 (CFC-111) CHLOROFLUOROCARBON-216 (CFC-216)
CHLOROFLUOROCARBON-112 (CFC-112) CHLOROFLUOROCARBON-217 (CFC-217)
CHLOROFLUOROCARBON-113 (CFC-113) HALON-1211
CHLOROFLUOROCARBON-114 (CFC-114) HALON-1301
CHLOROFLUOROCARBON-115 (CFC-115) HALON-2402
CHLOROFLUOROCARBON-211 (CFC-211) CARBON TETRACHLORIDE
CHLOROFLUOROCARBON-212 (CFC-212) METHYL CHLOROFORM

K. HAZARDOUS MATERIALS

Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a hazardous waste in accordance with 40CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00, "Submittal

Procedures."SD-01 Preconstruction Submittals

Environmental Protection Plan

SD-06 Test Reports

Laboratory

AnalysisSD-11 Closeout

Submittals

Some of the records listed below are also required as part of other Submittals. For the "Records" submittal, maintain on-site a separate three-ring environmental records binder and submit at the completion of the Project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Preconstruction Survey

Solid Waste Disposal

Permit

Waste Determination Documentation

Disposal Documentation for Hazardous and Regulated

WasteContractor 40 CFR Employee Training Records

Regulatory Notification

Solid Waste Disposal Report

Contractor Hazardous Material Inventory Log

1.4 LABORATORY ANALYSIS

Submit a copy of a laboratory analysis of solid waste and debris with the potential of becoming classified as a hazardous waste (i.e., abrasive/sand blasting debris, etc.). Waste stream determinations are required at the point of generation and must sufficiently document whether the waste will be a solid waste, hazardous waste, or Resource Conservation and Recovery Act (RCRA) exempt waste. Determinations must use EPA approved methods and provide written rationale for whether the waste is classified as hazardous or non-hazardous. The Contractor will bear the cost of the waste stream determinations, and the Owner

reserves the right to request waste stream determinations on questionable waste streams.

1.5 REPORTS

A. PRECONSTRUCTION SURVEY

Perform a preconstruction survey of the Project site with the Owner, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

B. SOLID WASTE DISPOSAL PERMIT

Submit one copy of a State and Local Permit or License showing such agencies' approval of the disposal plan before transporting wastes off Owner's property.

C. WASTE DETERMINATION DOCUMENTATION

The Contractor will complete a waste determination form (provided at the pre-construction conference) for all Contractor derived wastes to be generated. The waste determination must be based upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate).

All support documentation must be attached to the waste determination form. As a minimum, a waste determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

D. DISPOSAL DOCUMENTATION FOR HAZARDOUS AND REGULATED WASTE

Submit a copy of the applicable EPA and State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities.

E. CONTRACTOR 40 CFR EMPLOYEE TRAINING RECORDS

Prepare and maintain employee training records throughout the term of the Contract meeting applicable 40 CFR requirements. Submit these training records to the Owner at the conclusion of the Project, unless otherwise directed.

F. REGULATORY NOTIFICATION

The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and Local Regulations. The Contractor will forward copies to the Owner prior to commencement of Work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).

G. SOLID WASTE DISPOSAL REPORT

Monthly the Contractor will submit a solid waste disposal report to the Owner. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste. The Contractor will include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an Officer of the Contractor firm authorized to legally obligate or bind the Firm. The sales documentation or Contractor certification will include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor will submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received will not be reported to the Owner unless required by other provisions or Specifications of this Contract or Public Law.

1.6 CLASS I ODS PROHIBITION

Class I ODS as defined and identified herein will not be used in the performance of this Contract, nor be provided as part of the equipment. This prohibition will be considered to prevail over any other Provision, Specification, Drawing, or referenced Documents.

1.7 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the Contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the Project. Comply with Federal, State, and Local Regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Environmental Brief: Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the activity; types and quantities of wastes/wastewater that may be generated during the Contract.

A. FACILITY HAZARDOUS WASTE GENERATOR STATUS

All Work conducted within the boundaries of this activity must meet the regulatory requirements of this generator designation. The Contractor will comply with all provisions of Federal, State and Local Regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of all construction derived wastes.

B. LICENSES AND PERMITS

The Contractor is responsible to perform Quality Control inspections of the Work in progress, and to submit notifications and certifications to the applicable regulatory agency, via the Owner, that the Work conforms to the Contract and Permit Requirements.

C. CONTRACTOR LIABILITIES FOR ENVIRONMENTAL PROTECTION

The Contractor is advised that this Project is subject to Federal, State, and Local Regulatory Agency inspections to review compliance with environmental laws and regulations. The Contractor will fully cooperate with any representative from any Federal, State or Local Regulatory Agency who may visit the job site and will provide immediate notification to the Owner, who will accompany them on any subsequent site inspections. The Contractor will complete, maintain, and make available to the Owner or Regulatory Agency personnel all documentation relating to environmental compliance under applicable Federal, State and Local Laws and Regulations. The Contractor will immediately notify the Owner if a Notice of Violation (NOV) is issued to the Contractor or lower tier subcontractors.

The Contractor will be responsible for all damages to persons or property resulting from Contractor fault or negligence as well as for the payment of any civil fines or penalties which may be assessed by any Federal, State or Local Regulatory Agency as a result of the Contractor's or any lower tier subcontractor's violation of any applicable Federal, State or Local Environmental Law or Regulation. Should a Notice of Violation (NOV), Notice of Noncompliance (NON), Notice of Deficiency (NOD), or similar regulatory agency notice be issued to the Owner as facility Owner/Operator on account of the actions or inactions of the Contractor or one of its lower tier subcontractors in the performance of Work under this Contract, the Contractor will fully cooperate with the Owner in defending against regulatory assessment of any civil fines or penalties arising out of such actions or inactions.

1.8 ENVIRONMENTAL PROTECTION PLAN

- A. Five days after the Award of Contract, the Contractor will meet with the Owner to discuss the proposed Environmental Protection Plan and develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The Environmental Protection Plan will be submitted in the following format and will, at a minimum, address the following elements (also refer to paragraph entitled "Protection of Natural Resources" in this Section):

Description of the Environmental Protection Plan

1. General overview and purpose
2. General site information

Protection of Natural Resources

1. Replacement of damaged landscape features

Storm Water Management and Control

1. Temporary Measures
 - a. Mechanical Retardation and Control Runoff
 - b. Vegetation and Mulch

Prevention of Releases to the

Environment

1. Procedures to prevent releases to the environment
2. Notifications in the event of a release to the environment

Protection of the environment from waste derived from Contractor operations

1. Control and disposal of solid and sanitary waste
2. Control and disposal of hazardous waste (hazardous waste management section)

This item will consist of the management procedures for all hazardous waste to be generated. The elements of those procedures will coincide with the Site Specific hazardous waste management plan. A copy of the Site Specific hazardous waste management plan will be provided by the Owner. As a minimum, include the following:

- a. Procedures to be employed to ensure a written waste determination is made for appropriate wastes which are to be generated;
- b. Sampling/Analysis plan;
- c. Methods of hazardous waste accumulation/storage (i.e., in tanks and/or containers);
- d. Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted);
- e. Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with land disposal restrictions (40 CFR 268);
- f. Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and the like;
- g. Used oil management procedures in accordance with 40 CFR 279;
- h. Pollution prevention/hazardous waste minimization procedures;
- i. Plans for the disposal of hazardous waste by permitted facilities;
- j. Procedures to be employed to ensure all required employee training records are maintained.

B. ENVIRONMENTAL PROTECTION PLAN REVIEW

Fourteen days after the environmental protection meeting, submit the proposed Environmental Protection Plan for further discussion, review, and approval. Commencement of Work will not begin until the Environmental Protection Plan has been approved.

1.9 UNFORESEEN HAZARDOUS OR REGULATED MATERIAL

If material that is not indicated in the Contract Documents is encountered that may be dangerous to human health upon disturbance during construction operations, stop that portion of work and notify the Owner immediately. Intent is to identify materials such as PCB, lead paint, mercury, petroleum products, and friable and nonfriable asbestos. Within 14 calendar days the Owner will determine if the material is hazardous. If the material is not hazardous or poses no danger, Owner will direct the Contractor to proceed without Change. If the material is hazardous and handling of the material is necessary to accomplish the work, the Owner will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

1.10 CONTRACTOR HAZARDOUS MATERIAL INVENTORY LOG

Submit the "Contractor Hazardous Material Inventory Log" that provides information required by (EPCRA Sections 312 and 313) along with corresponding Material Safety Data sheets (MSDS) to the Owner at the start and at the end of construction (30 days from Final Acceptance), and update no later than January 31 of each calendar year during the life of the Contract. Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the Project boundaries and outside the limits of permanent Work. Restore to an equivalent or improved condition upon completion of Work. Confine construction activities to within the limits of the Work indicated or Specified.

A. LAND RESOURCES

Do not remove, cut, deface, injure, or destroy trees or shrubs without the Owner's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Owner. Where such use of attached ropes, cables, or guys is authorized, the Contractor will be responsible for any resultant damage.

1. Replacement

Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain the Owner's approval before replacement.

3.2 EROSION AND SEDIMENT CONTROL MEASURES

A. BURNOFF

Burnoff of the ground cover is not permitted.

B. TEMPORARY PROTECTION OF ERODIBLE SOILS

Use the following methods to prevent erosion and provide sediment control:

1. The Contractor shall implement and comply with the approved Erosion and Sediment Control Plan incorporated into the Contract Documents. If such a Plan is not provided for, the Contractor shall submit for Owner's acceptance his schedules for accomplishment of temporary and permanent Erosion and Sediment Control Plan for Work prior to the start of Construction. The schedules shall be applicable for clearing and grubbing, excavation, grading, construction and paving.

2. No Work shall be started until the Erosion and Sediment Control Schedules and Methods of Operation have been accepted by Federal, State, Local Laws and Regulations and Owner's Representative and implemented by the Contractor.
3. The Erosion and Sediment Control Permit will be issued at a the Preconstruction Conference or an on-site meeting arranged by Owner's Representative and attended by a Sediment Control Inspector / Authority Having Jurisdiction.
4. The Contractor shall notify the Authorities having Jurisdiction at least 80 hours before commencing Work on the Project. The site, work materials, Plans, Specifications and Permits shall be available on-site at all times during working hours for inspection by the County Representatives.
5. All Erosion and Sediment Control Devices that are disturbed during the Construction operations shall be fully repaired immediately but no later than by the end of the day on which they are disturbed. All Erosion and Sediment Control Devices shall be maintained for the winter season and during other times when the Project is closed down.
6. In the event that Erosion and Pollution Control measures are required due to the Contractor's negligence, carelessness or failure to install permanent control as part of the schedule Work, the Owner will order the work to be performed by the Contractor at his own expense.
7. Mechanical retardation and control of runoff:
Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, berms, and use of silt fences and straw bales to retard and divert runoff to protected drainage courses.
8. Vegetation and mulch:
 - a. Seeding: provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish a suitable stand of grass.

3.3 CONTROL AND DISPOSAL OF SOLID WASTES

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the Project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At Project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the Owner and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from Owner property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent Local, State, and Federal Requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

3.4 CONTROL AND DISPOSAL OF HAZARDOUS WASTES

A. HAZARDOUS WASTE/DEBRIS MANAGEMENT

The Contractor will identify all construction activities which will generate hazardous waste/debris. The Contractor must provide a documented waste determination for all resultant waste streams. Hazardous waste/debris will be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and Local Regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268. Hazardous waste will also be managed in accordance with the approved hazardous waste management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Owner facilities will be identified as being generated by the Owner. Prior to removal of any hazardous waste from Owner's property, all hazardous waste manifests must be signed by activity personnel from the Owner's Environmental Office. No hazardous waste will be brought onto Owner's property. Provide to the Owner a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-Subpart D. For hazardous wastes spills, verbally notify the Owner immediately.

1. Regulated waste storage/satellite accumulation/90 day storage areas

If the Work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor will request the establishment of a regulated waste storage area, a satellite accumulation area, or a 90 day storage area at the point of generation. The Contractor must submit a request in writing to the Owner providing the following information:

Contract Number	_____	Contractor	_____
Haz/Waste Or Regulated Waste POC	_____	Phone Number	_____
Type of Waste	_____	Source of Waste	_____
Emergency POC	_____	Phone Number	_____
Location of the Site:	_____		
	<i>(Attach site plan to the request)</i>		

Attach a waste determination form. Allow ten working days for processing this request.

B. POLLUTION PREVENTION/HAZARDOUS WASTE MINIMIZATION

The Contractor will actively pursue minimizing the use of hazardous materials and the generation of hazardous waste while Owner's site. The hazardous waste management section of the Environmental Protection Plan will include the Contractor's procedures for pollution prevention/ hazardous waste minimization. For preparing this part of the plan, the Contractor may consult the Owner's Environmental Office for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material. The Contractor will describe the types of the hazardous materials expected to be used in the construction when requesting information.

C. HAZARDOUS MATERIAL CONTROL

The Contractor will include hazardous material control procedures in the Safety Plan. The procedures will address and ensure the proper handling of hazardous materials, including the appropriate transportation requirements. The Contractor will submit a MSDS and estimated quantities to be used for each hazardous material to the Owner prior to bringing the material on Owner's property/Project site. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. At the end of the Project, the Contractor will provide the Owner with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the Project, and how the material was used. The Contractor will also ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. The Contractor will ensure that all containers of hazardous materials have NFPA labels or their equivalent. Copies of the MSDS for hazardous materials will be kept on site at all times and provided to the Owner at the end of the Project. The Contractor will certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

D. PETROLEUM PRODUCTS

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. All used oil generated on site will be managed in accordance with 40 CFR 279. The Contractor will determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. In addition, used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste. All hazardous waste will be managed in accordance with the paragraph entitled Hazardous Waste/Debris Management of this Section and will be managed in accordance with the approved Environmental Protection Plan.

E. RELEASES/SPILLS OF OIL AND HAZARDOUS SUBSTANCES

Take precautions to prevent releases/spills of oil and hazardous substances. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the activity by calling the Owner. All appropriate emergency responders will then be contacted by site personnel. The Contractor is responsible for verbal and written notifications as required by the federal 40 CFR 355, State, Local Regulations and site specific instructions. Spill response will be in accordance with 40 CFR 300 and applicable State and Local Regulations. Contain and clean up these spills without cost to the Owner. If Owner assistance is requested or required, the Contractor will reimburse the Owner for such assistance. Provide copies of the written notification and documentation that a verbal notification was made within 20 days.

3.5 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry powerbrooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.6 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the Owner, and then only during the designated times.

END OF SECTION 015750

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general procedural requirements governing Execution of the Work including, but not limited to, the following:
1. Construction layout.
 2. General installation of products.
 3. Progress cleaning.
 4. Starting and adjusting.
 5. Protection of installed construction.
 6. Correction of the work.
- B. See Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

SD-07 Landfill Receipts

Landfill receipts: submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. EXISTING CONDITIONS

The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning Work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

Before construction, verify the location and points of connection of utility services.

B. EXISTING UTILITIES

The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping, and underground electrical services.
2. Furnish location data for Work related to Project that must be performed by public utilities serving Project site.

C. ACCEPTANCE OF CONDITIONS

Examine substrates, areas, and conditions, with installer or applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. EXISTING UTILITY INFORMATION

Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. FIELD MEASUREMENTS

Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. SPACE REQUIREMENTS

Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS

Immediately on discovery of the need for clarification of the Contract Documents, submit a Request for Information to Owner. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. VERIFICATION

Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Owner promptly.

3.4 INSTALLATION

A. GENERAL

Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical Work plumb and make horizontal Work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. INSTALLING PRODUCTS IN APPLICATIONS

Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. PROPER TIME AND CONDITIONS FOR INSTALLING PRODUCTS

Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. TIMING OF CONSTRUCTION OPERATIONS

Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. TOOLS AND EQUIPMENT

Do not use tools or equipment that produce harmful noise levels.

F. TEMPLATES

Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. ANCHORS AND FASTENERS

Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the work.

1. Mounting heights: Where mounting heights are not indicated, mount components at heights directed by Owner.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. JOINTS

Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. HAZARDOUS MATERIALS

Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

A. GENERAL

Clean project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly.

Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. SITE

Maintain Project site free of waste materials and debris.

C. WORK AREAS

Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire Work area, as appropriate.

D. INSTALLED WORK

Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. CONCEALED SPACES

Remove debris from concealed spaces before enclosing the space.

F. EXPOSED SURFACES IN FINISHED AREAS

Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. WASTE DISPOSAL

Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. PROTECTION FROM DAMAGE

During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. MAINTAINING COMPLETED CONSTRUCTION

- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

K. LIMITING EXPOSURES

Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's field service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

This section includes procedural requirements for Cutting and Patching.

See Divisions 02 through 48 Sections for specific requirements and limitations applicable to Cutting and Patching individual parts of the Work.

1.2 QUALITY ASSURANCE

A. STRUCTURAL ELEMENTS

Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. OPERATIONAL ELEMENTS

Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. MISCELLANEOUS ELEMENTS

Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

D. VISUAL REQUIREMENTS

Do not cut and patch construction Work in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Owner's opinion, reduce the building's aesthetic qualities.
Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.3 WARRANTY

A. EXISTING WARRANTIES

Remove, replace, patch, and repair materials and surfaces cut or damaged during Cutting and Patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. GENERAL

Comply with requirements specified in other Sections.

B. IN-PLACE MATERIALS

Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine surfaces to be cut and patched and conditions under which Cutting and Patching are to be performed.

- A. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
- B. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. TEMPORARY SUPPORT

Provide temporary support of work to be cut.

B. PROTECTION

Protect in-place construction during Cutting and Patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during Cutting and Patching operations.

C. ADJOINING AREAS

Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. EXISTING UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. GENERAL

Employ skilled workers to perform Cutting and Patching. Proceed with Cutting and Patching at the earliest feasible time, and complete without delay.

Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. CUTTING

Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original installer; comply with original installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by Cutting and Patching operations.
5. Mechanical and electrical services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. PATCHING

Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-planesurface of uniform appearance.
5. Exterior building enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. CLEANING

Clean areas and spaces where Cutting and Patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

This section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

See Division 01 Section "Environmental Management" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.

1.2 DEFINITIONS

A. CONSTRUCTION WASTE

Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. DEMOLITION WASTE

Building and site improvement materials resulting from demolition or selective demolition operations.

C. DISPOSAL

Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator shall be performed in a manner acceptable to authorities having jurisdiction.

D. RECYCLE

Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. SALVAGE

Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. SALVAGE AND REUSE

Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 SUBMITTALS

SD-01 Waste Management Plan

SD-07 Waste Reduction Progress Reports

A. WASTE MANAGEMENT PLAN

Submit two copies of plan within 30 days of date established for commencement of the Work.

B. WASTE REDUCTION PROGRESS REPORTS

Concurrent with each Application for Payment, submit one copy of the report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. WASTE REDUCTION CALCULATIONS

Before request for Substantial Completion, submit two copies of calculated end-of-project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. RECORDS OF DONATIONS

Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. RECORDS OF SALES

Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. RECYCLING AND PROCESSING FACILITY RECORDS

Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. LANDFILL AND INCINERATOR DISPOSAL RECORDS

Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. QUALIFICATION DATA

For Refrigerant Recovery Technician.

I. STATEMENT OF REFRIGERANT RECOVERY

Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.4 QUALITY ASSURANCE

Refrigerant recovery technician qualifications: certified by EPA-approved certification program.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. GENERAL

Implement Waste Management Plan as approved by Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement Waste Management Plan during the entire duration of the Contract.

B. TRAINING

Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

Distribute Waste Management Plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. SITE ACCESS AND TEMPORARY CONTROLS

Conduct Waste Management Operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. SALVAGED ITEMS FOR REUSE IN THE WORK

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. GENERAL

Recycle paper and beverage containers used by on-site workers.

B. RECYCLING INCENTIVES

Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to.

C. PROCEDURES

Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. WOOD MATERIALS

Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

B. METALS

SEPARATE METALS BY TYPE.

1. Structural steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

C. GYPSUM BOARD

Stack large clean pieces on wood pallets and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

D. EQUIPMENT

Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

E. PLUMBING FIXTURES

Separate by type and size.

F. PIPING

Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

G. ELECTRICAL DEVICES

Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

H. CONDUIT

Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. PACKAGING

1. Cardboard and boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. WOOD MATERIALS

1. Clean cut-offs of lumber: Grind or chip into small pieces.
2. Clean sawdust: Bag sawdust that does not contain painted or treated wood.

C. GYPSUM BOARD

Stack large clean pieces on wood pallets and store in a dry location.

Clean gypsum board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. GENERAL

Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. BURNING

Do not burn waste materials.

C. DISPOSAL

Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 01 78 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes administrative and procedural requirements for Contract Closeout, including, but not limited to, the following:

Inspection Procedures.

Warranties.

Final Cleaning.

- B. See Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- C. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- D. See Division 01 Section "Operation and Maintenance Data" for Operation and Maintenance Manual requirements.
- E. See Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- F. See Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those sections

1.2 SUBSTANTIAL COMPLETION

A. PRELIMINARY PROCEDURES

Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, Operation and Maintenance Manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. INSPECTION

Submit a written request for inspection for Substantial Completion. On receipt of request, Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Owner, that must be completed or corrected before Certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

A. PRELIMINARY PROCEDURES

Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Owner's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Owner. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. INSPECTION

Submit a written request for final inspection for acceptance. On receipt of request, Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. PREPARATION

Submit two copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

Organize list of spaces in sequential order, starting with exterior areas first.

Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.5 WARRANTIES

A. SUBMITTAL TIME

Submit written warranties on request of Owner for designated portions of the Work where commencement of warranties, other than date of Substantial Completion, if such requirements are specified in the prime contract.

B. ORGANIZATION OF WARRANTY DOCUMENTS

Organize warranty documents into an orderly sequence based on the table of contents of the Project manual.

Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

Identify each binder on the front and spine with the typed or printed title "Warranties," Project name, and name of Contractor.

C. ADDITIONAL COPIES

Provide additional copies of each warranty to include in Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. CLEANING AGENTS

Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. GENERAL

Provide final cleaning. Conduct cleaning and waste-removal operations to comply with Local Laws and Ordinances and Federal and Local Environmental and Antipollution Regulations.

B. CLEANING

Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

Complete the following cleaning operations before requesting inspection for certification of substantial completion for entire Project or for a portion of Project:

1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
4. Remove tools, construction equipment, machinery, and surplus material from Project site.
5. Remove snow and ice to provide safe access to building.
6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
8. Sweep concrete floors broom clean in unoccupied spaces.
9. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

10. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
11. Remove labels that are not permanent.
12. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - A. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
13. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
14. Replace parts subject to unusual operating conditions.
15. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
16. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
17. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
18. Leave project clean and ready for occupancy.

C. SAFETY STANDARDS COMPLIANCE

Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017800

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 REFERENCES

- A. 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 E 1971 (2005) Stewardship for the Cleaning of Commercial and Institutional Buildings

1.2 SUMMARY

- A. This section includes administrative and procedural requirements for preparing Operation and Maintenance Manuals.
- B. See Divisions 02 through 49 Sections for specific Operation and Maintenance Manual requirements for the Work in those Sections.

1.3 SUBMITTALS

SD-10 Manuals

- A. Manuals
1. Submit one manual per building.
 2. Submit each manual exactly in the format and order shown under Part 2 – PRODUCTS and Part 3 – EXECUTION, as applicable.
 3. Initial submittal, and each subsequent Operation and Maintenance Manual resubmission, shall consist of one (1) electronic copy in PDF format in final format. Submission shall be made within thirty (30) calendar days after the last item is delivered to the contract site. PDF format shall also include numbering/naming of tabs in correct order within the manual.
 4. Upon approval, or approval with changes noted, the Contractor shall incorporate any changes noted and shall submit six (6) hard copies and one (1) electronic copy in PDF format of the final Operation and Maintenance manual.
- B. MANUAL
1. Submit five hard copies and one electronic copy in a PDF format of each manual for equipment/material in final form within 30 calendar days after the item is delivered to the contract site. In the event the Contractor fails to deliver O&M Data within the time limits specified, the Owner will withhold all Progress Payments until such O&M Data are provided.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

A. Organization

Unless otherwise indicated, organize each system and subsystem into a separate section for each Appendix within the manual. Provide a separate section for each piece of equipment not part of a system. Each Appendix shall contain a title page, table of contents, and Appendix contents.

B. Title Page(s)

Include the following information:

1. Title Page(s):
 - a. Project name and address of applicable project site.
 - b. Date of submittal.
 - c. Name, address, and telephone number of Contractor and sub-tier contractor(s).
2. First Page for each Appendix: Subject matter included in respective Appendix (i.e. "Appendix A- Manufacturer's Warranty Information").

C. Table of Contents

List each Appendix. For each Appendix, list each product included in the Appendix, identified by product name, indexed to the content of the volume.

D. Manual Contents

Organize into sets of manageable size (3" binder or smaller). Arrange contents alphabetically by system, subsystem, and equipment.

1. Binders

Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

- a. Identify each binder on front and spine, with printed title "Operation and Maintenance Manual," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers

Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents.

3. Protective Plastic Sleeves

Transparent plastic sleeves designed to enclose CD copies.

4. Drawings

- a. Attach reinforced, punched binder tabs on drawings and bind with text.
- b. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- c. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

A. Content

Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.

B. Type of Emergency

Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for fire, flood, gas leak, water leak, power failure, water outage, equipment failure, and chemical release or spill.

C. Emergency Instructions

Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, Supplier, and Manufacturer to maintain warranties.

D. Emergency Procedures

Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

2.3 INSTALLATION MANUALS

A. Content

Organize manual into a separate section for each system, subsystem and/or product. In addition to requirements in this Section, include all pre-installation instructions along with the installation instructions.

B. Source Information

List each system, subsystem and/or product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information

Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.

D. Installation and Removal Procedures

Include as necessary any required tools or equipment, figures or connection diagrams indicating proper installation, proper code compliance requirements, seasonal installation considerations, proper installation condition requirements (environmental, location, obstructions, etc.), safety related cautions or warnings, mounting or guarding requirements, electrical or grounding considerations and requirements, initial lubrication requirements, procedures for post installation testing and confirmation of proper installation, procedures for first time-start-up and any installation trouble-shooting. Include any items listed above necessary to ensure proper removal of equipment as well.

2.4 OPERATION MANUALS

A. Content

Organize manual into a separate section for each system, subsystem and/or product. In addition to requirements in this Section, include source information, product information, operation procedures, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.

B. Source Information

List each system, subsystem and/or product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information

Include the following, as applicable:

1. Product name and model number.
2. Total quantity of each equipment type installed under this contract.
3. Manufacturer's name.
4. Equipment identification with serial number of each component.
5. Equipment function.
6. Operating characteristics.
7. Limiting conditions.
8. Performance curves
9. Engineering data and tests.

10. Recommendations for proper calibrations.
11. Copies of approved certifications and laboratory test reports (where applicable).
12. Complete nomenclature and number of replacement parts.

D. Operating Procedures

Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; lubricating schedule; and required sequences for electric or electronic systems.

E. Systems and Equipment Controls

Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems

Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content

Organize manual into a separate section for each system, subsystem, product, material, and/or finish. Include source information, product information, maintenance procedures, maintenance and service schedules, repair materials and sources and maintenance service contracts (where applicable).

B. Source Information

List each system, subsystem and/or product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information

Include the following, as applicable:

1. Product name and model number.
2. Color, pattern, and texture.
3. Material and chemical composition.
4. Reordering information for specially manufactured products.

D. Maintenance Procedures

Include the following, as applicable:

1. Manufacturer's written recommendations for test and inspection procedures
2. Instructions that detail essential maintenance and overhaul procedures.
3. Special tools and test equipment required for maintenance or overhaul.

4. Service, cleaning and lubrication requirements; including types of cleaning agents, methods of cleaning, list of required lubricants for equipment, etc.
5. Separate schedules for preventive and routine maintenance, as well as service with standard time allotment.
6. Nomenclature of parts and components and repair instructions.
7. Trouble-shooting guides
8. Disassembly and re-assembly instructions

E. Maintenance Service Contracts (if applicable)

Include copies of maintenance agreements with name and telephone number of local service agent.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Title Sheet

B. Table of Contents

C. Appendix A: Manufacturer's Warranty Information

1. Include copies of warranties and bonds of all products and any additional components with warranties longer than the one (1) year Contractor's guaranteed warranty period.
2. Include lists of circumstances and conditions that would affect validity of warranties or bonds

D. Appendix B: Manufacturers' Product Data

1. Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed or highlight appropriate information. Mark each sheet to identify each product or component incorporated into the Work.
2. If data includes more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
3. Be sure to include all relevant technical and product spec sheets.
4. Be sure to tab each product or component separately and include a table of contents of all products or components included in the Appendix.
5. Approved product submittals satisfy the above requirements provided inapplicable information is clearly marked out or excluded.

E. Appendix C: Parts List

1. Include lists of parts, with parts identified and cross-referenced to manufacturers' maintenance documentation. (i.e. Product numbers)

2. If providing spare parts, include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation. (i.e. Product numbers). Indicate number of parts being provided
3. Provide names of local service companies that can provide the parts listed.
4. If the parts list is included as part of another manual / Appendix, it is acceptable to cross-reference this location. However, the page number and specific location of where the parts list can be found must be clearly indicated.

F. Appendix D: Operation and Maintenance Manuals

1. For each system or subsystem, assemble a complete set of maintenance data indicating care and maintenance of each system, product, material, and finish incorporated into the Work. Include all installation, operation and emergency data here as well.
2. Include the following Tabs (contents described under Part 2: Products)
 - a. Emergency Manual
 - b. Installation Manual
 - c. Operation Manual
 - d. Product Maintenance Manual
3. Include sub-tabs for each product or component separately under each tab, where applicable
4. Include a table of contents for all contents provided under each tab

G. Appendix E: Additional Manufacturer's Data

1. Prepare project-specific drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence or sequences of operation (describing start-up, normal operation, and shut-down procedures) and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
2. Provide all approved Testing and Balancing results as they relate to existing and record building conditions.

H. Schedule for O&M Documentation

Comply with Division 01 section "Closeout Procedures" for schedule for submitting Operation and Maintenance Documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

This section includes administrative and procedural requirements for Project Record Documents, including the following:

Record Drawings.

See Division 01 Section "Operation and Maintenance Data" for Operation and Maintenance Manual requirements.

See Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

SD-11 Record Drawings

RECORD DRAWINGS: Comply with the following:

Number of copies: Submit one set of marked-up Record Prints.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. RECORD PRINTS

Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, Contractor, or similar entity, to prepare the marked-up Record Prints.
 - A. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - B. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

3. Mark Record Sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Ordernumbers, and similar identification, where applicable.

B. FORMAT

Identify and date each Record Drawing; include the designation "Project Record Drawing" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As Follows:
 - A. Project name.
 - B. Date.
 - C. Designation "Project Record Drawings."
 - D. Name of Contractor and any subcontractor(s).

2.2 MISCELLANEOUS RECORD SUBMITTALS

Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. RECORDING

Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

Store Record Documents and samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes.

Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Owner's reference during normal working hours.

END OF SECTION 017839

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

This section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

See Divisions 02 through 49 Specification Sections for specific requirements for demonstration and training for products in those sections.

1.2 SUBMITTALS

SD-11 Instruction Program

Instruction Program: Submit one copy of outline of Instructional Program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1.3 QUALITY ASSURANCE

A. FACILITATOR QUALIFICATIONS

A Firm or Individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. INSTRUCTOR QUALIFICATIONS

A Factory-Authorized Service Representative, complying with requirements in Division 01 Section "Quality Control," experienced in operation and maintenance procedures and training.

C. TRAINING MODULES

Coordinate content of Training Modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until Operation and Maintenance Data has been reviewed and approved by Owner.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. PROGRAM STRUCTURE

Develop an Instruction Program that includes individual Training Modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. TRAINING MODULE

Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of system design, operational requirements, and criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
2. Documentation: Review emergency, Operations, and Maintenance Manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. FACILITATOR

Engage a qualified Facilitator to prepare Instruction Program and Training Modules, to coordinate instructors, and to coordinate between Contractor and Owner's participants, instruction times, and location.

B. QUALIFIED INSTRUCTORS

Engage Qualified Instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. SCHEDULING

Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

Schedule training through Owner, with at least seven days' advance notice.

END OF SECTION 017900

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including general and supplementary conditions and other Division 01 Specification Sections, apply to this Section.

PR and BOD documentation are included by reference for information only.

1.2 SUMMARY

Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

1.3 DEFINITIONS

- A. COMMISSIONING PLAN

A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

- B. CXA

Owner's Commissioning Authority.

- C. PR: PROJECT REQUIREMENTS

A document that details the functional requirements of a Project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

- D. SYSTEMS, SUBSYSTEMS, EQUIPMENT, AND COMPONENTS

Where these terms are used together or separately, they shall mean "As-Built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

- A. MEMBERS APPOINTED BY CONTRACTOR(S)

Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and Subcontractors, installers, suppliers, and specialists deemed appropriate by the CXA.

B. MEMBERS APPOINTED BY OWNER:

Representatives of the facility user and operation and maintenance personnel.

1.5 OWNER'S RESPONSIBILITIES

Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign Representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CXA for resolution of issues recorded in the issues log.
3. Integrate and coordinate commissioning process activities with construction schedule.
4. Review and accept construction checklists provided by the CXA.
5. Complete construction checklists as work is completed and provide to the commissioning authority on a weekly basis.
6. Review and accept commissioning process test procedures provided by the commissioning authority.
7. Complete commissioning process test procedures.

1.7 CXA's RESPONSIBILITIES

- A. Provide Project Requirement Documentation.
- B. Organize and lead the commissioning team.
- C. Provide commissioning plan.
- D. Convene commissioning team meetings.
- E. Provide Project-specific construction checklists and commissioning process test procedures.
- F. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the APR. When a random sample does not meet the requirement, the CXA will report the failure in the issues log.
- G. Prepare and maintain the issues log.
- H. Prepare and maintain completed construction checklist log.
- I. Witness systems, assemblies, equipment, and component startup.

- J. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 019113

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Owner and Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: The existing B&W boiler that is to be demolished may contain asbestos in the refractory within the unit. Contractor shall take care and during demolition of the boiler.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

- b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.

6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area off-site.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete. Obtain written authorization from Owner before moving Existing Items to Remain.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to EPA regulations.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Burning is prohibited. Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mix water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- E. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Cementitious materials and aggregates.
 - 2. Form materials and form-release agents.
 - 3. Steel reinforcement and reinforcement accessories.
 - 4. Fiber reinforcement.
 - 5. Admixtures.

6. Curing materials.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Epoxy joint filler.
12. Joint-filler strips.
13. Repair materials.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
 1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. **Testing Agency Qualifications:** An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. **ACI Publications:** Comply with the following, unless more stringent provisions are indicated:
 1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
 1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixes.
 - c. Ready-mix concrete producer.
 - d. Owner.
 - e. Concrete subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store in covered location, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1, or better.
 - b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
 - c. Structural 1, B-B, or better, mill-oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1, or better, mill-oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

STEEL REINFORCEMENT

- F. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- G. Steel Bar Mats: ASTM A 184, assembled with clips.
 - 1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.

- H. Plain-Steel Wire: ASTM A 82, or as drawn.
- I. Deformed-Steel Wire: ASTM A 496.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
- B. Portland Cement: ASTM C 150, Type II.
- C. Portland Cement: ASTM C 150, Type III.
- D. Blended Hydraulic Cement: ASTM C 595M, Type IS, portland blast-furnace slag cement.
- E. Blended Hydraulic Cement: ASTM C 595M, Type IP, portland-pozzolan cement.
- F. Blended Hydraulic Cement: ASTM C 595M, Type I (PM), pozzolan-modified portland cement.
- G. Blended Hydraulic Cement: ASTM C 595M, Type I (SM), slag-modified portland cement.
- H. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Class: Moderate weathering region, but not less than 3M.
 - 2. Nominal Maximum Aggregate Size: 3/4 inch.
 - 3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer than No. 50.
- I. Water: Potable and complying with ASTM C 94.

2.4 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- G. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- F. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Evaporation Retarder:
 - a. Cimfilm; Axim Concrete Technologies.
 - b. Finishing Aid Concentrate; Burke Group, LLC (The).
 - c. Spray-Film; ChemMasters.
 - d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
 - e. Sure Film; Dayton Superior Corporation.
 - f. Eucobar; Euclid Chemical Co.
 - g. Vapor Aid; Kaufman Products, Inc.
 - h. Lambco Skin; Lambert Corporation.
 - i. E-Con; L&M Construction Chemicals, Inc.
 - j. Confilm; Master Builders, Inc.
 - k. Waterhold; Metalcrete Industries.
 - l. Rich Film; Richmond Screw Anchor Co.
 - m. SikaFilm; Sika Corporation.
 - n. Finishing Aid; Symons Corporation.
 - o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.

2. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:
 - a. Klear-Kote Cure-Sealer-Hardener, 30 percent solids; Burke Group, LLC (The).
 - b. Polyseal WB; ChemMasters.
 - c. UV Safe Seal; Lambert Corporation.
 - d. Lumiseal WB Plus; L&M Construction Chemicals, Inc.
 - e. Vocomp-30; W. R. Meadows, Inc.
 - f. Metcure 30; Metalcrete Industries.
 - g. Vexcon Starseal 1315; Vexcon Chemicals, Inc.

2.6 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- C. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
 2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:
 1. Compressive Strength (28 Days): 3000 psi.
 2. Maximum Slump: 4 inches.
 3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches after admixture is added to concrete with 2- to 4-inch slump.
- D. Slab-on-Grade: Proportion normal-weight concrete mix as follows:
 1. Compressive Strength (28 Days): 4000 psi.
 2. Minimum Cementitious Materials Content: 470 lb/cu. yd.
 3. Maximum Slump: 4 inches.
- E. Suspended Slabs: Proportion normal-weight concrete mix as follows:
 1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum Slump: 4 inches.

- F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 20 percent.
 - 2. Combined Fly Ash and Pozzolan: 20 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 40 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 20 percent.
- G. Maximum Water-Cementitious Materials Ratio: 0.50 for concrete required to have low water permeability.
- H. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.
- I. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.
- J. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- K. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Contractor may use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 - 2. Contractor may use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Contractor may use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Contractor may use corrosion-inhibiting admixture in concrete mixes where indicated.

2.8 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - 1. Class B, 1/4 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Do not chamfer corners or edges of concrete.
- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. At least 70 percent of 28-day design compressive strength.
 - 2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
 - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring.
- B. Plan sequence of removal of shores to avoid damage to concrete.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 3. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
 - 1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.
 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp proofing, veneer plaster, or painting.
 2. Do not apply rubbed finish to smooth-formed finish.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic, or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
 2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:

- a. Specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15.
 - b. Specified overall values of flatness, F(F) 30; and levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and levelness, F(L) 15; for suspended slabs.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated or directed by Owner.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.11 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before

- bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. After concrete has cured at least 14 days, correct high areas by grinding.
 2. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 3. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 4. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 5. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Owner's and Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Owner's and Engineer's approval.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
 - a. Cast and field cure one set of four standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- E. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.

END OF SECTION 033000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.2 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 1. Provide stainless steel fasteners for fastening aluminum stainless steel or nickel silver.
 2. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

- F. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.3 MISCELLANEOUS MATERIALS

- A. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- B. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.

2.6 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize miscellaneous steel trim.

2.7 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.8 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.9 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.
 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

END OF SECTION 055000

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
- B. Shop Drawings: For roof accessories.
- C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, 0.079 inch thick.
 - 1. Finish: Baked enamel or powder coat.
 - 2. Color: As selected by Owner from manufacturer's full range.
- D. Construction:
 - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
 - 3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 - 4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
 - 5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
 - 6. Insulation: Factory insulated with 1-1/2-inch thick glass-fiber board insulation.
 - 7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 8. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
 - 9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
 - 10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
 - 11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
 - 12. Damper Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated.

2.2 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.
 - 1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 coated.

1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.
- C. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- D. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- F. Underlayment:
 1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 2. Polyethylene Sheet: 6-mil thick polyethylene sheet complying with ASTM D4397.
 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 5. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- H. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- I. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

- J. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
- C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099600 "High Performance Coatings."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Construction Solutions.
 - d. Grabber Construction Products.
 - e. Hilti, Inc.
 - f. HOLDRITE.
 - g. NUCO Inc.
 - h. Passive Fire Protection Partners.
 - i. RectorSeal.
 - j. Specified Technologies, Inc.
 - k. STC Sound Control.
 - l. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by

penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer

speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner may engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Joints in or between fire-resistance-rated constructions.
- 2. Joints at exterior curtain-wall/floor intersections.
- 3. Joints in smoke barriers.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

- 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. ClarkDietrich.
 - d. Grabber Construction Products.
 - e. Hilti, Inc.
 - f. Nelson Firestop; a brand of Emerson Industrial Automation.
 - g. NUCO Inc.
 - h. Passive Fire Protection Partners.
 - i. RectorSeal.
 - j. Rockwool International.
 - k. Specified Technologies, Inc.
 - l. Thermafiber, Inc.; an Owens Corning company.
 - m. Tremco, Inc.
 - n. Willseal LLC.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E2307.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. ClarkDietrich.
 - c. Hilti, Inc.
 - d. Johns Manville; a Berkshire Hathaway company.
 - e. Nelson Firestop; a brand of Emerson Industrial Automation.
 - f. NUCO Inc.
 - g. RectorSeal.
 - h. Rockwool International.
 - i. Specified Technologies, Inc.
 - j. Thermafiber, Inc.; an Owens Corning company.
 - k. Tremco, Inc.
 2. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

- D. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Hilti, Inc.
 - d. Nelson Firestop; a brand of Emerson Industrial Automation.
 - e. NUCO Inc.
 - f. Passive Fire Protection Partners.
 - g. RectorSeal.
 - h. Rockwool International.
 - i. Thermafiber, Inc.; an Owens Corning company.
 - j. Tremco, Inc.
 - k. Willseal LLC.
 - 2. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- F. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.

- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner may engage a qualified testing agency to perform tests and inspections according to ASTM E2393.

- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

END OF SECTION 078443

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Primers.
 2. Solvent-based finish coatings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
1. Product Data: For paints and coatings, indicating VOC content.
 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
 3. Environmental Product Declaration: For each product.
 4. Manufacturer Inventory: Provide manufacturer's ingredient inventory.
- C. Samples: For each type of topcoat product.
- D. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sherwin-Williams Company (The).

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Emissions Requirements: Verify field-applied paints and coatings that are inside the weatherproofing system comply with one of the following:

1. Low-Emitting Materials: Verify VOC emissions comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Colors: As selected by Owner from manufacturer's full range.

1. Ten percent of surface area will be painted with deep tones.

2.3 PRIMERS

A. Interior Latex Primer Sealer: Water-based latex sealer used on new interior plaster, concrete, and gypsum wallboard surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sherwin-Williams Company (The).

B. Alkyd Quick-Dry Primer for Metal: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, interior steel surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sherwin-Williams Company (The).

2.4 WATER-BASED FINISH COATS

2.5 SOLVENT-BASED FINISH COATS

A. Aluminum Paint: Aliphatic, solvent-based coating consisting of varnish or alkyd binder combined with aluminum pigment that is formulated for use as a stain-blocking coating and sealer on wood, metal, bituminous-coated, and prepared masonry surfaces and to be able to be recoated with conventional alkyd and latex paints.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sherwin-Williams Company (The).

2.6 FLOOR SEALERS AND PAINTS

2.7 DRY FALL COATINGS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- B. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
- C. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- C. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 1. Paint the following work where exposed in equipment rooms:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Metal conduit.

- d. Plastic conduit.
 - e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Owner, and leave in an undamaged condition.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 1. Aluminum Paint System:
 - a. Prime Coat: Alkyd quick-dry primer for metal.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.
- B. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.
 1. Aluminum Paint System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
 - 1. Interior Substrates:
 - a. Concrete, vertical and horizontal surfaces.

1.2 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

C. Colors: Match existing

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System:

- a. Prime Coat: Epoxy, matching topcoat.
- b. Intermediate Coat: Epoxy, matching topcoat.
- c. Topcoat: Epoxy, gloss.

2. Epoxy, High-Build System:

- a. Prime Coat: High-build epoxy, matching topcoat (reduced).
- b. Intermediate Coat: High-build epoxy, matching topcoat.
- c. Topcoat: High-build epoxy, low gloss.

B. Concrete Substrates, Horizontal Surfaces.

1. Epoxy System:

- a. Prime Coat: Epoxy, matching topcoat.
- b. Intermediate Coat: Epoxy, matching topcoat.
- c. Topcoat: Epoxy, gloss.

2. Epoxy, High-Build System:

- a. Prime Coat: High-build epoxy, matching topcoat (reduced).
- b. Intermediate Coat: High-build epoxy, matching topcoat.
- c. Topcoat: High-build epoxy, low gloss.

END OF SECTION 099600

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 1000 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Bimetallic-actuated thermometers.
- 2. Liquid-in-glass thermometers.
- 3. Thermowells.
- 4. Dial-type pressure gages.
- 5. Gage attachments.
- 6. Flowmeters.

- B. Related Requirements: Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

- 1. Section 232216 "Steam and Condensate Piping Specialties" for steam and condensate meters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings:

- 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Standard: ASME B40.200.
- B. Case: Liquid-filled and sealed type(s); stainless steel with 6-inch nominal diameter.
- C. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- D. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- E. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- G. Window: Plain glass or plastic.
- H. Ring: Stainless steel.
- I. Element: Bimetal coil.
- J. Pointer: Dark-colored metal.
- K. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Standard: ASME B40.200.
 - 2. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
 - 3. Case Form: Adjustable angle unless otherwise indicated.
 - 4. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 6. Window: Glass or plastic.
 - 7. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 - 9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

- A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
3. Material for Use with Steel Piping: 304 Stainless Steel.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.4 DIAL-TYPE PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type; cast aluminum or drawn steel; 6-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Stainless steel.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- ### A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping, siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.
- ### B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 FLOWMETERS

A. Venturi Flowmeters:

1. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
3. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
 - a. Design: Differential-pressure-type measurement for steam.
 - b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.

- c. Minimum Pressure Rating: 250 psig.
 - d. Minimum Temperature Rating: 400 deg F.
 - e. End Connections for NPS 2 and Smaller: Threaded.
 - f. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
 - g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.
 4. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
 - a. Scale: Pounds per hour.
 - b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.
 5. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot hoses, with carrying case.
 - a. Scale: Pounds per hour.
 - b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.
 6. Display: Shows rate of flow.
 7. Conversion Chart: Flow rate data compatible with sensor.
 8. Operating Instructions: Include complete instructions with each flowmeter.
- B. Vortex-Shedding Flowmeters:
1. Description: Flowmeter with sensor and indicator.
 2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
 3. Sensor: Inline type; for installing between pipe flanges and measuring flow directly in pounds per hour.
 - a. Design: Flow obstruction device, vortex-measurement type for steam.
 - b. Construction: Stainless-steel body, with integral transmitter and direct-reading scale.
 - c. Minimum Pressure Rating: 1000 psig.
 - d. Minimum Temperature Rating: 500 deg F.
 - e. Integral Transformer: For low-voltage power operation.
 4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
 5. Accuracy: Plus or minus 0.25 percent for liquids and 0.75 percent for gases.
 6. Display: Shows rate of flow.
 7. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- I. Install valve and syphon fitting in piping for each pressure gage for steam.
- J. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
- K. Install flowmeter elements in accessible positions in piping systems.
- L. Install connection fittings in accessible locations for attachment to portable indicators.
- M. Install thermometers where indicated.
- N. Install pressure gages where indicated.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Steam and Steam-Condensate Piping: 50 to 400 deg F.

3.5 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each pressure-reducing valve shall be the following:
 - 1. Sealed, direct-mounted, metal case.

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Steam Piping: 0 to 200 psi.

3.7 FLOWMETER SCHEDULE

- A. Flowmeters for Steam and Steam-Condensate Piping: Venturi or Vortex-shedding type.

END OF SECTION 230519

SECTION 230523.11 - GLOBE VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Iron globe valves.
 - 2. Chainwheels.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle and globe valves closed to prevent rattling.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.1 for power piping valves.
 - 5. ASME B31.9 for building services piping valves.
- C. Refer to HVAC valve schedule articles for applications of valves.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

2.2 BRONZE GLOBE VALVES

- A. Bronze Globe Valves, Class 150:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.3 IRON GLOBE VALVES

- A. Iron Globe Valves, Class 250:
 - 1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A126, gray iron with bolted bonnet.
 - d. Ends: Flanged.

- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.
- g. Operator: Handwheel or chainwheel.

2.4 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
 - 1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
 - 2. Chain: Hot-dip-galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Throttling Service except Steam: Globe valves.
 - 2. Throttling Service, Steam: Globe valves.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
 - 3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2 and Smaller: Bronze globe valves, Class 150, with bronze disc and threaded ends.
- B. Pipe Sizes NPS 2-1/2 and Larger: Iron globe valves, Class 250.

3.6 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze globe valves, Class 150, with bronze disc, and with threaded ends.
- B. Pipe NPS 2-1/2 and Larger: Iron globe valves, Class 250.

END OF SECTION 230523.11

SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.
 - 2. Steel ball valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B31.1 for power piping valves.
 - 6. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Refer to HVAC valve schedule articles for applications of valves.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
 - 2. Hand-lever: For quarter-turn valves smaller than NPS 4.
- H. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.
- I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.

- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.
- k. brass.
- l. Port: Regular.

2.3 STEEL BALL VALVES

A. Steel Ball Valves with Full Port and Stainless-Steel Trim, Class 300:

1. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 720 psig.
- c. Body Design: Split body.
- d. Body Material: Carbon steel, ASTM A216, Type WCB.
- e. Ends: Flanged.
- f. Seats: PTFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2 and Smaller: Bronze ball valves, two-piece with stainless-steel trim and full port.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel ball valves, Class 300.

3.5 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze ball valves, two-piece with stainless-steel trim and full port.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel ball valves, Class 300.

END OF SECTION 230523.12

SECTION 230523.14 - CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze swing check valves.
 - 2. Iron swing check valves.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.1 for power piping valves.
 - 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 150:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.3 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves with Metal Seats, Class 250:
 - 1. Description:

- a. Standard: MSS SP-71, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.
- F. Install valve tags. Comply with requirements for valve tags and schedules in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- B. Select valves, except wafer types, with the following end connections:
 - 1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
 - 3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze swing check valves with bronze disc, Class 150.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron swing check valves with metal seats, Class 250.

3.6 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze swing check valves with bronze disc, Class 150.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. NPS 2-1/2 to NPS 4: Iron valves may be provided with threaded ends instead of flanged ends.
 - 2. Iron swing check valves with metal seats, Class 250.

END OF SECTION 230523.14

SECTION 230523.15 - GATE VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze gate valves.
 - 2. Iron gate valves.
 - 3. Chainwheels.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. RS: Rising stem.
- E. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set gate valves closed to prevent rattling.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.

2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 1. ASME B1.20.1 for threads for threaded-end valves.
 2. ASME B16.1 for flanges on iron valves.
 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 4. ASME B31.1 for power piping valves.
 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. RS Valves in Insulated Piping: With 2-inch stem extensions.
- H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE GATE VALVES

- A. Bronze Gate Valves, RS, Class 150:
 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig
 - c. Body Material: ASTM B62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.

- h. Handwheel: Malleable iron.

2.3 IRON GATE VALVES

A. Iron Gate Valves, OS&Y, Class 250:

1. Description:

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig
- c. Body Material: ASTM A126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

2.4 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.

- 1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve.
- 2. Chain: Hot-dip-galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Gate valves.
- B. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends, except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2 and Smaller: Bronze gate valves, RS, Class 150.
- B. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y Class 250.

3.6 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze gate valves, RS, Class 150.
- B. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y, Class 250.

END OF SECTION 230523.15

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Pipe stands.
4. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following to include Product Data for components:

1. Pipe stands.
2. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pre-galvanized, hot-dip galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Indoor Applications: Zinc-coated steel.

2.4 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.5 MATERIALS

- A. Aluminum: not allowed.
- B. Carbon Steel: ASTM A1011/A1011M.

- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non staining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14 24 inches long and 0.075 inch thick.
 - 4. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.
 - 1. finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 4. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

5. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 6. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 7. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 8. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
 10. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
 11. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

- M. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Open-spring isolators.
 - 5. Housed-spring isolators.
 - 6. Restrained-spring isolators.
 - 7. Housed-restrained-spring isolators.
 - 8. Pipe-riser resilient supports.
 - 9. Resilient pipe guides.
 - 10. Elastomeric hangers.
 - 11. Spring hangers.
 - 12. Vibration isolation equipment bases.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 2. Size: Factory or field cut to match requirements of supported equipment.
 3. Pad Material: Oil and water resistant with elastomeric properties.
 4. Surface Pattern: Ribbed pattern.

2.2 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts:
 1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
 2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top housing with attachment and leveling bolt.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes.
 - c. Internal leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
 1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.9 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.10 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 - 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.11 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.12 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

- a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033543 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033543 "Cast-in-Place Concrete."

END OF SECTION 230548.13

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: Match existing.
 - 3. Background Color: Match existing.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 6. Fasteners: Stainless-steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing number where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Match existing.
- C. Background Color: Match existing.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

- B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Reinforced grommet and wire or string.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
 - 1. High-Pressure Steam Piping: Match existing or as directed by Owner.
 - 2. Steam Condensate Piping: Match existing or as directed by Owner.
 - 3. Boiler Feedwater Piping: Match existing or as directed by Owner.
 - 4. Boiler Blowdown: Match existing or as directed by Owner.
 - 5. Drains: Match existing or as directed by Owner.
 - 6. Natural Gas: Match existing or as directed by Owner.
 - 7. Potable Water: Match existing or as directed by Owner.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. High-Pressure Steam: 2 inches, round.
 - b. Steam Condensate: 2 inches, round.
 - c. Boiler Feedwater: 2 inches, round.
 - d. Boiler Blowdown: 2 inches, round.
 - e. Drains: 2 inches, round.
 - f. Natural Gas: 2 inches, round.
 - g. Potable Water: 2 inches, round.
 - 2. Valve-Tag Colors:
 - a. Defined by Owner: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing steam systems.
 - 2. Testing, Adjusting, and Balancing Equipment:
 - a. Motors.
 - b. Boilers.
 - c. Heat-transfer coils.
 - 3. Sound tests.
 - 4. Vibration tests.
 - 5. Control system verification.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by the Owner, conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 1. Instrument type and make.
 2. Serial number.
 3. Application.
 4. Dates of use.
 5. Dates of calibration.

1.6 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC.
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. TAB Specialists Qualifications: Certified by NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.

2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.7 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan curves.
 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in

AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design."
Compare results with the design data and installed conditions.

- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- J. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Fans are operating, free of vibration, and rotating in correct direction.
 - c. Variable-frequency controllers' startup is complete and safeties are verified.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural

Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

- B. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- D. Verify that motor starters are equipped with properly sized thermal protection.
- E. Check dampers for proper position to achieve desired airflow path.
- F. Check for airflow blockages.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 4. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 6. Measure and record all operating data.
 7. Record final fan-performance data.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
 1. Check liquid level in expansion tank.

2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.
 - a. Position valves for full flow through coils.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gage heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
 2. Perform temperature tests after flows have been verified.
- E. For systems without pressure-independent valves or flow-measuring devices at terminals:
1. Measure and balance coils by either coil pressure drop or temperature method.
 2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
- F. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
 2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
 3. Mark final settings.
- G. Verify that memory stops have been set.

3.8 PROCEDURES FOR STEAM SYSTEMS

- A. Measure and record upstream and downstream pressure of each piece of equipment.
- B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
- C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- D. Check settings and operation of each safety valve. Record settings.
- E. Verify the operation of each steam trap.

3.9 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.10 PROCEDURES FOR BOILERS

- A. Steam Boilers:

1. Measure and record entering-water temperature.
2. Measure and record feed water flow.
3. Measure and record leaving-steam pressure and temperature.
4. Record relief valve pressure setting.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.12 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 5 locations as designated by the Owner.

B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).

3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:
 - a. Location.
 - b. System tested.
 - c. dBA reading.
 - d. Sound pressure level in each octave band with equipment on and off.
2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.13 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10 hp.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.14 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.15 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.16 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.17 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Engineer's name and address.
 6. Contractor's name and address.
 7. Report date.
 8. Signature of TAB supervisor who certifies the report.

9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 10. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Data for terminal units, including manufacturer's name, type, size, and fittings.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.

- c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- F. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.

3.18 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner.
- B. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.19 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 1. Steam and steam condensate piping, indoors.
 2. Boiler feedwater piping, indoors.
 3. Flash steam piping, indoors.
 4. Hot overflow piping, indoors.
 5. Hot drain piping, indoors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive,

mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I.
 - 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I.
 - 3. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Block Insulation: ASTM C552, Type I.
 - 2. Special-Shaped Insulation: ASTM C552, Type III.
 - 3. Board Insulation: ASTM C552, Type IV.
 - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C552, Type II, Class 1.
 - 5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C450 and ASTM C585.
- H. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 2. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type II, Grade A, with factory applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg.
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 400 deg F.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.3 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.

2.4 SEALANTS

- A. Cellular-Glass, Phenolic, and Polyisocyanurate Joint Sealants:
- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 400 deg F.
 - 4. Color: Aluminum.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ Jacket: White kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. Metal Jacket:
 - 1. Aluminum Jacket: Comply with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2 percent.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.8 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
 - 2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 400 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt

- each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Interior Painting."

1. Flat Acrylic Finish: **Two** finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

- B. Color: Final color as selected by Owner. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Owner, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Steam and Steam Condensate, 350 Deg F and Below:
 - 1. NPS 3/4 and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 - 2. NPS 1 and Larger: Insulation shall be one of the following:
 - a. Calcium Silicate: 4 inches thick.
- B. Steam and Steam Condensate, above 350 Deg F:

1. NPS 3/4 and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 2. NPS 1 and Larger: Insulation shall be one of the following:
 - a. Calcium Silicate: 4 inches thick.
- C. Heat-Recovery Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Boiler Feedwater Piping: Insulation shall be one of the following:
1. Calcium Silicate: 4 inches thick.
 2. Mineral-Fiber, Preformed Pipe, Type I or II: 4 inches thick.
- E. Flash Steam Piping, from blowdown separator, deaerator tank, hot condensate drain cooler, safety relief valve and drip pan elbow: Insulation shall be one of the following:
1. Calcium Silicate: 4 inches thick.
 2. Mineral-Fiber, Preformed Pipe, Type I or II: 4 inches thick.
- F. Hot Drain Piping, from boiler blowdown, blowdown separator and deaerator tank: Insulation shall be one of the following:
1. Cellular Glass: 4 inches thick.
 2. Mineral-Fiber, Preformed Pipe, Type I or II: 4 inches thick.
- 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE
- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
 - B. If more than one material is listed, selection from materials listed is Contractor's option.
 - C. Piping, Exposed:
 1. Aluminum, Stucco Embossed for piping up to 10 feet above floor: 0.040 inch thick.

END OF SECTION 230719

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Motorized gas valves.
6. Pressure regulators.
7. Dielectric fittings.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple

pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Qualification Data: For qualified professional engineer.
- C. Welding certificates.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Building: 15 psig.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless-steel underground.
 - f. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
5. Mechanical Couplings:
 - a. Steel flanges and tube with epoxy finish.
 - b. Buna-nitrile seals.
 - c. Steel bolts, washers, and nuts.

2.3 PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

- B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 MANUAL GAS SHUTOFF VALVES

- A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
 - 1. CWP Rating: 125 psig.
 - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Body: Bronze, complying with ASTM B 584.
 - 2. Ball: Chrome-plated bronze.
 - 3. Stem: Bronze; blowout proof.
 - 4. Seats: Reinforced TFE; blowout proof.
 - 5. Packing: Threaded-body packnut design with adjustable-stem packing.
 - 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 7. CWP Rating: 600 psig.
 - 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

1. Body: Bronze, complying with ASTM B 584.
2. Plug: Bronze.
3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig.
6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Body: Cast iron, complying with ASTM A 126, Class B.
2. Plug: Bronze or nickel-plated cast iron.
3. Seat: Coated with thermoplastic.
4. Stem Seal: Compatible with natural gas.
5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
6. Operator: Square head or lug type with tamperproof feature where indicated.
7. Pressure Class: 125 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

1. Body: Brass or aluminum.
2. Seats and Disc: Nitrile rubber.
3. Springs and Valve Trim: Stainless steel.
4. Normally closed.
5. Visual position indicator.
6. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

1. Pilot operated.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
6. NEMA ICS 6, Type 4, coil enclosure.
7. Normally closed.
8. Visual position indicator.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 5 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 5 psig.

2.8 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

- a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 or the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 or the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 or the International Fuel Gas Code for installation and purging of natural-gas piping.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Locate valves for easy access.
- E. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Verify final equipment locations for roughing-in.
- I. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- J. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
 - 1. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- K. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- L. Connect branch piping from top or side of horizontal piping.
- M. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- N. Do not use natural-gas piping as grounding electrode.
- O. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

- P. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

- C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting.
- F. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 PAINTING

- A. Paint exposed, exterior metal piping, valves and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (flat).

- d. Color: Gray.
- B. Paint exposed, interior metal piping, valves and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat).
 - d. Color: Gray.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (flat).
 - d. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 or the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with steel welding fittings and welded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG

A. Aboveground Piping: Maximum operating pressure more than 5 psig.

B. Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.

C. Aboveground, distribution piping shall be the following:

1. Steel pipe with steel welding fittings and welded joints.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Steel pipe and fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Joining materials.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
1. Boiler Feedwater Piping: 125 psig at 350 deg F.
 2. Blowdown-Drain Piping: 200 deg F.
 3. Air-Vent Piping: 200 deg F.
 4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

- a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Boiler Feedwater piping, aboveground, NPS 2-1/2 and larger, shall be the following:
- 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- B. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- C. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- C. Install piping to permit valve servicing.
- D. Install piping at indicated slopes.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Install piping to allow application of insulation.
- H. Select system components with pressure rating equal to or greater than system operating pressure.

- I. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- J. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- K. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- L. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- M. Install valves according to the following:
 - 1. Section 230523.11 "Globe Valves for HVAC Piping."
 - 2. Section 230523.14 "Check Valves for HVAC Piping."
 - 3. Section 230523.15 "Gate Valves for HVAC Piping."
- N. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- O. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- P. Install shutoff valve immediately upstream of each dielectric fitting.
- Q. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
- D. Install hangers for steel piping with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping within 12 inches of each fitting and coupling.

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Air-control devices.
2. Strainers.

B. Related Requirements:

1. Section 230523.11 "Globe Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
2. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
3. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
4. Section 230523.15 "Gate Valves for HVAC Piping" for specification and installation requirements for gate valves common to most piping systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product:

1. Include construction details and material descriptions for hydronic piping specialties.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Safety Valves and Pressure Vessels: Shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

2.2 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- C. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install strainers at inlet to pressure regulating valves, pumps, and other devices as shown on the drawings.

END OF SECTION 232116

SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fittings for HP steam and condensate piping:
 - 1. Steel pipe and fittings.
 - 2. Joining materials.
- B. Related Requirements:
 - 1. Section 232216 "Steam and Condensate Heating Piping Specialties" for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Steel pipe and fitting.
 - 2. Joining material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to the following:

1. ASME Compliance: Comply with ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 1. HP Steam Piping: 150 psig.
 2. Condensate Piping: 150 psig at 250 deg F.
 3. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
 4. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
 5. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, welded and seamless, Grade B, and Schedule as indicated in piping applications articles.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in piping applications articles.
- C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in piping applications articles.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in piping applications articles.
- E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in piping applications articles; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

PART 3 - EXECUTION

3.1 HP STEAM PIPING APPLICATIONS

- A. HP Steam Piping, NPS 2 and Smaller: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- B. HP Steam Piping, NPS 2-1/2 through NPS 12: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- C. Condensate piping above grade, NPS 2 and smaller, shall be the following:
 - 1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- D. Condensate piping above grade, NPS 2-1/2 and larger, shall be the following:
 - 1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.2 ANCILLARY PIPING APPLICATIONS

- A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- B. Vacuum-Breaker Piping: Outlet, same as service where installed.
- C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.
- C. Install piping to permit valve servicing.
- D. Install piping free of sags and bends.
- E. Install fittings for changes in direction and branch connections.
- F. Install piping to allow application of insulation.
- G. Select system components with pressure rating equal to or greater than system operating pressure.
- H. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- I. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- J. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- K. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- L. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- M. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to top of main pipe.
- N. Install valves according to the following Sections or other Sections as needed:
 - 1. Section 230523.11 "Globe Valves for HVAC Piping."
 - 2. Section 230523.12 "Ball Valves for HVAC Piping."
 - 3. Section 230523.14 "Check Valves for HVAC Piping."
 - 4. Section 230523.15 "Gate Valves for HVAC Piping."
- O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

- Q. Install shutoff valve immediately upstream of each dielectric fitting.
- R. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- S. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- T. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
 - 1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
 - 2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

3.4 STEAM AND CONDENSATE PIPING SPECIALTIES INSTALLATION

- A. Comply with requirements in Section 232216 "Steam and Condensate Heating Piping Specialties" for installation requirements for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for installation of hangers, supports, and anchor devices.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
- C. Install hangers for steel steam supply piping and steel steam condensate piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of steel steam supply piping and steel steam condensate piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- F. Support vertical runs of fiberglass piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install traps and control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

3.8 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping," and ASME B31.9, "Building Services Piping," and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
 - 3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
- E. Prepare test and inspection reports.

END OF SECTION 232213

SECTION 232216 - STEAM AND CONDENSATE HEATING PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following piping specialties for steam and condensate piping:
 - 1. Strainers.
 - 2. Stop-check valves.
 - 3. Safety valves.
 - 4. Steam traps.
 - 5. Steam meters.
- B. Related Requirements:
 - 1. Section 230523.11 "Globe Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
 - 2. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
 - 3. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
 - 4. Section 230523.15 "Gate Valves for HVAC Piping" for specification and installation requirements for gate valves common to most piping systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Strainer.
 - 2. Valve.
 - 3. Steam trap.
 - 4. Meter.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to the following:
 - 1. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - 1. HP Steam Piping: 150 psig.
 - 2. Condensate Piping: 150 psig at 250 deg F.
 - 3. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
 - 4. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.2 STRAINERS

- A. Y-Pattern Strainers:
 - 1. Body: ASTM A126, Class B cast iron, with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
 - 3. Strainer Screen: Stainless-steel, 60-mesh strainer or perforated stainless-steel basket.
 - 4. Tapped blowoff plug.
 - 5. CWP Rating: 250-psig working steam pressure.

2.3 STOP-CHECK VALVES

- A. Stop-Check Valves:
 - 1. Body and Bonnet: Malleable iron.
 - 2. End Connections: Flanged.
 - 3. Disc: Cylindrical with removable liner and machined seat.
 - 4. Stem: Brass alloy.
 - 5. Operator: Outside screw and yoke with cast-iron handwheel.
 - 6. Packing: PTFE-impregnated packing with two-piece packing gland assembly.
 - 7. Pressure Class: 250.

2.4 STEAM SAFETY VALVES

- A. Cast-Iron Steam Safety Valves: ASME labeled.
 - 1. Disc Material: Forged copper alloy with bronze nozzle.
 - 2. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
 - 3. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
 - 4. Pressure Class: 250.
 - 5. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
 - 6. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
 - 7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.5 STEAM TRAPS

- A. Inverted Bucket Steam Traps:
 - 1. Body and Cap: Cast iron.
 - 2. End Connections: Threaded.
 - 3. Head and Seat: Stainless steel.
 - 4. Valve Retainer, Lever, and Guide Pin Assembly: Stainless steel.
 - 5. Bucket: Brass or stainless steel.
 - 6. Strainer: Integral stainless-steel inlet strainer within the trap body.
 - 7. Air Vent: Stainless-steel thermostatic vent.
 - 8. Pressure Rating: 250 psig.

2.6 STEAM METERS

- A. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.
 - 1. Computer shall have 4- to 20-mA or 2- to 10-V output for temperature, pressure, and contact closure for flow increments.
 - 2. Independent timers to store four peak flow rates and total flow.
 - 3. Interface compatible with existing central workstation.
 - 4. Microprocessor Enclosure: NEMA 250, Type 4.
- B. Sensor: Vortex Shedding type with stainless-steel wetted parts and flange connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
- B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.2 PIPING INSTALLATION

- A. Install piping to permit valve servicing.
- B. Install drains, consisting of a tee fitting, NPS 3/4 full-port ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- C. Install valves according to Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."
- D. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment and elsewhere as indicated.
- E. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full-port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

3.3 STEAM-TRAP INSTALLATION

- A. Install steam traps in accessible locations as close as possible to connected equipment.
- B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.4 STEAM METER INSTALLATION

- A. Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's written instructions.

- B. Provide data acquisition wiring.

3.5 SAFETY VALVE INSTALLATION

- A. Install safety valves according to ASME B31.1, "Power Piping."
- B. Pipe safety-valve discharge without valves to atmosphere outside the building.
- C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
- D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

END OF SECTION 232216

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sheet metal materials.
2. Hangers and supports.

B. Related Requirements:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

1.2 DEFINITIONS

- ##### A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
13. .

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- D. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G60 .
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.3 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- J. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

- K. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
- B. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 1.00 inch wg.
 - b. Minimum SMACNA Seal Class: C .
 - c. SMACNA Leakage Class for Rectangular: 16.
- C. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel Carbon steel coated with zinc-chromate primer
Galvanized steel or carbon steel coated with zinc-chromate primer.
- D. Elbow Configuration:
 - 1. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- E. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.

END OF SECTION 233113

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Louvered-penthouse ventilators.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product
- B. Shop Drawings: For gravity ventilators.
 - 1. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
 - 2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

1.6 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

- B. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."
- C. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.
- D. Capacities and Characteristics:
 - 1. Drawing Tag No.: L-2-23 .
 - 2. Type: Louvered penthouse .
 - 3. Height: 43 inches.
 - 4. Width: 66 inches.
 - 5. Depth: 66 inches.
 - 6. Air Flow: 9,200 cfm.
 - 7. Maximum Air Pressure Drop: Not more than 0.10- inch wg static pressure drop.
 - 8. Maximum Free Area Velocity: 500 fpm.
 - 9. Function: Intake .

2.2 FABRICATION

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.3 LOUVERED-PENTHOUSE VENTILATORS

- A. Description: Multitier rectangular louvered penthouse for intake air.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Aire Technologies, Inc.; DMI Companies.
 - 2. Greenheck Fan Corporation.
 - 3. Loren Cook Company.
- C. Source Limitations: Obtain louvered-penthouse ventilators from single manufacturer.
- D. Construction:

1. Material: All-welded assembly with 6-inch-deep louvers, mitered corners, and aluminum sheet roof.
2. Frame and Blade Material, Extruded Aluminum: Thickness required to comply with structural performance requirements, but not less than 0.080 inch for frames and 0.080 inch for blades.
3. Insulation: None .
4. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a free-area intake velocity of 500 fpm.
5. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.
6. Insect Screening: Aluminum, 18-by-16 mesh wire .

E. Dampers:

1. Location: Penthouse neck .
2. Control: Gravity backdraft.
3. Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated .

F. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 12 inches.

2.4 SOURCE QUALITY CONTROL

- A. AMCA Certification for Hooded Ventilators: Test, rate, and label gravity ventilators in accordance with AMCA 511.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.
- D. Stainless Steel Sheet: ASTM A666, Type 304, with No. 4 finish.
- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
1. Use types and sizes to suit unit installation conditions.
 2. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

- F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure gravity ventilators to roof curbs with zinc-plated hardware . Use concealed anchorages where possible. Refer to Section 077200 "Roof Accessories."
- C. Install gravity ventilators with clearances for service and maintenance.
- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes, so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- I. Refer to Section 077200 "Roof Accessories" for flashing and counterflashing of roof curbs.

3.2 DUCT CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 235133 - INSULATED SECTIONAL CHIMNEYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Listed building-heating-appliance chimneys.
 - 2. Guying and bracing materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.
- B. Shop Drawings: For chimneys and stacks.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly of hangers and restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Seismic Qualification Certificates: For factory-fabricated chimneys and stacks, accessories, and components from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity, and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in stacks.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, structural failures caused by expansion and contraction.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS

- A. Description: Double-wall metal vents tested according to UL 103 and rated for 1000 deg F continuously or 1700 deg F for 10 minutes; with neutral or negative flue pressure complying with NFPA 211.
- B. Construction: Inner shell and outer jacket separated by at least a 2-inch annular space.
- C. Inner Shell: ASTM A666, Type 316 stainless steel.
- D. Outer Jacket: Stainless steel.
- E. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

2.2 GUYING AND BRACING MATERIALS

- A. Cable: Three galvanized, stranded wires of the following thickness:
 - 1. For ID Sizes 32 to 36 Inches: 1/2 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Listed Building-Heating-Appliance Chimneys: Boilers.

3.3 INSTALLATION OF LISTED CHIMNEYS

- A. Suspend chimneys independent of their appliance connections.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
- C. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- D. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- E. Lap joints in direction of flow.
- F. Erect stacks plumb to finished tolerance of no more than 1 inch out of plumb from top to bottom.
- G. Support chimneys from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C clamps, or beam clamps according to manufacturer's written instructions

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. Provide temporary closures at ends of chimneys and stacks that are not completed or connected to equipment.

END OF SECTION 235133

SECTION 235239 - FIRE-TUBE BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes horizontal, packaged, factory-fabricated and -assembled fire-tube boilers, trim, and accessories for generating steam.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product include the following:
 - 1. Construction details, material descriptions, dimensions, and weights of individual components, profiles, and finishes for boilers.
 - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Predicted boiler efficiency while operating at design capacity and at varying part loads with basis indicated.
 - 4. Predicted emissions levels while operating at design capacity and at varying part loads with basis indicated. Indicate operation that produces worst-case emissions.
 - 5. Technical data for refractory and insulation, including temperature rating, thermal performance, attachment, and arrangement.
 - 6. Temperature and pressure rating, size, and materials of construction for boiler trim components, including piping, fittings, flanges, unions, and valves. Provide valve manufacturer's product data for each valve furnished. For safety valves, include trip and reset settings and flow capacity.
 - 7. Manufacturer's product data showing size, scale range, and accuracy of thermometers and pressure gages.
 - 8. Pressure rating, size, and materials of construction for boiler fuel train components including piping, fittings, flanges, unions, switches, and valves. Provide manufacturer's product data for each valve and switch furnished.
 - 9. Detailed information of controls, including product data with technical performance, operating characteristics, and sequence of operation.
 - 10. Product data for each motor, including performance, operating characteristics, and materials of construction.
- B. Shop Drawings: For boilers, boiler trim, and accessories.
 - 1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Design calculations and base details, manufacturer certified.
 - a. Design Calculations: Calculate requirements for selecting seismic restraints and for designing bases.
 - b. Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring. Differentiate between factory and field installation.
5. Include piping diagrams of factory-furnished piping that indicate size and each piping component.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan and elevation views, drawn to 1/4" scale, indicating equipment manufacturers' service clearances, structure and base attachment, piping, power, controls, and flues. Each view shows a screened background with the following:
 1. Column grids, beams, columns, and concrete housekeeping pads.
 2. Room layout with walls, floors, and roofs, including each room name and number.
 3. Equipment and products of other trades that are located in vicinity of boilers and are part of final installation, such as lighting, fire-suppression systems, and plumbing systems.
- B. Installation instructions.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.
- F. Other Informational Submittals:
 1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
 2. Startup service reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.
- B. Spare Parts List: Recommended spare parts list with quantity for each.

- C. Touch-up Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.
- D. Instructional Videos: Including those that are prerecorded and those that are recorded during training.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Touch-up Paint: 32 oz. container of paint used for finish coat. Label on outside of container shall have a detailed description of paint to allow for procurement of a matching paint in the future.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Ship boilers from the factory free of water. Drain water and blow dry with compressed air if required to remove all water before shipping.
- B. Cover and protect flue, electrical controls, and piping connections before shipping. Protect and seal openings and connections with blinds, caps, plugs, and other materials during delivery, storage, and handling.
- C. Protect boiler components with removable temporary enclosures to prevent damage during shipping, storage, and installation.
- D. Package boiler for export shipping in totally enclosed crate with bagging.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace front-door refractory and heat exchangers of boilers that fail in materials or workmanship within specified warranty period.
 - 1. Horizontal Fire-Tube Boilers: Refractory in front door, 10 years from date of startup by factory-authorized personnel.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Basis of Design: Design Documents are based on a Hurst S5-WK80MONO/1-1000-150SP, natural gas fired, 1,000 b.h.p, 34,500 lbs/hr output, 4-pass wetback, steam boiler or approved equal.
- B. Fuel-to-steam efficiency indicated shall be based on the following:
 - 1. ASME Performance Test Code (PTC) 4, Input-Output method.
 - 2. Test Operating Conditions:

- a. Ambient Temperature: 100 degrees Fahrenheit.
 - b. Ambient Relative Humidity: 50%.
 - c. Percent Excess Air in Exhaust Flue Gas: 15.
 - d. Fuel Heating Value: 1040 btu/cu. Ft.
- C. Gas-Fired Boiler Emissions: Not to exceed allowable ambient air quality standards in governing jurisdiction and indicated values.
1. Carbon monoxide:
 - a. 50 parts per million at any point from 100 percent to 50 percent fire.
 - b. 150 parts per million at any point below 50percent fire.
 2. Nitrogen compounds: 30 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
 3. Sulfur compounds: One part per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
 4. Hydrocarbon and Volatile Organic Compounds: 10 parts per million (dry volume basis and corrected to 3 percent oxygen) at any point from 100 percent to low fire.
 5. Particulate Matter: 0.01 lb/MMBtu.
 6. Smoke: Not visible and not to exceed No. 1 on the Bacharach smoke scale.
- D. Seismic Performance: Boiler shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the boiler will remain in place without separation of any parts when subjected to the seismic forces specified and the boiler will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.
- E. Steam Quality: Staturated.
- F. Operation Following Loss of Normal Power:
1. Equipment associated factory- and field-installed controls, and associated electrical equipment and power supply connected to back-up power system shall automatically return equipment and associated controls to the operating state occurring immediately before loss of normal power without need for manual intervention by an operator when power is restored either through a back-up power source or through normal power if restored before back-up power is brought online.
 2. Refer to Drawings for equipment served by back-up power systems.
 3. Provide means and methods required to satisfy requirement even if not explicitly indicated.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

- I. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil-Fired Boilers - Minimum Efficiency Requirements."
- J. ISO 14000 Certification: Boiler manufacturer to provide certification stating that it has self-certified its company to ISO 14000.
- K. UL Compliance: Test Boilers for compliance with UL 726 and UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

2.2 HORIZONTAL FIRE-TUBE BOILERS

- A. Available Manufacturers:
 - 1. Hurst (Basis-of-Design)
 - 2. Cleaver-Brooks
 - 3. Victory
- B. Pressure Vessel Design: Water back design with the following:
 - 1. Four passes.
 - 2. Minimum Heat-Exchanger Surface: As required to achieve performance indicated.
 - 3. Provisions for lifting boiler in-place.
- C. Base:
 - 1. Factory-mounted pressure vessel and other boiler components on steel saddles or supports that are fastened securely to a structural steel base that is constructed to make a complete self-supported unit requiring only a flat level surface for support.
 - 2. Base included with attachments if required to secure boiler to structure.
 - 3. Manufacturer's standard provisions for lifting include the following.
 - a. Designed for handling and installation conditions encountered.
 - b. Sufficient to carry total weight of fully assembled boiler with a safety factor of 1.2.
- D. Shell:
 - 1. Horizontal, cylindrical, steel pressure vessel of size to satisfy performance requirements indicated.
 - 2. Manholes and Handholes:
 - a. Manhole for waterside inspection and access.
 - b. Handholes at front and rear of boiler for waterside inspections.
 - c. According to current ASME Boiler and Pressure Vessel Code.
 - 3. Steam Boilers:
 - a. Connections for steam supply, feedwater, level controls, and chemical treatment.
 - b. Baffle in shell below steam outlet to provide dry steam with no water carry over.
 - c. Bottom and surface blowdown connections.
 - d. Connections with safety relief valve(s).
 - e. Connections for other trim indicated.

E. Furnace:

1. Welded cylindrical steel chamber that is welded to steel tube sheets.
2. Arranged to provide uniform heat distribution under all firing conditions with no flame impingement on any refractory-covered or water-backed surface.
3. Surrounded by water without interfering with natural circulation of water within shell.
4. Positioned from shell to inhibit unequal thermal stresses during operation.

F. Fire Tubes:

1. Steel, seamless or resistance welded.
2. Fitted in accurately sized holes in tube sheets and rolled or welded in place.
3. Aligned to prevent noticeable deformation with undue stress when boiler is put in service.
4. Tube and tube sheet assembly shall be water- and gastight.
5. Arranged not to interfere with natural circulation of water in shell or to inhibit cleaning and flushing of water sides.
6. Readily removable from one end of boiler.
7. Provided without spinners, turbulators, and other inserted devices.

G. Flue:

1. Flanged connection located along top centerline of boiler and capable of supporting a field-installed flue stack with a weight of at least 2000 lb.
2. Equip boiler flue with bimetal thermometer in a stainless-steel case, with angle position adjustment and nominal 5-inch diameter face having a graduated scale and range of approximately 1.5 times the outlet temperature. Mount thermometer in a Type 316 stainless-steel thermowell that is located in a visible location to indicate flue-gas temperature.

H. Front Door:

1. Hinged or davited, sealed with heat-resistant gaskets and fastened with lugs and cap screws.
2. Designed so tube sheets and flues are fully accessible for inspection or cleaning when doors are open without the need to disconnect burner, blower, and fuel piping.
3. Include observation ports in doors at both ends of boiler for inspection of flame conditions.
4. Door refractory or insulation shall be accessible for inspection and maintenance.
5. The water back boiler rear head shall be fitted with a refractory access plug for rear fireside inspection.

I. Refractories:

1. Refractories retained shall withstand temperature occurring under maximum load conditions.
2. Formed or cast-in sections shall be easily replaceable through factory openings.
3. Secure refractory sections in position to withstand vibration and shock occurring during shipment, and to withstand burner combustion pulsations.
4. Where used for the burner combustion ring and rear or target baffle, refractories shall have a parametric cone equivalent of not less than 33.

5. Provide refractory for doors and end covers exposed to temperatures of 600 deg F and higher.

J. Insulation:

1. Minimum 2-inch- thick, mineral-fiber insulation surrounding the boiler shell and secured in place to prevent sagging or displacement.

K. Jacket: Sheet metal, with factory-applied protective finish.

1. Nominal Thickness: Not less than 0.030 inch.
2. Preformed shape to follow a smooth and uniform contour of pressure vessel and encapsulating insulation.
3. Consisting of multiple removable sections attached with corrosion-resistant screw-fasteners to facilitate removal and replacement multiple times.
4. Painted after assembly.

2.3 BURNER

A. Burner designed to fire natural gas.

B. Welded construction with multi-vane, stainless-steel, flame-retention diffuser.

C. Single-tip retractable nozzle for low-pressure air-atomizing burner.

D. Mount burner on hinged front access door to permit unrestricted access to combustion chamber.

E. Burner Operation: Full modulating control to return to low-fire position for ignition.

1. Gas-Fired Burner: Turndown shall be dependent on boiler size and NO_x level but not less than 6 to 1 turndown.
2. A lesser turndown shall be considered if published factory performance testing shows no loss in operating performance and no negative impact on service life and maintenance while operating throughout full range of system operating conditions encountered.

F. Burner Fuel Combustion Efficiency: Minimum 99.9 percent.

G. Gas Pilot: Premix type with automatic electric ignition, complete with electronic flame scanner to monitor the pilot, so primary fuel valve cannot open until pilot flame has been established.

H. Manual adjustments not required to operate at varying loads.

I. Performance shall be repeatable after changes in firing rate.

J. Control devices and sequence shall comply with FM Global requirements.

K. Damper: Designed to provide accurate control of combustion air with minimum hysteresis. Damper shall close when boiler is off.

2.4 BLOWER

- A. Combustion air supplied by a forced-draft blower assembly that is isolated to reduce vibration and noise.
- B. Mount blower integral to burner to permit unrestricted access to combustion chamber.
- C. Centrifugal type, with a forward-curve, backward-inclined airfoil or radial blade wheel.
- D. Blower and drive assembly shall be controlled through boiler's integral controls in response boiler manufacturer's prescribed sequence of operation that is coordinated with burner and fuel train to achieve performance indicated.
 - 1. Where indicated or required to achieve performance, provide blower with unit-mounted variable-frequency controller to vary blower speed in response to prescribed control set point and changes in operating conditions.
 - 2. Variable-speed fan operation shall be checked for resonant frequencies and adjusted to provide no resonant frequencies throughout entire operating range.
- E. Blower Drive Assembly: Direct drive.
- F. Blower Motor:
 - 1. General Requirements: Comply with requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment" unless more stringent requirements are indicated below:
 - a. Efficiency: Premium efficient.
 - b. Enclosure: Open dripproof.
 - c. Insulation Class: H.
 - d. Service Factor: 1.15.
 - e. Motors operated through variable-frequency controllers shall be inverter duty rated according to NEMA MG-1.
 - 2. Motor Sizes: Minimum size as indicated and large enough so driven load does not require motor to operate in service factor.

2.5 GAS TRAIN

- A. Comply with Owner insurance underwriter requirements. In absence of specific requirements, comply with more stringent requirements indicated.
- B. Pilot gas piping train shall include:
 - 1. One manually operated, lubricated plug cock or ball valve upstream of all valves and accessories.
 - 2. One pressure regulator with vent.
 - 3. Pressure gage located downstream of pressure regulator. Nominal 6-inch diameter face with graduated scale to indicate gas pressure. Gage shall have normal operating pressure of about 50 percent of full range.

4. Primary and secondary automatic valves to operate simultaneously.
5. Normally open, full port electrically operated valve in a vent pipe connected between automatic valves.
6. Manually operated valve with threaded plug located downstream of both automatic gas valves to permit leakage testing.

C. Main gas piping train shall include:

1. Threaded pressure tapping with threaded plug upstream and downstream of valve and regulator.
2. One manually operated, lubricated plug cock, ball valve, or butterfly valve upstream and downstream of all valves and accessories.
3. One main pressure regulator with vent.
4. Primary and secondary automatic valves to operate simultaneously.
5. Manually operated gas valve with threaded plug located downstream of both automatic gas valves to permit leakage testing.
6. Normally open, full port electrically operated valve in a vent pipe connected between automatic valves.
7. Pressure gage with isolation valve located upstream and downstream of pressure regulator and at inlet to burner. Nominal 6-inch diameter face with graduated scale to indicate gas pressure. Gage shall have normal operating pressure of about 50 percent of full range.
8. Low-gas-pressure and high-gas-pressure switch.

D. Control devices and sequence shall comply with FM Global requirements.

E. Main gas valves shall be wired to close automatically in the event of power failure, low water level, or any safety shutdown condition.

F. Mount pilot and main gas trains on side of boiler and support from boiler base.

G. Mount train on side of boiler and support from boiler base.

2.6 STEAM BOILER TRIM

A. Include devices sized to comply with ASME B31.1 and ASME B31.9.

B. Pressure Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve:

1. Size and Capacity: As required for equipment according to 2010 ASME Boiler and Pressure Vessel Code.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

D. Pressure Gage: Nominal 6-inch diameter face with graduated scale and siphon, with isolation valve to indicate pressure vessel steam pressure. Gage shall have boiler normal operating pressure of about 50 percent of full range and an accuracy of 0.5 percent.

- E. Bimetal Thermometer: Stainless-steel case with angle position adjustment and nominal 5-inch diameter face having a graduated scale with a range of approximately 1.5 times the outlet temperature. Mount thermometer in a Type 316 stainless-steel thermowell to indicate steam temperature inside pressure vessel.
- F. Water Column: Minimum 12-inch glass gage with gage rods to protect glass, ball check and shutoff cocks, water column blowdown valves, and vacuum breaker. Midpoint of gage shall be at normal operating water level.
- A. Bottom Blowdown Valves: Factory-installed bottom, two slow-acting and one quick-acting blowdown valves same size as boiler nozzle. Blow-down valves shall be combination of slow and quick acting as required by ANSI B31.1. Valves shall be installed and hydrostatically tested at the factory. Ball valves shall not be used.
- B. Surface Blowdown Valves: Provide a solid state, intermittent sampling conductivity controller. The controller shall periodically open an electric valve to sample the boiler water conductivity. If the sample is below the setpoint, blowdown is not required, and the valve shall close. If above the setpoint, the valve shall remain open until the controller setpoint is satisfied. The sample interval (1/4 to 3 hours) and sample duration (1/2 to 10 minutes) are both controlled by adjustable timers. In addition to the two adjustable timers, the controller shall also include a setpoint potentiometer (graduated in micromhos), and LED indicator lights mounted in a NEMA 4X enclosure. The conductivity controller requires the addition of a valve assembly that includes an appropriately sized and pressure rated valve, probe, tee assembly and orifice kit.
- C. Stop Valves: Boiler outlets, except safety relief valves, shall be equipped with duty-rated stop valve in an accessible location as near as is practical to boiler nozzle and same size or larger than nozzle. Valves larger than NPS 2 shall have rising stem.
- D. Stop-Check Valves: Factory-installed, duty-rated stop-check valve and stop valve at boiler outlet with free-blow drain valve field installed between the two valves and visible when operating stop-check valve.
- E. Feedwater Valves: Factory-installed, duty-rated stop and check valves and interconnecting piping. Stop valves larger than NPS 2 shall have rising stem.
- F. Feedwater Valves: Factory-installed, three-valve bypass arrangement with modulating control valve positioned between duty-rated stop valves, bypass piping with throttling valve, check valve, and interconnecting piping. Stop and throttling valves larger than NPS 2 shall have rising stem. Modulating control valve shall have the following features and characteristics:
 - 1. Duty rated with electric operator to control water level through boiler controls.
 - 2. Equal percentage flow characteristic.
 - 3. Valve Flow: 1.25 times boiler output.
 - 4. Valve Pressure and Temperature Rating: Equal to boiler.
 - 5. Shut-off Leakage: 0.0001 percent of valve coefficient.
- G. Chemical Injection Assembly: Factory-installed, duty-rated injection quill with ball check valve and isolation valve compatible with dispensed chemical.
- H. Sample Cooler: Factory furnished for field installation, with needle valve for each connection. Constructed of Type 316 stainless steel.

2.7 CONTROLS

- A. Boiler operating controls shall include the following devices and features:
1. Control transformer(s) with fuse protection, as required by manufacturer, to implement requirements indicated. Provide transformer with 25 percent spare capacity.
 2. Set-Point Adjust: Operating and alarm set points shall be field adjustable.
- B. Pressure Control for Steam Boilers:
1. Operating-Pressure Control: Factory wired and mounted to control boiler to maintain boiler at constant pressure within 2 percent of set point.
 2. High-Pressure Cutoff with Automatic Reset: Control stops burner if operating conditions rise above normal operating-pressure set point. Set point shall be adjustable.
 3. High-Pressure Cutoff with Manual Reset: Control stops burner operation upon reaching adjustable high limit set point that is below safety valve setting.
- C. Water-Level Control for Steam Boilers:
1. Operating Water-Level Control: Cycle feedwater pump(s) for water-level control.
 2. Operating Water-Level Control: Operate feedwater pump(s) continuously and modulate boiler feedwater valve in response to water level, steam flow rate, and rate of pressure change for water-level control.
 3. Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
 4. Auxiliary Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low-water alarm limit. Cutoff switch shall be manual-reset type.
 5. Microprocessor-based control.
 6. Accuracy within 0.01 inch.
 7. Visual indication of level, alarms, and errors through alphanumeric display.
 8. Features:
 - a. Continuous water-level indication.
 - b. Low-water cutoff and alarm.
 - c. High-water alarm.
 - d. Low- and high-water warning.
 - e. Control of modulating feedwater control valve.
 - f. Continuous monitoring of float operation.
 - g. Column blowdown detection and reminder.
 - h. Auxiliary low-water cutoff check.
 - i. Auto and manual reset.
 - j. Alarm annunciation.
- D. Boiler Emergency Shutdown: Interlock with field-installed boiler emergency shutdown switch to shut down boiler when activated. Manufacturer to furnish break-glass-type switch with permanent nameplate titled "Boiler Emergency Shutdown" for field installation.
- E. Burner Safety Controls for Steam Boilers: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic and Manual reset stops burner if operating conditions rise above maximum boiler operating pressure.
 2. Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
 3. Auxiliary Low-Water Cutoff Switch: Float and electronic probe shall prevent burner operation on low-water alarm limit. Cutoff switch shall be manual-reset type.
 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- F. Burner Flame Safeguard Controls:
1. Factory equipped with flame safeguard control and infrared flame scanner.
 2. Microprocessor-based, solid-state control having sequence and flame-on visual indication and fault code indications of flame safeguard trip functions.
 3. Control shall include dynamic self-check logic.
 4. Control shall have a fixed operating sequence incapable of being manually altered that includes start, pre-purge, pilot and main fuel ignition run, and post-purge cycles.
 5. Control shall be non-recycle type for maximum safety that shall shut down the burner and indicate, as a minimum, the following trip functions:
 - a. Pilot and main flame failure.
 - b. High- and low-fire proving switch faults.
 - c. Running interlocks open.
 - d. False flame signal and fuel valve open.
 6. Control shall include a run/test switch to allow interruptions to sequence just after pre-purge and during pilot ignition trial, and run cycles for adjustments to firing rate motor, damper linkages, and pilot flame for minimum turndown tests.
- G. Combustion-Air Controls: Factory equipped with motor-operated combustion-air damper and blower control to regulate burner fire according to load demand.
- H. Oxygen Trim Control:
1. Provide oxygen trim system to continuously monitor and display oxygen concentrations in boiler flue gas and adjust fuel and airflow to maintain an adjustable oxygen-level set point.
 2. System shall compensate for changes in ambient temperature, barometric pressure, humidity, and variations in fuel characteristics.
- I. Surface Blowdown Control: Provide a conductivity sensor and control circuitry to operate an automatic control valve in surface blowdown piping to maintain total dissolved solids (TDS) within boiler manufacturer's prescribed level.
- J. Plant Controls System Interface: None. Local control only.
- K. Integrated Boiler-Control System:
1. Integral control of burner management for flame safety, boiler modulation, and operator interface functions with features and functions indicated.
 2. Factory preconfigured.

3. Utilizing solid-state controls and sensors to provide various control functions, including the following:
 - a. Automatic sequencing of the boiler through standby, pre-purge, pilot flame establishing period, main flame establishing period, run, flame proving and lockout, and post-purge.
 - b. Full modulating control of air and fuel through Proportional-Integral-Derivative (PID) algorithm.
 - c. Thermal shock protection.
 - d. High and low limit alarms and shutdowns.
 4. Local operator interface through nominal 10-inch color touch screen graphical display for setup, monitoring, and data acquisition.
 - a. Manual control of the boiler firing rate using control screens to increment or decrement firing rate.
 - b. Indication of burner management controller status and diagnostics.
 - c. Display of system alarms and faults.
 - d. Display of history of alarms and faults.
 - e. Display of recommendations for troubleshooting of fault conditions.
 - f. Display of water-level indication and alarm(s).
 - g. Stack flue-gas, combustion-air, and shell water-temperature indication.
 - h. Boiler efficiency calculation and display.
 - i. Low-fire hold with minimum temperature control.
 - j. Assured low-fire cutoff (ALFCO).
 - k. High stack temperature annunciation with auto cutoff.
 - l. Audible alarm and silencing through touch screen intervention.
 5. Fully integrated control of the following:
 - a. Blower operation and combustion-air damper for varying operating conditions.
 - b. Oxygen trim and monitoring to compensate for combustion-air variations.
 - c. Parallel positioning for independent fuel and air control for enhanced fuel efficiency.
 - d. Multiple boiler lead/lag control with hot standby.
 - e. Draft control for maintaining proper and consistent draft for enhanced fuel efficiency.
 6. E-mail and paging feature to multiple contacts via Internet and phone line independent of control system interface.
 7. LAN/WAN interface with remote monitoring software to allow remote monitoring independent of control system interface.
- L. Control Enclosures:
1. NEMA 250, Type 12.
 - a. Provide enclosure with integral vents, fans, heater, and air conditioner as required to automatically control temperature inside enclosure within safe operating limits of devices installed within the enclosure.

2. Wiring shall be numbered and color-coded to match wiring diagram. Provide a laminated wiring diagram located inside enclosure.
 3. Mounted on boiler assembly at a location convenient to operator.
 4. Provide hinged full-size door with key lock. Provide common key for all locks.
 5. Enclosure shall consist of multiple sections divided by a partition with a separate hinged door for each section. One section shall house low-voltage controls and other section shall house line voltage controls.
 6. Enclosure shall house the following:
 - a. Control transformers with fuses.
 - b. Labeled terminal strips.
 - c. Controller(s) to provide control and alarm functions indicated.
 - d. Audible indication of safety alarms.
 7. Face of enclosure shall provide the following:
 - a. Visual indication of operating components and alarms.
 - b. Auto/local capability to allow operator to manually operate boiler locally.
 - c. Audible alarm-silence capability.
 - d. Labels for switches, lights, and displays to provide clear indication of service.
- M. Control Instrument Enclosures: Control instruments and devices that are mounted on the boiler assembly and cannot be installed inside the control enclosure shall have same or higher level of protection indicated for control enclosures.
- N. Control Cable and Wire:
1. Control cable and wiring shall be numbered and color-coded to match wiring diagram.
 2. Install cable and wiring located outside of enclosure(s) in a raceway. Use flexible conduit to make final terminations. Provide watertight installation for applications exposed to moisture.

2.8 ELECTRICAL POWER

- A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
1. Enclosure: NEMA 250, Type 12.
 - a. Enclosure shall have integral vents, fans, heat, and air conditioner as required to automatically control temperature inside enclosure within safe operating limits of devices installed within the enclosure.
 - b. Mounted on boiler assembly at a location convenient to operator.
 - c. Enclosure shall have hinged full-size door with key lock with common key for all locks.
 2. Wiring shall be numbered and color-coded to match wiring diagram. Provide a laminated wiring diagram located inside enclosure.

3. Install wiring outside of an enclosure in a metal raceway. Make final connections to motors using flexible conduit. Provide watertight installation for applications exposed to moisture.
4. Field power interface shall be to a fused disconnect switch. Withstanding rating of disconnecting means shall protect equipment. Coordinate requirements with field electrical power source.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection. Provide variable-frequency controller with manual bypass and line reactors for each variable-speed motor indicated.
7. Provide transformer with fuses and power wiring to power a 20-A 120-V duplex receptacle mounted in each boiler control panel for use in connecting analytical and testing equipment.

2.9 FINISH

A. General:

1. Paint boiler, using manufacturer's standard procedures, except comply with requirements indicated.
2. Miscellaneous surfaces shall be finished to match continuous surfaces.
3. Manufacturer shall field touch up or entirely repaint surface finishes, which were damaged during shipment, to original condition, using original materials and methods.
4. Paint shall be suitable for temperatures encountered on painted surfaces.
5. Requirements indicate minimum quality level. Provide more robust paint system if required to comply with other requirements indicated.

B. Preparation:

1. Follow paint manufacturer's published preparation and application instructions.
2. When paint manufacturer's recommended preparation requirements differ from those specified, use more stringent requirements.
3. Structural steel with visible corrosion shall be sandblasted according to SSPC SP-6 or SSPC SP-10 before applying primer and paint.
4. Before application of a primer and a top coat, remove oil and grease from surfaces to be coated using clean rags soaked in thinner according to SSPC SP-1.
5. Treat galvanized-steel surfaces that cannot be procured with a phosphatized finish with a phosphate rinse to ensure proper paint adhesion.

C. Primer:

1. Rust-inhibiting type with a minimum dry film thickness of 2 mils.
2. Provide multiple passes if required to prevent runs.
3. Select a primer that is compatible with substrate and finish coat.

D. Finish Coat:

1. Finish coat shall be alkyd enamel.

2. Use dry film thickness recommended by paint manufacturer, but not less than 2 mils. Provide multiple passes if required to prevent runs.
- E. Paint the following surfaces with both a primer and finish coat:
1. Base and miscellaneous supports that are not hot dip galvanized.
 2. Carbon steel that is not galvanized.
 3. Exterior surfaces of unit exposed to view.
 4. Piping and trim.
- F. Do not paint aluminum or stainless steel.

2.10 CAPACITIES AND CHARACTERISTICS

- A. See Schedule on Drawings.

2.11 SOURCE QUALITY CONTROL

- A. Test and inspect factory-assembled boilers, before shipping, according to current ASME Boiler and Pressure Vessel Code.
- B. Burner and Hydrostatic Test:
1. Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve performance requirements indicated.
 2. Perform hydrostatic test of pressure vessel, piping, and trim of assembled boiler.
- C. Witness Testing:
1. Allow Owner access to witness source quality-control testing of boilers.
 2. Notify Owner 30 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and flue; piping; controls; and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
1. Boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for flue, piping, controls, and electrical connections.
- B. Examine areas where boilers will be installed for suitable conditions.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Coordinate size and location of bases. Cast anchor-bolt inserts into concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Equipment Mounting:
 - 1. Install boiler on cast-in-place concrete equipment base. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Install gas-fired boilers according to NFPA 54.
- D. Install oil-fired boilers according to NFPA 31.
- E. Assemble and install boiler trim, components, and accessories that are not factory installed.
- F. Install control and electrical devices furnished with boiler that are not factory mounted.
- G. Install control and power wiring to field-mounted control and electrical devices furnished with boiler that are not factory installed.
- H. Perform boil-out and cleaning procedures according to boiler manufacturer's or Owner's chemical treatment representative's written instructions after completion of hydrostatic testing and before performing other field tests. Boiler manufacturer's factory-authorized representative shall witness boil-out and cleaning procedures. Following boil-out and cleaning procedures, boiler shall be washed and flushed until water leaving boiler is clear.
- I. Protect boiler fireside and waterside from corrosion.
 - 1. Before boiler is filled with water, protect by dry storage method recommended by boiler manufacturer.
 - 2. After boiler is filled with water and left not fired for more than 10 days, protect by wet storage method recommended by boiler manufacturer.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to boiler, allow space for service and maintenance.
- C. Connect gas piping to boiler gas-train inlet with dirt leg, shutoff valve, and union or flange. Piping shall be at least full size of gas-train connection. Provide a reducer if required.
- D. Connect steam and condensate piping to supply-, return-, and blowdown-boiler connections with union or flange at each connection. Provide each connection with shutoff valve if shutoff valves are not factory furnished with boiler trim. Provide check valves in blowdown piping of each boiler that connects multiple boilers.

- E. Connect feedwater piping with union or flange at each connection. Provide each connection with shutoff valve and other accessories indicated and recommended by manufacturer.
- F. Install piping from safety relief valves to nearest floor drain.
- G. Install piping from safety valves and drip-pan elbows. Extend piping from safety valves and terminate to vent outdoors. Extend piping from drip-pan elbow drain to nearest floor drain.
- H. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- I. Hot equipment drains connected to sanitary drainage system shall be cooled before discharging into the system if required to comply with more stringent of governing code requirements and requirements indicated.
 - 1. Provide a temperature-controlled non-potable domestic cold water source to cool hot equipment drains to deliver a discharge temperature of 120 deg F.
- J. Connect chemical-treatment piping to each boiler chemical-treatment connection with check valve and isolation valve.

3.4 FLUE CONNECTIONS

- A. Connect breeching to full size of boiler outlet. Comply with requirements in Section 235133 "Insulated Sectional Chimneys" for venting materials.
- B. Install flue-gas recirculation duct from vent to burner if not factory furnished and installed.
- C. Install easily accessible test ports for field testing of flue gas from each boiler.

3.5 ELECTRICAL POWER CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between boilers and other equipment to interlock operation as required, to provide a complete and functioning system.

3.7 NETWORK AND PHONE CONNECTIONS

- A. Connect phone system cable to boiler controls to provide connectivity for remote monitoring and alarm notification through integrated boiler control system.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Factory Hydrostatic Leak Test: Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
 - b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and steam pressure.
 - c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Boiler will be considered defective if it cannot pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Performance Tests:
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
 - 2. Boilers shall comply with performance requirements indicated, as determined by field-performance tests. Adjust, modify, or replace equipment in order to comply.
 - 3. Perform field-performance tests to determine the capacity and efficiency of boilers.
 - a. Test for full capacity.
 - b. Test for boiler efficiency shall be performed at all boiler turndown points percent of full capacity. Determine and document efficiency at each test point.
 - 4. Test each safety valve. Record pressure at valve blowdown and reset. Test valve(s) with boiler operating at full capacity to ensure valve has capacity to prevent further rise in pressure.

5. For boilers equipped with automatic oxygen trim control, conduct tests with automatic oxygen trim control on manual at zero trim and record performance. Repeat tests with automatic oxygen trim control under automatic control and record performance.
6. Repeat tests until results comply with requirements indicated.
7. Provide measurement and analysis equipment required to determine performance.
8. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
9. Notify Owner 20 days in advance of test dates.
10. Document test results in a report and submit with informational submittals.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235239

SECTION 235239.11 - BOILER PLANT START-UP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes Provisions and requirements for the start-up of the Boiler Plant.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Loop calibration reports for all instruments with set points and tolerance.
- C. Resume of Start-up Engineer.
- D. Start-up and Test Plan: A written schedule and procedure with dates of start-up, tests, installation and check-out of equipment.
- E. Start-up Certification: Certified written statement, signed by the Start-up Engineer, that the equipment is installed in accordance with the manufacturer's recommendations or requirements.

1.4 QUALITY ASSURANCE

- A. Start-up Engineer: The Contractor shall provide the service of a qualified engineer and technician for start-up, test, and installation of equipment as specified below. Provide the services of technician and engineer until the installation of equipment is coordinated and completed with checkout. The Owner reserves the right to reject the Start-up Engineer and technician proposed if the engineer's and technician's qualifications are not suitable or are questionable. More than one engineer and technician may be provided based on the types of specific equipment. One engineer and technician as appointed by the Contractor shall supervise and be responsible for the overall installation, start-up, and testing and checkout of systems.

1.5 ASSOCIATED WORK

- A. Requirements for interconnecting piping, insulation, fuel supply, vibration isolation and other related work necessary to provide a complete and operable steam system, whether or not specifically mentioned above, shall conform to applicable requirements of other sections of Division 23, and electrical work shall conform to applicable requirements in Division 26.

1.6 SUPERVISION

- A. Start-Up, Test, and Installation: The Contractor shall provide the services of a qualified engineer for start-up, test, and installation of equipment.
- B. Start-Up and Test: In addition to the requirements above, the start-up and test engineer shall be approved by the Owner.
- C. Installation: In addition to the requirements above, provide an installation engineer to install and supervise the installation of boilers, blowdown system, and associated devices. Provide the engineer until the installation of equipment is coordinated and completed with checkout.

1.7 FUEL:

- A. Midwestern State University will provide the fuel for start-up and performance testing that generates steam that is beneficial to the needs of Midwestern State University. This steam usage will be documented by the steam discharge meters and approved by Midwestern State University.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Arrange the work in a neat and orderly manner so that minimum storage of equipment and material is required at the project site. Install the equipment and material in accordance with the best commercial practices and manufacturer's recommendations. All systems shall be neat in appearance, compact, workmanlike in construction and assembly, and installed for continuous service. All parts shall be readily accessible for inspection, repair, and renewal. Inspect the equipment and material upon delivery and test after installation. Protect material and equipment from the weather. Any damage caused by the Contractor in the prosecution of the work shall be repaired and left in a condition equal to the existing before the Work was started. Verify that first subparagraph below is correct for this Project. Statement is true if AIA standard documents are used correctly.
- B. The start-up and test plan shall be reviewed by a start-up team chaired by the Owner and Engineer with the Contractor's Start-up Engineer.
- C. The Start-up Engineer shall provide a detailed pre-test briefing on all major tests and the initial system energizations to the start-up team.

3.2 FIELD TEST AND INSPECTIONS

- A. General: The Contractor shall be responsible for the performance of all tests and inspections as specified herein to demonstrate that the new boiler and controls, as installed, are in compliance with contract-requirements. During boiler system start-up tests, factory-trained engineers and technicians employed by individual suppliers of the boiler, burner, flame safeguard and

combustion controls shall be present, as required, to insure the proper functioning, adjustment, and testing of the individual components and systems, and to train plant operation personnel in the operation and maintenance of them. A detailed written record of the start-up performance, including burner setting data over the entire load range, shall be furnished to the Owner before the Contractor's and sub-contractor's test personnel leave the site. All labor, equipment, and test apparatus required for testing shall be furnished by the Contractor. Perform boiler start-up procedures in strict accordance with boiler manufacturer's requirements. Fuel, water, and electricity for testing will be provided. All controls as described in Division 23 shall be tested and approved before testing boilers and supporting systems. All electrical systems shall be tested and approved by the Owner before testing boilers and supporting systems.

- B. Tests and Inspections: All tests and inspections at the site shall be made under the direction of and be subject to the approval of the Owner. The Contractor shall operate each boiler and all appurtenances prior to final testing and shall insure that all necessary adjustments have been made. A 30 calendar days' advance written notice shall be submitted to the Owner indicating the equipment is ready for testing. Draft, fuel pressure, and steam flow may be measured by permanent gages and meters installed under the contract. Control of noise levels developed by exhaust steam, including muffler, globe, and gate valves, shall be conducted in such a manner as not to create a nuisance or hazard and shall be subject to the approval of the Owner. The tests shall include the following and shall be performed when feasible, in the sequence listed:

1. Strength and tightness tests
2. Standards compliance tests
3. Combustion tests
4. Operational tests
5. Capacity and efficiency tests
6. Tests of auxiliary equipment
7. Feedwater equipment test
8. Emissions compliance test

- C. Strength and Tightness Tests: Subject boilers to the following strength and tightness tests:

1. Hydrostatic Testing: The hydrostatic test shall be in accordance with ASME BPVC SEC I with the test pressure applied for a period required by the Owner. The hydrostatic test at the site shall be certified by an inspector holding an authorized commission from the National Board of Boiler and Pressure Vessel Inspectors. ASME BPVC, Section I requirements take precedence. Owner shall witness test.
2. Pneumatic Testing: Pneumatically test air casing and breeching exterior to the furnace. Test results shall be submitted in writing to the Owner for approval.

- D. Combustion Tests: Test the fuel burning and combustion control equipment with each of the specified fuels at the minimum limit of the turndown range and at increments of 50, 75, and 100 percent of full rated load. The combustion control system shall maintain the amount of excess air specified by burner manufacturer at all load settings. Tests shall be conducted by factory-trained combustion equipment engineers as previously specified. Analyze and graphically present test data to show for each boiler at tested loads: rates of steam flow; flue gas temperatures; percentages of carbon monoxide; oxygen in the flue gas; and percent excess air. Also record the steam quality. Run tests on each fuel until stack temperatures are constant, and conformance with the combustion requirements of this specification has been verified and recorded. Also verify proper operation of all instrumentation and gages during the test.

- E. Operational Test: Test the boilers continuously under varying load conditions to demonstrate proper operability of the combustion control, flame safeguard control, programming control, and safety interlocks. Conduct this test after the adjustment of the combustion controls has been completed under the combustion test. The operational test shall continue for a period of at least 72 hours and shall include the following:
1. Sequencing: The boiler shall start, operate, and stop in strict accordance with the operational sequence specified in Division 15.
 2. Flame Safeguard: Verify the operation of the flame safeguard controls by simulated flame and ignition failures. Test burners having intermittent pilots by simulating main flame failure while the pilot is burning. Verify the trail-for-pilot ignition, trail-for-main flame ignition, combustion control reaction, and valve closing times by stopwatch. Provide flame safeguard documentation for submitting to owner's insurance carrier. Test purge system prior to injecting fuel into boiler.
 3. Immunity to Hot Refractory: Operate the burner at high fire until the combustion chamber refractory reaches maximum temperature. The main fuel valve shall then be closed manually. The combustion safeguard shall drop out immediately causing the safety shutoff valves to close within the specified control reaction and valve closing times.
 4. Pilot Intensity Required: Gradually reduce the fuel supply to the pilot flame to the point where the combustion safeguard begins to drop out (sense "no flame") but holds in until the main fuel valve opens. At this point of reduced pilot fuel supply, the pilot flame shall be capable of safely igniting the main burner. If the main fuel valve can be opened on a pilot flame of insufficient intensity to safely light the main flame, make required burner and burner management system adjustments.
 5. Boiler Limit and Fuel Safety Interlocks: Safety shut down shall be caused by simulating interlock actuating conditions for each boiler limit and fuel safety interlock. Safety shutdowns shall occur in the specified manner.
 6. Combustion Controls: Demonstrate the accuracy, range, and smoothness of operation of the combustion controls by varying the steam demand through the entire firing range required by the turndown ratio specified for the burner.
 7. Safety Valves: the high-pressure limit switch shall be locked out or otherwise made inoperative, and the boiler safety valves shall be lifted by steam. The relieving capacity, popping pressure, blowdown, and reseating pressure shall be determined by observation and measurement to be in accordance with the ASME BPVC SEC I. The ASME standard symbol will be accepted only as indicating compliance with the design and material requirements of the code.
- F. Capacity and Efficiency Tests: Perform the capacity and efficiency tests after satisfactory completion of all tests previously specified herein and after the boiler (s) have been operating continuously for 5 days with no nuisance shutdowns and without the necessity for frequent or difficult adjustments. (Perform these tests on each boiler.) Conduct tests using each of the specified fuels. The test procedures shall be in accordance with the input-output method of ASME PTC 4.1 and shall be reported on the ASME Test Form for Abbreviated Efficiency Test. Test shall be performed at 10, 25, 50, 75, and 100 percent loads. The duration of the tests shall be sufficient to record all necessary data but in no case shall it be less than 4 hours on each fuel.
- G. Steam Quality: Test steam quality and water level stability shall be simultaneous under the operating conditions specified.

- H. Steam Tests: The steam for boilers shall be tested in accordance with the conductivity method in ASTM D 2186, with the conductivity of the steam corrected for carbon dioxide and ammonia content not to exceed 4.0 micromhos/cm at 18 degrees C.
- I. Water Level Stability Test: Test shall first be conducted by use of the manual bypass around the feedwater control valve. Test shall be repeated using the automatic feedwater control valve. To be acceptable, the boiler shall maintain specified water level stability under both conditions.
- J. Boiler Plant and Combustion Control System: Test of control system shall demonstrate that the controls system installed meets the requirements specified in Division 23.

3.3 WARRANTY AND PERFORMANCE GUARANTEE

- A. The Contractor shall provide the Owner a warranty and performance guarantee that the boiler plant meets all the performance requirements of the contract documents and that it will meet these requirements for a period of 12 months following acceptance by the Owner.

If the boiler plant does not meet the requirements of the contract documents, repair and correction shall be made at no cost to the Owner.

END OF SECTION 235239.11

SECTION 235239.12 – MECHANICAL SYSTEM COMMISSIONING

PART I. GENERAL

1.01 WORK INCLUDED

- A. Systems and equipment testing and start-up
- B. Validation of proper and thorough installation of Division 23 systems and equipment
- C. Equipment performance verification
- D. Functional testing of control systems
- E. Documentation of tests, procedures, and installations
- F. Coordination of training
- G. Sequencing and Coordination

1.02 GENERAL DESCRIPTION

- A. Commissioning is the process of ensuring that all building and plant systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the owner's operational needs, the installation is adequately documented and that the Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building systems from installation to full dynamic operation and optimization.
- B. Commissioning Authority shall work with the Contractor and the Owner to direct and oversee the Commissioning process and perform functional performance testing.

1.03 SCOPE

- A. Systems to be commissioned include the following:
 - 1. Steam Boiler
 - 2. Steam and Condensate Piping Systems
 - 3. Natural Gas Systems

1.04 RELATED WORK AND DOCUMENTS

- A. The drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

- B. Individual Division 23 Sections: Individual sections stipulate installation, start up, warranty and training requirements for the system or device specified in the section.
- C. Section 235239.11 – Boiler Plant Start-up

1.05 DEFINITIONS AND ABBREVIATIONS

- A. Acceptance Phase: This is the phase of the project where the facility and its systems and equipment are inspected, tested, verified, etc. and when most of the functional performance testing and formal training occurs. This will generally occur after the construction phase is complete (start up and check out have been accomplished). The Acceptance Phase typically begins with Substantial Completion and ends with Functional Completion
- B. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers
- C. ASME – American Society of Mechanical Engineers
- D. Contractor: As used herein is a general reference to the applicable installing party and can therefore refer to the GC, subcontractors, or vendors.
- E. Construction Phase: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subs complete installation, start up forms, submit O&M information, establish trends, etc. Contractor/Vendors conduct equipment specific training Construction phase will generally end upon completed start up.
- F. Commissioning (Cx) - The process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the owner’s operational needs.
- G. Commissioning Authority (CA) - An individual or company who will oversee the Commissioning process, stipulate many of the Commissioning requirements and validate that systems and equipment are designed, installed and tested to meet the Owners requirements.
- H. Commissioning Team: The group of individuals who will collaborate to ensure the facility is fully. This will include the CA, the Owner’s Facilities representative, the TAB Contractor, and a Commissioning coordinator provided by the Contractor. The installing Contractor, subcontractors, and/or manufacturer will be an integral member of the team for any given system or equipment.
- I. Functional Completion: A milestone which marks the successful completion of the Acceptance Phase and the functional performance testing of the systems in the initial season.
- J. Functional Performance Testing (FPT): The detailed and thorough testing of the building systems and their interactions with the building components and other

building systems – Systems and equipment will be tested in various modes of operation and under different conditions. Both component performance and environmental objectives will be monitored during this testing.

- K. Deficiency: An installation or condition that is not in conformance with the construction documents and/or the design intent
- L. Facility Management System (FMS): The computer-based control or automation system. May also be referred to as automatic temperature control (ATC) system, direct digital control (DDC) system, building automation system (BAS), building management and control system (BMCS) or digital control system (DCS).
- M. Party – Individual, company or entity. Refer to the Commissioning Plan for names and definitions.
- N. Project Phases – Phases of the project include the Construction Phase, Acceptance Phase, and Warranty Phase
- O. Preliminary Service - Systems/equipment are being used by the occupants although final adjusting, functional performance testing is on going.
- P. Pre-Test - preliminary testing accomplished during a scheduled system outage to verify system functionality prior to placing the system/equipment into preliminary service.
- Q. Scheduled Outage - period, scheduled by Owner, in which the system is out of service or not to be used by occupants.
- R. Start-up - The process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the start-up checklist, energizes the device, and verifies it is in proper working order. When the start-up for a system or equipment item is complete, the system or item shall be ready for continuous, safe, and satisfactory operation and shall be expected to produce design capacity when required by conditions.
- S. Warranty Phase: Includes the early occupancy of the building and can continue through the warranty period and at least into the opposite season from when it was initially tested.

1.06 DOCUMENTATION

- A. Contractor shall send Commissioning Authority one copy of the following:
 - 1. Shop drawings and product data related to systems or equipment to be commissioned. Commissioning Authority shall review and incorporate comments via the Owner.
 - 2. Draft equipment Start-up check lists along with the manufacturers start up procedures: Contractor shall submit to the Commissioning Authority not more than 60 days following receipt of approved submittals. CA will assist in the development if requested and recommend approval.

3. Draft Test Reports: CA will review and provide comments to the Owner.
 4. System Test Reports including but not limited to hydrostatic testing, welding inspection, and the like: Contractor shall submit these to the Commissioning Authority as they are completed. CA will review and compile prior to FPT.
 5. Completed Equipment Start-up certification forms along with the manufacturer's field or factory performance and start up test documentation: CA will review and compile prior to FPT.
 6. Equipment Warrantees
 7. Training Plans
 8. O&M Information per Division 1 requirements
 9. Record Drawings
- B. Record Drawings: Contractor shall maintain at the site an updated set of record or "as-built" documents reflecting actual installed conditions.

1.07 SEQUENCING AND SCHEDULING

- A. Refer to the sequencing illustration at the end of this section for a graphical representation of the precedents related to the Commissioning tasks. These precedents are generally to be applied per system and/or area. Where applicable, in order to expedite the close out of the facility, various systems can be in various stages of the commissioning process. CA and Contractor shall cooperate to schedule the Commissioning tasks to minimize the duration of the Commissioning activities.
- B. Commissioning Scheduling: Contractor shall incorporate the commissioning process into the project schedule. Start up and Functional Performance Testing shall be itemized as applicable for each system/area. CA will review the duration for the tasks.

1.08 COORDINATION MANAGEMENT PROTOCOLS

- A. Coordination responsibilities and management protocols relative to Commissioning shall be documented in the Construction Phase Commissioning coordination meeting. Contractor shall have input in the protocols and all parties will commit to scheduling obligations. The CA will record and distribute.

1.09 COMMISSIONING AUTHORITY RESPONSIBILITIES

- A. Construction Phase
1. Conduct Commissioning meeting.
 2. Review applicable project documentation (shop drawings, product data, TAB reports, record drawings, O&M information, etc.) for adequacy and to ensure system functionality.
 3. Review and approve start up checklist forms.
 4. Observe installation progress periodically.

5. Attend selected progress meetings to observe progress and help expedite completion.
6. Witness selected tests start-ups, and equipment training.
7. Review O&M information and systems overview contained in the O&M manuals.

B. Acceptance Phase

1. Verify (spot check) start-up reports.
2. Verify (spot check) control component calibration.
3. Verify (spot check) equipment performance certifications.
4. Analyze trend logs.
5. Functionally test systems and equipment.
6. Review training plan
7. Coordinate training activities.
8. Record commissioning procedures

1.10 CONTRACTOR RESPONSIBILITIES

A. Construction Phase

1. Include Commissioning requirements in price and plan for work.
2. Attend coordination meetings called by CA.
3. Remedy any deficiencies identified throughout construction.
4. Prepare and submit required draft forms and systems information.
5. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract Documents, as required by reference or industry standards, and as specifically indicated in Part - 3 of this section.
6. Start-up, test, adjust, and balance systems and equipment prior to functional performance testing. Start-up procedures shall be in accordance with Contract Documents, reference or industry standards, and specifically Part - 3 of this section.
7. Record start-up and testing procedures on start-up forms or checklists and certify that the systems and equipment have been started and or tested in accordance with the requirements specified above. Each form shall be signed and dated by the individual responsible for the start-up or test. Tag equipment started with individuals name and date.
8. Complete approved start up checklists and submit along with other installation certification information such as balancing reports, warranties, testing results, etc.
9. Schedule and coordinate Commissioning efforts required by appropriate subcontractors and vendors. Participate in respective portions of start-ups and training.
10. Demonstrate the systems as specified and assist with functional performance testing.

11. Certify that systems have been correctly installed and are operating per Contract Documents.
12. Maintain an updated set of record documentation.
13. Copy Commissioning Authority on indicated documentation.
14. Conduct equipment specific operation, maintenance, diagnosis, and repair training as required by the respective section of the specifications.

B. Acceptance Phase

1. Assist Commissioning Authority in functional performance testing. Assistance will generally include the following:
 - a) Manipulate systems and equipment to facilitate testing.
 - b) Provide instrumentation necessary for verification and performance testing.
 - c) Manipulate control systems to facilitate verification and performance testing.
 - d) Provide a Control technician to work at the direction of Commissioning Authority for up to 8 hours beyond assistance specified above.
2. Correct any work not in accordance with Contract Documents.
3. Participate in the systems and operational training relative to use of O&M information.
4. Compensate Owner for additional Commissioning Authority site time and expenses resulting from incompleteness of or deficiencies in systems or equipment at time of functional performance testing.

C. Warranty Phase

1. Provide warranty service.
2. Participate in the opposite season testing.
3. Correct any deficiencies identified.
4. Update record documentation to reflect any changes made throughout the Warranty Phase

1.11 CONTRACTOR NOTIFICATION

- A. Contractor shall completely install, thoroughly inspect, start-up, test, adjust, and balance systems and equipment. All activities shall be documented on specified forms. Contractor shall notify A/E, Owner, and CA in writing that systems are complete and ready for demonstration and functional performance testing.
- B. Contractor shall notify CA at least 14 days in advance of any tests, start-ups, or training. CA shall witness selected tests and start-ups.

1.12 START-UP CHECKLISTS AND MANUFACTURERS START UP INSTRUCTIONS

- A. Start-up checklists for each type of equipment and system shall be submitted to Commissioning Authority for approval prior to start-up. Appropriate subcontractors or vendors shall design the forms meeting the requirements of the Contract Documents. Forms shall be developed for the equipment being installed for this project.
- B. Start up checklists shall include the following for each (as applicable):
 - 1. Project specific designation, location and service
 - 2. Pertinent nameplate data including model and serial numbers.
 - 3. Party performing the test.
 - 4. Place for signature of the start up technician along with the date
 - 5. Clear explanation of the inspection, test, measurement and the like with a pass/fail indication a record of measure parameters.
 - 6. Include a checklist item indicating all O&M instructions, warranties, record documents have been completed and submitted.
 - 7. Include a checklist item for proper maintenance clearances maintained.
 - 8. Include a checklist item indicating that special tools and/or spare tools required were turned over to the Owner.
 - 9. Generally, include checklist items indicating that required prerequisite equipment and systems were successfully started.
- C. Start-up procedures shall be in accordance with Contract Documents, reference or industry standards, and specifically Part - 3 of this section. Contractor shall compile the start up and check out procedures indicated in the manufacturer's documentation prior to designing the forms. As applicable include acceptance criteria specified therein. The manufacturers start up and check out procedures shall be submitted to the CA along with the draft start up checklists.
- D. Completed Start-up checklists for all pieces of equipment shall be submitted to Commissioning Authority prior to verification and performance testing.

1.13 FUNCTIONAL TEST PARTICIPATION

- A. Part IV of this specification contains generic functional testing procedures that are representative of the actual tests that shall be performed by the Commissioning Team. CA will provide the final functional tests following receipt of all the required equipment and control submittal data.
- B. Required participating parties are indicated with the individual tests. Typically, multiple parties are required for any given test, yet participation for any given party is only required for the respective portion of the test for which the party is responsible. For instance, controls contractor does not have to be present for capacity testing of the boilers, only the control related performance testing. In many cases, the maximum required time in hours is indicated in parenthesis for any given test. The time is typically per unit system unless indicated otherwise

(i.e.: 1 hr per air handler tested). If no time is indicated, participation is required throughout the entire test.

- C. Frequently, on multiple samples where a given party does not directly conduct the test, the participation of that party will only be required for an initial quantity of systems/equipment. CA will continue with the remaining portion of the sample without assistance from the contractor. In this case the time requirement will be indicated as total.
- D. It is required that the parties be available on site throughout the testing of any given system for which they are required participants. Therefore, time for which they are not directly involved can be spent performing other work (typically addressing identified punch list items or failed tests)
- E. No party involved with the project is prohibited from participation in or witnessing of any tests. Any contractor may elect to witness all tests on their systems even if their involvement is not directly required (for instance, ATC involvement is sometimes required on the first few of a sample and not on the entire sample)
- F. CA will endeavor to coordinate effectively with the individual contractors throughout FPT and minimize their required involvement.

1.14 TRENDING

- A. Trending requirements are specified in Section 15959
- B. CA will analyze trends of the system operating parameters to evaluate normal system function. The requirements of the trending are specified with the FPT procedures in the Commissioning Plan. Contractor shall establish these trends, ensure they are being stored properly, and forward the data in electronic format.

1.15 FUNCTIONAL PERFORMANCE TESTING

- A. General: CA will direct functional performance tests after the successful start up and complete documentation of systems and equipment. Generic procedures for the functional performance testing are described in the Commissioning Plan. CA will record data and complete the test forms. Contractor shall assist as described above with manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders, specialty test equipment, and the like), and on the spot remediation of minor identified deficiencies. CA may execute selected tests, with Contractor's approval, at CA's discretion. Contractor shall assume full responsibility for the equipment and systems during the testing. Required participation is outlined in the Commissioning plan.
- B. Detailed Test Forms: CA will prepare detailed and itemize testing procedures and forms to dictate and document the FPT. These will be developed during the construction phase and completed during the acceptance phase.

- C. Completeness: All systems must be completed and ready for FPT. TAB must be complete, and the control systems must be tested and started for the respective system or component.
- D. Test Documentation: CA will conduct, direct, and witness tests as applicable. CA will record test results on the forms developed for the testing. CA will Pass or Fail the testing and record the date and time of the test. Deficiencies shall clearly be indicated in when the test is failed. When all related testing is completed successfully, CA shall recommend acceptance of the system or component.
- E. Deficiencies and Re-testing: When deficiencies are identified during testing, depending on their extent or magnitude, they may be corrected during the test and the testing continued to successful completion. Deficiencies that are more significant will require failure of the test and re-testing. Deficiencies that are not corrected will result in an action item on the Action List. The resolution of the deficiency will then subsequently be tracked by the CA via the Action List. All tests shall be repeated until successful completion.
- F. Sampling: Some types of identical equipment (such as terminal devices) will be tested using a sampling strategy. The sample percentage is indicated in the generic test procedure listed in the Commissioning Plan.
- G. Failure Limit on Sample Tests: With the sampling percentages is listed a failure limit. This limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. This is based on the concept that if many failures occur it is a result of inadequate start up by the Contractor. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.
 - 1. Where sample tests involve multiple systems, (For example: checking strainers on different hydronic systems) the maximum failure limit will apply per system.
 - 2. The responsible Contractors shall reimburse the Owner for the CA's cost of that sample test and redo the start-up/TAB for the applicable devices/systems.
 - 3. All work necessitated by sample failures shall be at no cost to the Owner.

1.16 FPT ACCEPTANCE CRITERIA

- A. Acceptance criteria for tests are indicated in the Commissioning plan and in the specification sections applicable to the systems being tested. The criteria for acceptance shall be that specified with the individual system, equipment, component, or device, unless unspecified, in which case, it shall be in accordance with the general criteria given in the Commissioning Plan.

1.17 TRAINING

- A. Adequate and thorough training of the operators and the facilities staff is vital to effective transition of operation and early acceptance of the project and its

component systems. A key goal of the Commissioning team is to ensure this is accomplished.

- B. Contractor shall submit training plan to CA for review. Training plan shall summarize training sessions with topics to be covered and approximate duration.
- C. All parties will be involved in the training process. Many of the documents created and gathered throughout the Commissioning process will be used in training. Detailed requirements for training are include in the construction specification sections. Training will be conducted both on site an in a classroom setting as suits the subject matter.
- D. The GC shall compile the training agendas of the subs and vendors and submit a comprehensive training plan to the CA, A/E and the Owner for review. Training plan shall include at a minimum:
 - 1. Topic and applicable spec section
 - 2. Scheduled date(s) for the session.
 - 3. Location and setting (classroom or field)
 - 4. Lead Instructor and instructor's qualifications
 - 5. Co instructors and their qualifications
 - 6. Session outline or agenda
 - 7. Anticipated duration
 - 8. Who should attend each session.
- E. Owner will be responsible for video taping the training sessions for later use at Owner's option.
- F. Subcontractors and Vendors will typically conduct training on the equipment or systems they install and cover proper operation, maintenance, repair, and diagnosis of the component. For instance the boiler manufacturer will conduct training on the proper operation and maintenance of the boiler. The controls contractor will conduct training on the operation and maintenance of the control system. This training will typically be accomplished towards the end of the Construction Phase.
- G. Subcontractors or Vendors shall document the training sessions. Documentation shall include the name of the instructor, an outline of the topics covered, the duration of the session, any material handed out during the training, and the names of the attendees. The instructor and the attendees will initial the document listing their name. Training shall follow handouts that list the key points in bullet form presentation style or follow detailed written documentation. Training will not be approved unless it contains accompanying written documentation.
- H. Facility and Systems Overview and Operational Intent training shall typically be conducted in a classroom setting and shall be conducted by the CA and/or A/E. The Contractor shall perform all other training.

- I. Training sessions should typically start and end in a classroom setting. Field demonstrations shall also typically be conducted to demonstrate the hands-on aspects of the required tasks.
- J. Equipment Specific Training: The appropriate Contractor or vendor shall instruct the Owners designated representative on the safe and proper operation, maintenance, diagnosis, and repair of each piece of equipment. Submitted operation and maintenance information shall be used during training. Sessions shall include as a minimum:
 - 1. Conceptual overview of how the equipment works
 - 2. Names, addresses, numbers etc. of sources for information, tools, spare parts, etc. for the equipment
 - 3. Details of the warranty or guarantee
 - 4. Intended sequences of operation in all modes of operation
 - 5. Limits of responsibility (example: unit mounted control vs. DCS control)
 - 6. Sources of utility support
 - 7. Routine operator tasks involving monitoring and operation covering all modes of operation and mode switching as applicable
 - 8. Relevant health and safety practices/concerns
 - 9. Common problems and their diagnosis and repair
 - 10. Proper maintenance schedules, tasks and procedures with demonstrations
 - 11. Emergency response documentation and recovery procedures
- K. Controls Contractor Training Involvement: Training on the proper use and operation of the control system is specified in the control sections. Controls Contractor shall also participate in the overall systems training.

PART II. PRODUCTS

2.01 INSTRUMENTATION

- A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Generally, no equipment will be required beyond that required to perform Contractors work under these Contract Documents.

PART III. EXECUTION

3.01 GENERAL

- A. Part III of this section outlines specific start up, check out, testing and training requirements for systems and equipment. These procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct. The items following provide a minimum or guideline for development of start up procedures, checklists and tests along with the general requirements indicated above (that are common to all). Contractor shall use

these requirements along with the manufacturer's and/or applicable codes and standards to develop specific and itemized start up procedures specific to the equipment and systems installed on this project. Should the following requirements conflict in any way with the manufacturer's requirements, the manufacturer's requirements shall take precedence. In this event, this shall be so noted with the submittal of the draft forms.

3.02 VALVES

- A. Confirm that valves are installed in accordance with the manufacturer's instructions. Valves with stems shall be oriented with stem above horizontal unless specifically approved otherwise.
- B. Operate all valves, manual and automatic, through their full stroke. Ensure smooth operation through full stroke and appropriate sealing or shutoff.
- C. Confirm that there is no leakage from pressure containing parts such as stem packing, bonnets and the like.
- D. Verify actuators are properly installed with adequate clearance.
- E. For automatically operated valves, verify signal input, spring range where applicable, and adjust positioners where applicable.

3.03 METERS AND GAUGES

- A. Adjust faces of meters and gages to proper angle for best visibility.
- B. Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touch-up paint. For meters and gages requiring temporary manual connection of read out device such as pressure taps on a flow-measuring device, ensure threads are clean and undamaged and that connection can be made easily.
- C. Meters and gauges shall be installed with sufficient clearance to allow removal with normal tools, without removal of any adjacent components, or insulation.
- D. Meters and gages requiring manual connection of readout device shall be installed with adequate access to allow connection of device with normal tools, without removal of adjacent components.

3.04 MECHANICAL IDENTIFICATION

- A. Verify all valve tags, piping, duct, and equipment labeling corresponds with drawings and indexes and meets requirements specified. Correct any deficiencies for all piping and duct systems.
- B. Adjusting: Relocate any mechanical identification device that has become visually blocked by work of this division or other divisions.

- C. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.05 MECHANICAL INSULATION

- A. Examine all systems and equipment specified to be insulated. Patch and repair all insulation damaged after installation. Ensure the integrity of vapor barrier around all cold surfaces.

3.06 PIPING - GENERAL

- A. This applies to all piping systems installed, including underground site utilities.
- B. Inspect all piping for proper installation, adequate support with appropriate vibration isolation where applicable, and adequate isolation valves for required service.
- C. Flush all piping and use cleaning chemicals, where specified in other sections, and clean all strainers.
- D. Ensure adequate drainage is provided at low points and venting is provided at high points. Ensure air is thoroughly removed from the system as applicable.
- E. Ensure all piping is adequately supported and anchored to allow expansion. Ensure that piping systems or components requiring pressure thrust restraint are provided with restraints suitable for both the operating and test pressure requirements. Inspect systems for excessive pipe movement during system start-up and operation, and install additional hangers, snubbers, and the like as required to restrain movement to within acceptable limits.
- F. Pressure and/or leak test all applicable systems in accordance with the requirements in the applicable specifications sections and ASME B 31.1 and 31.9 as applicable. Use corrosion inhibitors in water for hydrostatic testing where specified in other sections.
- G. Sterilize applicable piping systems as specified in the individual sections and as required by regulatory authorities.
- H. Submit test reports that document the testing results with certification of the results.
- I. Verify the operation of applicable safety relief valves, operating controls, safety controls, etc. to ensure a safe installation.
- J. Set and adjust fill, pressure, or level controls to the required setting.

3.07 AC MOTORS (600 VOLTS AND LESS)

- A. Verify proper alignment, installation, and rotation.

- B. Measure resistance phase to phase and phase to ground for motors $\frac{3}{4}$ horsepower and larger.
- C. Verify properly sized overloads are in place.
- D. Measure voltage available to all phases after motor has been placed in operation under load measure amps and RPM.
- E. Record all motor nameplate data.

3.08 NATURAL GAS SYSTEMS

- A. Test gas piping in accordance with NFPA 54, local utility requirements and Section 231123. Submit written documentation including name of personnel performing test, date and start and end time of test, remarks, corrections made, and time of successful completion.
- B. Remake leaking joints and connections using new materials.
- C. Test and adjust controls, meters, and safety devices. Replace damaged or malfunctioning items.
- D. Train owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
- E. Review data in operating and maintenance manuals.
- F. Before activating system perform these steps:
 - 1. Remove and clean strainer screens.
 - 2. Check that all gas regulators and relief valves have appropriate vent piping as specified extending to a safe location outdoors.
 - 3. Check installation and settings of controls of fuel burner units.
 - 4. Check installation of and setting of pressure regulating valves.
 - 5. Open valves slowly to fully open position.
 - 6. Purge air from piping system

3.09 STEAM AND CONDENSATE PIPING

- A. Preparation for testing: Prepare steam and condensate piping in accordance with Section 15182, ASME B31.1 or B31.9 as applicable and as follows:
 - 1. Leave joints including welds uninsulated and exposed for examination during the test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.

4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested, except under operational conditions after reassembly with blind removed.
5. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of over pressure during the test.

B. Testing: Test steam and condensate piping as follows:

1. Test pressure, duration, and approval criteria shall be in accordance with section 232213.
2. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components. Conform to chemical treatment requirements specified elsewhere as applicable.
3. Use vents installed at high points in the system to release trapped air while filling the system. Use drip legs installed at low points for complete removal of the liquid.
4. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.
5. Subject piping system to a hydrostatic test pressure that at every point in the system is not less than the pressure specified in section 15182. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. For systems with significant hydrostatic head, make a check to verify that the stress due to pressure at the lowest elevation in the system does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "se" value in appendix a of ASME B31.1.
6. After the hydrostatic test pressure has been applied for at least 10 minutes, examine the system for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate. Repeat hydrostatic test until there are no leaks.
7. Submit written documentation including name of personnel performing test, date and start and end time of test, remarks, corrections made, and time of successful completion.
8. Flush the system with clean water. Remove, clean, and replace strainer screens.

C. Start-up: start up steam and condensate piping systems as follows:

1. Operate boiler at low fire.
2. Gradually warm-up piping and connected equipment. Slowly introduce steam to piping system by throttling valves or operating main valve bypass if applicable.

3. Take precautions to prevent water hammer or slugging in piping. Open all low point drains to check for accumulated condensate.
4. Vent air and non-condensable gases from system.
5. Supervise condensate removal at system traps. Temporarily, bypass traps if required.
6. After all piping and equipment has been warmed to operating temperature, open manual valves fully.
7. Verify complete condensate removal from piping and equipment and that traps are functioning properly.
8. Replace faulty components in new piping. Notify Owner of faulty components in existing system.

3.10 PACKAGED STEAM BOILERS

- A. Follow the procedures indicated in the ASME Boiler and Pressure Vessel Code, Section VII Recommended Guidelines for the Care of Power Boilers, and the manufacturer's recommended procedures. Start-up activities shall be supervised by the boiler manufacturer's authorized representative.
- B. Flush and clean boilers upon completion of installation, in accordance with manufacturer's instructions and under the supervision of the owner's chemical treatment Contractor. Contractor shall provide chemicals for boil out as recommended by the boiler manufacturer and approved by the chemical treatment Contractor. Submit proposed boil out procedure for review by chemical treatment Contractor at least 6 weeks in advance of proposed boil out date. Submittal shall include the estimated system volume, and boiler manufacturer's recommended type and quantity of boil out chemical.
- C. Allow boiler to cool following boil out. Remove chemical from boiler and dispose of in compliance with applicable waste disposal regulations. Flush boiler with clean water. Open all water side manholes and hand holes following boil out and allow manufacturer's and Owner's representative to visually inspect clean internal surfaces. Replace manhole and handhole gaskets as necessary.
- D. Coordinate chemical treatment requirements with the owner and owner's chemical treatment Contractor during start-up and testing. Add start-up chemical dosage to boiler when the boiler is initially filled following boil out and flushing.
- E. Hydrostatically test assembled boiler and boiler external piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code, and ASME B31.1.
- F. Arrange with the owner's underwriter's inspector for inspection of boiler installation, piping connections, observation of hydrostatic testing, and for certification of completed boiler units. The owner's inspector shall write the certificate.

- G. Provide a copy of the boiler start-up checklist and the testing plan to the Owner and the Commissioning Agent for review at least 30 days prior to start-up and testing.

- H. Furnish personnel and equipment and have a manufacturer's representative present to perform the following boiler equipment installation inspection, start-up, adjustments and tests:
 - 1. Fuel metering systems
 - 2. Flame safeguard
 - 3. Limit action
 - 4. Flame failure
 - 5. Power failure
 - 6. Hot refractory hold-in
 - 7. Boiler water level controls
 - 8. Burner fuel pressures.
 - 9. Adjust fuel/air ratios at each point on cams
 - 10. Adjust O₂ trim systems.
 - 11. Adjust flue gas recirculation systems where applicable.
 - 12. Record the following data for each fuel at low fire, 25 percent, 50 percent, 75 percent, and 100 percent firing rate and submit with start-up report:
 - a) Fuel input, gallons oil or standard cubic feet gas per hour
 - b) Flue gas temperature
 - c) O₂
 - d) CO₂
 - e) NO_x
 - f) CO
 - g) Percent excess air
 - h) Combustion efficiency
 - 13. Demonstrate safeties as applicable including:
 - a) Operating and auxiliary low water cut-off switches
 - b) High steam pressure switch
 - c) Draft control safeties
 - d) High water level switches
 - e) Safety/relief valve equipment and piping
 - 1) Manually operate safety valves at or above boiler operating pressure to demonstrate that discharge piping is properly designed and installed and free from obstruction. Alternately, with boiler stop valves closed, demonstrate that boiler relief

valves operate at set pressure and close following blow down to closing pressure.

- I. Boiler package control demonstration: following burner adjustment, operate each boiler for a minimum of 72 hours with no safety shutdowns in its local panel automatic modulating mode to demonstrate that the boiler controls are properly adjusted and that the boiler can successfully follow normal system load swings.
- J. Following completion of the 24 - hour package control system demonstration, the boiler shall be performance tested at specified full load, according to ASME PTC 4.1, using the ASME test form for abbreviated efficiency test, input - output method, contained in that standard. Test period shall be four hours. Data shall be collected at 15-minute intervals and averaged over the 4-hour period. Submit completed form along with back-up data to the Owner and Commissioning Agent following the test.
- K. Provide the following items for support of functional testing if not provided for elsewhere in these specifications:
 - 1. Visual display of temperature and pressure of feedwater supply to each boiler
 - 2. Stack gas thermometers
 - 3. Visual display of pressure and flow rate of steam leaving each boiler
 - 4. Visual display of flow rate of fuel entering each boiler (Visual displays may be by calibrated digital control or gauges and meters.)
 - 5. A mechanism to vent steam to enable test of each boiler under full range of load, regardless of testing season. The mechanism shall include a steam silencer to limit sound levels to meet OSHA regulations.
- L. Boiler operation from existing PLANT CONTROL SYSTEM demonstration: None. Local boiler control only.

3.11 BOILER ACCESSORIES

- A. Flush and clean boiler accessories upon completion of installation, and in accordance with manufacturer's installation instructions.
- B. Hydrostatically test, if required, assemble boiler accessories and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.
- C. Operate all safeties and control interlocks and to ensure proper operation and adjustment.

3.12 BREECHINGS, CHIMNEYS, AND STACKS

- A. Clean breechings internally during installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

- B. Check to ensure adequate draft throughout firing range and with all variations of multiple boilers on common breeching or stack.
- C. Start-up and test draft inducing equipment in accordance with the manufacturer's recommendations.

3.13 CONTROL SYSTEMS

- A. Start-Up: This generally requires manufacturers authorized representative to start-up, test, adjust, and calibrate control systems and demonstrate compliance with requirements. This will include verification of sequences, normal and emergency operations, calibration, interfaces, interlocks, and the like.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

PART IV. GENERIC FUNCTIONAL PERFORMANCE TESTS

4.01 GENERAL

- A. Tests indicated herein are general functional testing requirements that apply to typical equipment, systems, sub-systems, etc. CA shall prepare itemized testing plans and procedures that will:
 - 1. Specify individual tests and procedures that meet the general requirements of this plan.
 - 2. Serve to document and record the testing procedures and the results of the tests.

4.02 INSTRUMENTATION

- A. Standard instrumentation used across generic systems shall be provided by the CA for spot-checking flow adjustments, controls and electrical power quality.
- B. Proprietary instrumentation required to verify performance of specialty equipment shall be provided by Contractor and made available to Commissioning Agent. No testing equipment will be required beyond that required to perform Contractors work under these Contract Documents.
- C. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6 month period. Certificates of calibration shall be submitted.

4.03 COORDINATION BETWEEN TESTING PARTIES

- A. Factory Start Ups: For many systems and equipment, factory start-ups are specified. These are Start Up related activities that will be reviewed and checked during functional performance testing. All costs associated with the factory start-ups are included with the bid unless otherwise noted. Contractor shall make

notification of when these factory start-ups are occurring and coordinate these with witnessing parties. CxT members may witness many of these start ups at their discretion. Aspects of functional performance testing accomplished during the factory start up may be accomplished and approved by the CxT if they judge they meet the intent of the FPT.

- B. Independent Testing Agencies: For systems where independent testing agencies are specified, the cost of this testing is included with the bid unless otherwise noted. Much of the testing performed by these independent agencies will cover aspects required in the start-ups and functional performance tests. Contractor and testing agencies shall coordinate with the CxT so that they can witness the testing and approve the applicable aspects of the FPTs. CxT may in some cases independently spot check work of the testing agencies if the tests were not witnessed. However, it is not the intent for the CxT to repeat testing that is specified in the construction specifications. For instance much of the testing requirements for the electrical systems will be performed by the independent electrical testing agency provided with under the bid. CxT will witness the indicated sample of the testing and record the results in the record of functional performance testing.

4.04 PREREQUISITES

- A. All equipment, components and devices applicable to the test must be started and this start up must be documented. This includes completion of the checklists, pressure testing of equipment, duct, pipe, etc., flushing/cleaning of applicable systems, completed labeling and identification, completed insulation of applicable systems, and the like.
- B. Unless specifically agreed to by Owner and CA, all support systems shall be complete prior to FPT. A boiler for instance will require that:
 - 1. The electrical system serving it is completed and tested.
 - 2. Start-up and initial adjustments have been accomplished for all fuels.
 - 3. The control system points associated with the boiler have been started and calibrated.
- C. The CA shall determine the optimal sequence of testing.

4.05 COMMON ELEMENTS FOR ALL SYSTEMS

- A. Have the required submitted documentation convenient to testing area. Validate that all required documentation has been submitted and is per the contract requirements (very cursory review).
- B. Contractor shall provide the start up documentation at the time of testing. Review the start up tests and checklist documentation. The checklists and start up tests/measurements shall be spot checked at the beginning of FPT.
- C. Contractor shall demonstrate that access is sufficient to perform required maintenance.

- D. Trends on control systems shall have been established as required in the documents. These shall be reviewed prior to or during FPT.
- E. All dynamic systems powered by electricity shall be tested to simulate a power outage to ensure proper sequencing. Those on emergency power or uninterruptible power shall be tested on all sources.
- F. Capacities and adjusted conditions as applicable will be checked.
- G. Sequencing Verification: All modes of operation and actions shall be verified for equipment/system samples.
- H. Configurations shall be compared against the contract documents.
- I. All controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation.
- J. Dynamic Graphics: The graphic for all components, systems, and areas sampled and required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints are required to be adjustable, verify that they can be adjusted directly from the graphic screen.

4.06 NATURAL GAS SYSTEMS

- A. Participants shall allow 1 hour.
- B. Review and spot check the submitted start-up documentation:
- C. Review operation of pressure controls
- D. Review operation of metering equipment

4.07 STEAM AND CONDENSATE PIPING

- A. Participants shall allow 2 hours.
- B. Review and spot check the submitted start-up documentation:
- C. Review operation of pressure controls
- D. Review operation of metering equipment

4.08 PACKAGED STEAM BOILERS

- A. Participants shall allow 8 hours per item.
- B. Review and spot check the submitted start-up documentation:

- C. CA will either attend the latter part of the start-up or will require a demonstration by the manufacturer's representative of a sampling of the following:
1. Fuel metering systems
 2. Flame safeguard
 3. Limit action
 4. Flame failure
 5. Power failure
 6. Hot refractory hold-in
 7. Boiler water level controls
 8. O₂ trim systems.
 9. Adjust flue gas recirculation systems where applicable.
 10. Operate each boiler on each fuel at low fire, 25 percent, 50 percent, 75 percent, and 100 percent firing rate and record the following:
 - a) Fuel input, gallons oil or standard cubic feet gas per hour
 - b) Flue gas temperature
 - c) O₂
 - d) CO₂
 - e) NO_x
 - f) CO
 - g) Percent excess air
 - h) Combustion efficiency
 11. Demonstrate safeties as applicable including:
 - a) Operating and auxiliary low water cut-off switches
 - b) Manual and auto reset high steam pressure switches
 - c) Draft control safeties
 - d) High water level switches
 - e) Flame failure safeties
 - f) Atomizing air and fuel pressure safeties
 - g) Safety/relief valve equipment and piping
 - 1) Manually operate safety valves at or above boiler operating pressure to demonstrate that discharge piping is properly designed and installed and free from obstruction. Alternately, with boiler stop valves closed, demonstrate that boiler relief valves operate at set pressure and close following blow down to closing pressure.
- D. CA will attend ASME Performance Testing for each boiler.

- E. Provide the following items for support of functional testing if not provided for elsewhere in these specifications:
 - 1. Visual display of temperature and pressure of feedwater supply to each boiler
 - 2. Stack gas thermometers
 - 3. Visual display of pressure and flow rate of steam leaving each boiler
 - 4. Visual display of flow rate of fuel entering each boiler (Visual displays may be by calibrated digital control or gauges and meters.)
 - 5. A mechanism to vent steam to enable test of each boiler under full range of load, regardless of testing season. The mechanism shall include a steam silencer to limit sound levels to meet OSHA regulations.

4.09 BOILER ACCESSORIES

- A. Participants shall allow 2 hours.
- B. Review and spot check the submitted start-up documentation.
- C. Review operation of surface blowdown controls

4.10 BREECHINGS, CHIMNEYS, AND STACKS

- A. Participants shall allow 1 hour.
- B. Review installation and operation of draft controls

4.11 AUTOMATIC CONTROLS

- A. Participants shall include the commissioning team, mechanical and controls contractors.
- B. Controls system sampling will typically correspond to the sampling rate of a system or piece of equipment. These sampling rates are indicated above for the respective item.
- C. Contractor shall operate the equipment and subsystems through all specified modes of control and sequences of operation including full and part load conditions, and emergency conditions.
- D. Verify that equipment operates in accordance with design intent and approved control diagrams. This shall include checking the operation of dampers, valves, high and low limit controls.
- E. Analog Input Sensors: (Sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) Spot check analog input sensors for acceptable accuracy (which is as specified for the device).

- F. Valves, Dampers and Actuators: (Sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) Ensure that valves and dampers close off or seal against the maximum pressure differential. Ensure that the actuators stroke throughout the correct range and that the positioners are set correctly where applicable.
- G. Establish trends of control system points for a minimum of a two-week period prior to and throughout the Acceptance period. Trends shall be analyzed to identify any control problems, lack of capacity, control loops fighting or unstable, etc.
- H. Spot (at a sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) check the operation of all automatic switches (pressure switches, current switches, flow switches, etc.) to ensure that they are adjusted to proper make and break settings.
- I. Verify the stand-alone functionality of the controllers. Disconnect LAN communication wiring and ensure that the controller functions properly and that the loss of communication is acknowledged by the interface. Restore communications and ensure an orderly restoration to normal control.
- J. Verify that the DCS interface, DCS software, graphics and functions are in accordance with design intent and approved control diagrams.
- K. Check dial in, dial out, local network and internet communications where applicable to ensure functionality.

END OF SECTION 235239.12

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Data: Provide cutsheets for wire connectors.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with **ASTM B8** for stranded conductors.
- D. Conductor Insulation:
 - 1. Type NM: Comply with UL 83 and UL 719.
 - 2. Type RHH and Type RHW-2: Comply with UL 44.
 - 3. Type USE-2 and Type SE: Comply with UL 854.
 - 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 5. Type THHN and Type THWN-2: Comply with UL 83.
 - 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 7. Type UF: Comply with UL 83 and UL 493.
 - 8. Type XHHW-2: Comply with UL 44.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Comply with UL 1569.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Ground Conductor: Bare.
- E. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- F. Armor: Steel or Aluminum, interlocked.
- G. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One or Two hole with standard or long barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
 - 1. Equipment grounding.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- D. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- E. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Single-phase motor and appliance branch circuits.
 - 3. Three-phase motor and appliance branch circuits.
 - 4. Flexible raceway runs.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 3. Channel Width: Selected for applicable load criteria.
 - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Channel Material: 6063-T5 aluminum alloy.
 - 3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
5. Toggle Bolts: Stainless-steel springhead type.
6. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 1. NECA 1.
 2. NECA 101
 3. NECA 102.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69 or Spring-tension clamps.
 - 7. To Light Steel: Sheet metal screws.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. EMT: Electric metallic tubing.
- B. LFMC: Liquid-tight flexible metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For EMT, fittings, and LFMC.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. EMT: Comply with ANSI C80.3 and UL 797.
 - 3. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
 - 1. Comply with NEMA FB 1 and UL 514B.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.

4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Set screw or compression.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- D. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep or 4 inches by 2-1/8 inches by 2-1/8 inches deep.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
- B. Minimum Raceway Size: 3/4-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. EMT: Use set screw or compression, steel cast-metal fittings. Comply with NEMA FB 2.10.
 2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface raceways only as indicated on Drawings.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- C. Do not fasten conduits onto the bottom side of a metal deck roof.
- D. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- E. Complete raceway installation before starting conductor installation.
- F. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- H. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- I. Support conduit within 12 inches of enclosures to which attached.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

- P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- S. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of above ground EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to **top** of box unless otherwise indicated.
- U. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- V. Locate boxes so that cover or plate will not span different building finishes.
- W. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less:

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
5. Color for Neutral: White or gray.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 2. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 3. .
- D. Self-Adhesive Labels:
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.

2.6 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- H. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

- I. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "POWER."
- J. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- K. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
- L. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- M. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
- N. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on minimum 1-1/2-inch- high sign; where two lines of text are required, use signs minimum 2 inches high.
- O. Metal-Backed Butyrate Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.
- P. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.
- Q. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- high, black letters on 20-inch centers.
 - 1. Locate identification at changes in direction at 10-foot maximum intervals.
- B. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- C. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs or Metal-backed, butyrate warning signs.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- D. Equipment Identification Labels:
 - 1. Indoor Equipment: Baked-enamel signs or Metal-backed butyrate signs.
 - 2. Equipment to Be Labeled:
 - a. Enclosures and electrical cabinets.
 - b. Access doors and panels for concealed electrical items.
 - c. Enclosed switches.
 - d. Enclosed circuit breakers.

END OF SECTION 260553

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Molded-case circuit breakers (MCCBs).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

1.6 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be as indicated on the drawings.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. If series rated breakers are not allowed, delete the references to series rated in the following paragraph.
- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated as indicated on the Drawings.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 60 deg C rated wire on 125-A circuit breakers and below.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits.

1.7 MOLDED-CASE SWITCHES

- A. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- B. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- C. Features and Accessories:
 - 1. Compatible with existing Motor Controls center as indicated on the drawings.
 - 2. Lugs:

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Examine circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

2.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

2.3 INSTALLATION

- A. Coordinate layout and installation circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

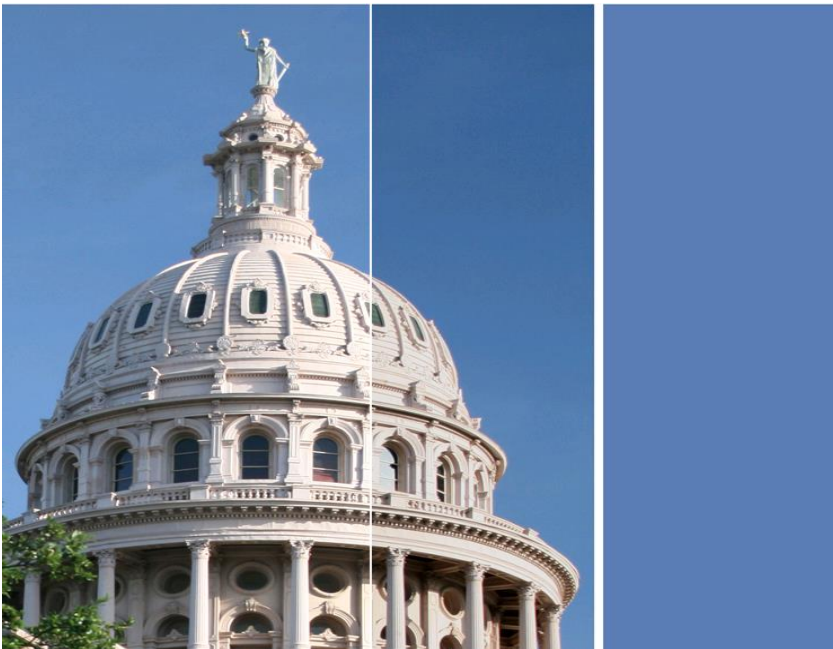
2.4 FIELD QUALITY CONTROL

- A. Tests and Inspections for Molded Case Circuit Breakers:
 - 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.

- a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.

END OF SECTION 262816

APPENDIX A:
UNIFORM GENERAL CONDITIONS AND
SUPPLEMENTARY GENERAL CONDITIONS FOR
CONSTRUCTION CONTRACTS



2010 Uniform General Conditions

Rev. 9/27/17

Uniform General Conditions and Supplementary General Conditions for Construction Contracts

Bold provisions are Supplementary General Conditions (SGC's)

Rev. 9/27/17

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Article 1. Definitions

Unless the context clearly requires another meaning, the following terms have the meaning assigned herein.

- 1.1 ***Alternates* means all project scopes identified by Texas Tech to be separated (materials and labor costs) from base services in an attempt to evaluate costs relative to project scope.**
- 1.2 *Application for Payment* means Contractor's monthly partial invoice for payment that includes any portion of the Work that has been completed for which an invoice has not been submitted and performed in accordance with the requirements of the Contract Documents. The Application for Payment accurately reflects the progress of the Work, is itemized based on the Schedule of Values, bears the notarized signature of Contractor, and shall not include subcontracted items for which Contractor does not intend to pay.
- 1.3 *Application for Final Payment* means Contractor's final invoice for payment that includes any portion of the Work that has been completed for which an invoice has not been submitted, amounts owing to adjustments to the final Contract Sum resulting from approved change orders, and release of remaining Contractor's retainage.
- 1.4 *Architect/Engineer (A/E)* means a person registered as an architect pursuant to Tex. Occ. Code Ann., Chapter 1051, as a landscape architect pursuant to Tex. Occ. Code Ann., Chapter 1052, a person licensed as a professional engineer pursuant Tex. Occ. Code Ann., Chapter 1001, and/or a firm employed by Owner or Design-Build Contractor to provide professional architectural **and/or** engineering services and to exercise overall responsibility for the design of a Project or a significant portion thereof, and to perform the contract administration responsibilities set forth in the Contract.
- 1.5 *Baseline Schedule* means the initial time schedule prepared by Contractor for Owner's information and acceptance that conveys Contractor's and Subcontractors' activities (including coordination and review activities required in the Contract Documents to be performed by A/E and ODR), durations, and sequence of work related to the entire Project to the extent required by the Contract Documents. The schedule clearly demonstrates the critical path of activities, durations and necessary predecessor conditions that drive the end date of the schedule. The Baseline Schedule shall not exceed the time limit current under the Contract Documents.
- 1.6 *Certificate of Final Completion* means the certificate issued by A/E that documents, to the best of A/E's knowledge and understanding, Contractor's completion of all Contractor's Punchlist items and pre-final Punchlist items, final cleanup and Contractor's provision of Record Documents, operations and maintenance manuals, and all other closeout documents required by the Contract Documents.
- 1.7 ***Change Directive (CD)* means a Change Proposal (CP) which has been marked "Accepted" by the ODR and, upon receipt of the CD by the Contractor,**

constitutes notice to proceed with the changed work described therein.

- 1.8 *Change Order* means a written modification of the Contract between Owner and Contractor, signed by Owner, Contractor and A/E.
- 1.9 *Change Proposal (CP)* means a Contractor generated document in response to a Change Request (CR) which states the adjustment necessary to the Contract Sum and Time, if any, in response to the changed work described in the Change Request (CR).
- 1.10 *Change Request (CR)* means a document which describes a change in the Work, including a description and Drawings and Specifications, as necessary, to inform the Contractor, Owner, and Design Professional of the nature of the change.
- 1.11 *Close-out Documents* mean the product brochures, submittals, product/equipment maintenance and operations instructions, manuals, and other documents/warranties, record documents, affidavit of payment, release of lien and claim, and as may be further defined, identified, and required by the Contract Documents.
- 1.12 *Contract* means the entire agreement between Owner and Contractor, including all of the Contract Documents.
- 1.13 *Contract Date* is the date when the agreement between Owner and Contractor becomes effective.
- 1.14 *Contract Documents* mean those documents identified as a component of the agreement (Contract) between Owner and Contractor. These may include, but are not limited to, Drawings; Specifications; General, Supplementary General, and Special Conditions; and all pre-bid and/or pre-proposal addenda.
- 1.15 *Contract Sum* means the total compensation payable to Contractor for completion of the Work in accordance with the terms of the Contract.
- 1.16 *Contract Time* means the period between the start date identified in the Notice to Proceed with construction and the Substantial Completion date identified in the Notice to Proceed or as subsequently amended by a Change Order.
- 1.17 *Contractor* means the individual, corporation, limited liability company, partnership, firm, or other entity contracted to perform the Work, regardless of the type of construction contract used, so that the term as used herein includes a Construction Manager-at-Risk or a Design-Build firm as well as a general or prime Contractor. **To the extent contracts other than construction contracts incorporate these Uniform General Conditions and Supplementary General Conditions, and to the extent appropriate under the terms of the particular type of contract in question, the term Contractor means the party Texas Tech is contracting with (for example, a Design Professional, Testing and Balancing Agent, Commissioning Agent).** The Contract Documents refer to Contractor as if singular in number.

SECTION 00400
UNIFORM GENERAL CONDITIONS/
SUPPLEMENTARY GENERAL CONDITIONS

- 1.18 *Construction Documents* mean the Drawings, Specifications, and other documents issued to build the Project. Construction Documents become part of the Contract Documents when listed in the Contract or any Change Order.
- 1.19 *Construction Manager-at-Risk*, in accordance with Tex. Gov't Code, Chapter 2166, means a sole proprietorship, partnership, corporation, or other legal entity that assumes the risk for construction, rehabilitation, alteration, or repair of a facility at the contracted price as a general contractor and provides consultation to Owner regarding construction during and after the design of the facility.
- 1.20 ***Critical Path Schedule means the Baseline Schedule. Reference I.5.***
- 1.21 *Date of Commencement* means the date designated in the Notice to Proceed for Contractor to commence the Work.
- 1.22 *Day* means a calendar day unless otherwise specifically stipulated.
- 1.23 *Design-Build* means a project delivery method in which the detailed design and subsequent construction is provided through a single contract with a Design-Build firm; a team, partnership, or legal entity that includes design professionals and a builder. The Design-Build Project delivery shall be implemented in accordance with Tex. Gov't Code § 2166.2531.
- 1.24 ***Design Professional (DP) means the Architect/Engineer (A/E), reference 1.4.***
- 1.25 *Drawings* mean that product of A/E which graphically depicts the Work, **or the work product of the A/E which depicts the location and quantity of elements of the Work.**
- 1.26 *Final Completion* means the date determined and certified by A/E and Owner on which the Work is fully and satisfactorily complete in accordance with the Contract. **The Contractor shall obtain Final Completion by correcting or fixing all deficiencies listed on the pre-final Punch-list within a fixed amount of time as stated in 12.1.2.**
- 1.27 *Final Payment* means the last and final monetary compensation made to Contractor for any portion of the Work that has been completed and accepted for which payment has not been made, amounts owing to adjustments to the final Contract Sum resulting from approved change orders, and release of Contractor's retainage.
- 1.28 *Historically Underutilized Business (HUB)* pursuant to Tex. Gov't Code, Chapter 2161, means a business that is at least 51% owned by an Asian Pacific American, a Black American, a Hispanic American, a Native American and/or an American Woman; is an entity with its principal place of business in Texas; and has an owner residing in Texas with proportionate interest that actively participates in the control, operations, and management of the entity's affairs.

SECTION 00400
UNIFORM GENERAL CONDITIONS/
SUPPLEMENTARY GENERAL CONDITIONS

- 1.29 ***Interior Designers and Certified Asbestos Abatement Technicians*** means an Interior Designer that meets the requirements of TX Occ. Code Chapter 1053 (as amended or modified), and a Certified Asbestos Abatement Technician that is certified in the State of Texas as an asbestos abatement services manager or industrial hygienist.
- 1.30 *Notice to Proceed* means written document informing Contractor of the dates beginning Work and the dates anticipated for Substantial Completion.
- 1.31 *Open Item List* means a list of work activities, Punchlist items, changes or other issues that are not expected by Owner and Contractor to be complete prior to Substantial Completion.
- 1.32 *Owner* means the State of Texas, and any agency of the State of Texas, acting through the responsible entity of the State of Texas identified in the Contract as Owner. **The term “Owner” or “Texas Tech” herein refers to the Board of Regents of the Texas Tech University System.**
- 1.33 ***Owner’s Contingency*** means an amount that is included in the Base Proposal for authorizing additional work in connection with the Project. **The use of the allowance requires the written approval of the ODR authorizing that the cost of a Change Directive be charged to the allowance. Unless otherwise provided in the Agreement, the Owner will not pay a mark-up for profit and overhead on any Change paid out of the contingency allowance. Any unused amount from the Owner’s Contingency will be returned to the Owner.**
- 1.34 *Owner’s Designated Representative (ODR)* means the individual assigned by Owner to act on its behalf and to undertake certain activities as specifically outlined in the Contract. ODR is the only party authorized to direct changes to the scope, cost, or time of the Contract. **The Owner’s Representative and/or the Project Manager, as defined herein, may serve as ODR.**
- 1.35 ***Owner’s Representative (OR)*** means a sole proprietorship, partnership, corporation or other legal entity that acts as a fiduciary and provides consultation to Texas Tech regarding construction, rehabilitation, alteration or repair of a facility. **The term “Owner’s Representative” is synonymous with “Construction Manager-Agent,” as defined in section 51.781 Tex Educ. Code (as amended or modified).**
- 1.36 ***Pre-Final Inspection*** means an inspection conducted to determine that the Project, or a portion thereof, is Substantially Complete and to identify deficiencies or incomplete work.
- 1.37 *Project* means all activities necessary for realization of the Work. This includes design, contract award(s), execution of the Work itself, and fulfillment of all Contract and warranty obligations.
- 1.38 ***Project Manager*** means the individual who acts as the Owner’s point of contact for

all matters involving contract administration, including without limitation Contract Document interpretation, defining the scope of the work, approving work schedules, and approving Contract payments.

- 1.39 *Progress Assessment Report (PAR)* means the monthly compliance report to Owner verifying compliance with the HUB subcontracting plan (HSP).
- 1.40 *Project Schedule* means the **Baseline Schedule. Reference 1.5.**
- 1.41 ~~*Proposed Change Order (PCO)* means a document that informs Contractor of a proposed change in the Work and appropriately describes or otherwise documents such change including Contractor's response of pricing for the proposed change.~~
- 1.42 *Punchlist* means a list of items of Work to be completed or corrected by Contractor after Substantial Completion. Punchlists indicate items to be finished, remaining Work to be performed, or Work that does not meet quality or quantity requirements as required in the Contract Documents.
- 1.43 *Record Documents* mean the drawing set, Specifications, and other materials maintained by Contractor that documents all addenda, Architect's Supplemental Instructions, Change Orders and postings and markings that record the as-constructed conditions of the Work and all changes made during construction.
- 1.44 *Request for Information (RFI)* means a written request by Contractor directed to A/E or ODR for a clarification of the information provided in the Contract Documents or for direction concerning information necessary to perform the Work that may be omitted from the Contract Documents.
- 1.45 *Samples* mean representative physical examples of materials, equipment, or workmanship used to confirm compliance with requirements and/or to establish standards for use in execution of the Work.
- 1.46 *Schedule of Values* means the detailed breakdown of the cost of the materials, labor, and equipment necessary to accomplish the Work as described in the Contract Documents, submitted by Contractor for approval by Owner and A/E.
- 1.47 *Shop Drawings* mean the drawings, diagrams, illustrations, schedules, performance charts, brochures, and other data prepared by Contractor or its agents which detail a portion of the Work.
- 1.48 *Site* means the geographical area of the location of the Work.
- 1.49 *Special Conditions* mean the documents containing terms and conditions which may be unique to the Project. Special Conditions are a part of the Contract Documents and have precedence over the Uniform General Conditions and Supplementary General Conditions.
- 1.50 *Specifications* mean the written product of A/E that establishes the quality and/or

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performance of products utilized in the Work and processes to be used, including testing and verification for producing the Work.

- 1.51 **State means Texas. Reference 1.32.**
- 1.52 *Subcontractor* means a business entity that enters into an agreement with Contractor to perform part of the Work or to provide services, materials, or equipment for use in the Work.
- 1.53 *Submittal Register* means a list provided by Contractor of all items to be furnished for review and approval by A/E and Owner and as identified in the Contract Documents including anticipated sequence and submittal dates.
- 1.54 *Submittal Schedule means a schedule that correlates with the Critical Path Schedule that shows the dates the Contractor intends to submit the required submittals to the Design Professional or ODR. This schedule should be part of the Critical Path Schedule so that submittals that affect the critical path are clearly identified.*
- 1.55 *Substantial Completion* means the date determined and certified by Contractor, A/E, and Owner when the Work, or a designated portion thereof, is sufficiently complete, in accordance with the Contract, so as to be operational and fit for the use intended.
- 1.56 *Supplementary General Conditions* mean procedures and requirements that modify the Uniform General Conditions. Supplementary General Conditions, when used, have precedence over the Uniform General Conditions. **Texas Tech's Supplementary General Conditions are in bold font.**
- 1.57 **Texas Tech means owner. Reference 1.32.**
- 1.58 *Unit Price Work* means the Work, or a portion of the Work, paid for based on incremental units of measurement.
- 1.59 *Unilateral Change Order (ULCO)* means a Change Order issued by Owner without the complete agreement of Contractor, as to cost and/or time.
- 1.60 *Work* means the administration, procurement, materials, equipment, construction and all services necessary for Contractor, and/or its agents, to fulfill Contractor's obligations under the Contract.

- 1.61 *Work Progress Schedule* means the continually updated time schedule **based on Critical Path Schedule**, prepared and monitored by Contractor that accurately indicates all necessary appropriate revisions as required by the conditions of the Work and the Project while maintaining a concise comparison to the Baseline Schedule.

Article 2. Wage Rates and Other Laws Governing Construction

- 2.1 Environmental Regulations. Contractor shall conduct activities in compliance with applicable laws and regulations and other requirements of the Contract relating to the environment and its protection at all times. Unless otherwise specifically determined, Owner is responsible for obtaining and maintaining permits related to stormwater run-off. Contractor shall conduct operations consistent with stormwater run-off permit conditions. Contractor is responsible for all items it brings to the Site, including hazardous materials, and all such items brought to the Site by its Subcontractors and suppliers, or by other entities subject to direction of Contractor. Contractor shall not incorporate hazardous materials into the Work without prior approval of Owner, and shall provide an affidavit attesting to such in association with request for Substantial Completion inspection.
- 2.2 Wage Rates. Contractor shall not pay less than the wage scale of the various classes of labor as shown on the prevailing wage schedule provided by Owner in the bid or proposal specifications. The specified wage rates are minimum rates only. Owner is not bound to pay any claims for additional compensation made by any Contractor because the Contractor pays wages in excess of the applicable minimum rate contained in the Contract. The prevailing wage schedule is not a representation that qualified labor adequate to perform the Work is available locally at the prevailing wage rates **or in accordance with Government Code §2258.022 for projects located in counties bordering United Mexican States or in a county adjacent to a county bordering the United Mexican States. The Contractor is responsible for compliance with the prevailing wage law.**
- 2.2.1 Notification to Workers. Contractor shall post the prevailing wage schedule in a place conspicuous to all workers on the Project Site and shall notify each worker, in writing, of the following as they commence work on the Contract: the worker's job classification, the established minimum wage rate requirement for that classification, as well as the worker's actual wage. The notice must be delivered to and signed in acknowledgement of receipt by the worker and must list both the wages and fringe benefits to be paid or furnished for each classification in which the worker is assigned duties. When requested by Owner, Contractor shall furnish evidence of compliance with the Texas Prevailing Wage Law and the addresses of all workers.
- 2.2.1.1 Contractor shall submit a copy of each worker's wage-rate notification to ODR with the application for progress payment for the period during which the worker was engaged in activities on behalf of the Project.
- 2.2.1.2 The prevailing wage schedule is determined by Owner in compliance with

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Tex. Gov't Code, Chapter 2258. Should Contractor at any time become aware that a particular skill or trade not reflected on Owner's prevailing wage schedule will be or is being employed in the Work, whether by Contractor or by Subcontractor, Contractor shall promptly inform ODR of the proposed wage to be paid for the skill along with a justification for same and ODR shall promptly concur with or reject the proposed wage and classification. Contractor is responsible for determining the most appropriate wage for a particular skill in relation to similar skills or trades identified on the prevailing wage schedule. In no case, shall any worker be paid less than the wage indicated for laborers.

2.2.2 Penalty for Violation. Contractor, and any Subcontractor, will pay to the State a penalty of sixty dollars (\$60) for each worker employed for each day, or portion thereof, that the worker is paid less than the wage rates stipulated in the prevailing wage schedule.

2.2.3 Complaints of Violations.

2.2.3.1 Owner's Determination of Good Cause. Upon receipt of information concerning a violation, Owner will conduct an investigation in accordance with Tex. Gov't Code, Chapter 2258 and make an initial determination as to whether good cause exists that a violation occurred. Upon making a good cause finding, Owner will retain the full amounts claimed by the claimant or claimants as the difference between wages paid and wages due under the prevailing wage schedule and any supplements thereto, together with the applicable penalties, such amounts being subtracted from successive progress payments pending a final decision on the violation.

2.2.3.2 No Extension of Time. If Owner's determination proves valid that good cause existed to believe a violation had occurred, Contractor is not entitled to an extension of time for any delay arising directly or indirectly from the arbitration procedures.

2.2.3.3 Arbitration Required if Violation not Resolved. After Texas Tech makes its initial determination, the affected Contractor or Subcontractor and worker have 14 days in which to resolve the issue of whether a violation occurred, including the amount that should be retained by Texas Tech or paid to the affected worker. If the Contractor or Subcontractor and affected worker reach an agreement concerning the worker's claim, the Contractor shall promptly notify Texas Tech in a written document signed by the worker. If the Contractor or Subcontractor and affected worker do not agree before the 15th day after Texas Tech's determination, the Contractor or Subcontractor and affected worker must participate in binding arbitration in accordance with the Texas General Arbitration Act, Chapter 171, Tex. Civ. Prac. & Rev. Code. The parties to the arbitration have 10 days after the expiration of the 15 days referred to

above, to agree on an arbitrator; if by the 11th day there is no agreement to an arbitrator, a district court shall appoint an arbitrator on the petition of any of the parties to the arbitration.

2.2.3.4 Arbitration Award. If an arbitrator determines that a violation has occurred, the arbitrator shall assess and award against the Contractor or Subcontractor the amount of penalty as provided in paragraph 2.2.2 thereof and the amount owed the worker. Texas Tech may use any amounts retained under paragraph 2.2.3.1 to pay the worker the amount as designated in the arbitration award. If Texas Tech has not retained enough from the Contractor or Subcontractor to pay the worker in accordance with the arbitration award, the worker has a right of action against the Contractor and Subcontractor as appropriate, and the surety of either to receive the amount owed, attorney's fees and costs and court costs. The Contractor shall promptly furnish a copy of the arbitration award to Texas Tech.

2.2.3.5 Prevailing Wage Retainage. Money retained pursuant to paragraph 2.2 shall be used to pay the claimant or claimants the difference between the amount the worker received in wages for labor on the Project at the rate paid by the Contractor or Subcontractor and the amount the worker would have received at the general prevailing wage rate as provided by the agreement of the claimant and the Contractor or Subcontractor affected, or in the arbitrator's award.. Any retained funds in excess of these amounts shall be paid to the Contractor on the earlier of the next progress payment or final payment. Provided, however, that Texas Tech shall have no duty to release any funds to either the claimant or the Contractor until it has received the notices of agreement or the arbitration award as provided under paragraphs 2.2.3.3 and 2.2.3.4.

2.3 Choice of Law; Venue for Suits. The Contract Documents shall be governed by and construed in accordance with Texas law and without regard to its conflict of laws principles. Provided the dispute resolution requirements of Article 15 of the Uniform General Conditions are met, venue and jurisdiction over any suit brought for breach of contract for this Project shall be in any court of competent jurisdiction in Lubbock, Lubbock County, Texas.

2.4 Licensing of Trades. Contractor shall comply with all applicable provisions of State law related to license requirements for skilled tradesmen, contractors, suppliers and or laborers, as necessary to accomplish the Work. In the event Contractor, or one of its Subcontractors, loses its license during the term of performance of the Contract, Contractor shall promptly hire or contract with a licensed provider of the service at no additional cost to Owner.

2.5 Royalties, Patents, and Copyrights. Contractor shall pay all royalties and license fees, defend suits or claims for infringement of copyrights and patent rights, and shall hold Owner harmless from loss on account thereof, but shall not be responsible for such

defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by Owner or A/E. However, if Contractor has reason to believe that the required design, process, or product is an infringement of a copyright or a patent, Contractor shall be responsible for such loss unless such information is promptly furnished to A/E.

Contractor shall defend all suits or claims for infringement of any patent or copyright and shall save Texas Tech harmless from loss or liability, direct or indirect, arising with respect to the Contractor's process in the formulation of its bid or proposal or performance of the Work or otherwise arising in connection therewith. Texas Tech reserves the right to provide its own defense to any suit or claim of infringement of any patent or copyright, in which event the Contractor shall indemnify and save harmless Texas Tech from all costs and expenses, including reasonable attorney's fees, costs and judgments, arising from such defense.

2.6 State Sales and Use Taxes. Owner qualifies for exemption from certain State and local sales and use taxes pursuant to the provisions of Tex. Tax Code, Chapter 151. Upon request from Contractor, Owner shall furnish evidence of tax exempt status. Contractor may claim exemption from payment of certain applicable State taxes by complying with such procedures as prescribed by the State Comptroller of Public Accounts. Owner acknowledges not all items qualify for exemption. Owner is not obligated to reimburse Contractor for taxes paid on items that qualify for tax exemption.

2.7 Compliance with Laws. **In the execution of the Contract Documents and the Work, the Contractor shall comply with all applicable State and Federal laws, including but not limited to, laws governing labor, equal employment opportunity, safety, environmental protection, energy and water conservation and consumption, and prevailing wage rates. The Contractor shall make itself familiar with and at all times shall observe and comply with all Federal, State and Local laws, ordinances and regulations which in any manner affect the conduct of the Work. The Contractor shall indemnify and save harmless the State and its official representatives against any claim arising from violation of any such law, ordinance or regulation by itself, its subcontractors and its employees. Except where expressly required otherwise by applicable laws and regulations, neither Texas Tech nor the Design Professional shall be responsible for monitoring Contractor's compliance with any laws or regulations.**

2.7.1 **The Contractor shall cooperate with city or other governmental officials at all times where their jurisdiction applies. The Contractor shall make application, pay all fees and provide supporting documentation necessary to secure permits, which are required for the performance of the Contract Documents and the Work. Contractor has a continuing obligation throughout the term of the Contract to conduct its operations under duly issued permits and, in the event Contractor loses or has revoked a necessary permit, Contractor must take immediate steps to apply for and receive another permit.**

- 2.8 **Antitrust Claims.** The Contractor hereby assigns to Texas Tech any and all claims for overcharges associated with this Contract which arise under the antitrust laws of the United States, 15 U.S.C.A. Sec. 1 et seq.
- 2.9 **Antiquities.** Contractor shall take precaution to avoid disturbing primitive records and antiquities of archaeological, paleontological, educational, scientific, or historical significance. No objects of this nature shall be disturbed without written permission of Texas Tech and the Texas Historical Commission. When such objects are discovered, the Contractor shall stop all Work in close proximity and notify the ODR and the Texas Historical Commission of their presence and shall not disturb them until written permission and permit to do so is granted. All primitive records and antiquities, as described in Chapter 191, Texas Natural Resources Code, discovered on Texas Tech's property shall remain property of the State of Texas, the Texas Historical Commission. If it is determined by Texas Tech, in consultation with the Texas Historical Commission that exploration or excavation of primitive records or antiquities on Project Site is necessary to avoid loss, Contractor shall cooperate in salvage work attendant to preservation. If the Work stoppage or salvage work causes an increase in the Contractor's cost of, or time required for, performance of the Work, Contractor may file with the ODR a Notice of Claim as described in §11.3.
- 2.10 **State Property and Building Permits and Laws.** Construction projects performed on state property are exempt from City Permit Fees, etc., as they are owned by the State of Texas. The Contractor, performing work on leased facilities for Texas Tech shall comply with all Federal, State and Municipal Laws, Codes and Ordinances. The Contractor shall obtain and pay for all permits required in connection with the execution of all Work. The Design Professional shall be furnished with certified copies of these permits if the Design Professional so requests. If the above Laws, Codes or Ordinances conflict with the Contract Documents, then the A/E will determine and design to the more stringent between the two.
- 2.11 **Storm Water Pollution Prevention Program.** The Texas Tech Storm Water Pollution Prevention Program requires preparation of a Storm Water Pollution Prevention Plan (SW3P) for projects that causes a disturbance of soil on any campus of the Texas Tech University System. The plan will incorporate measures in response to and ensure compliance with the terms of the Texas Pollution Discharge Elimination System (TPDES) General Permit for Storm Discharges from Construction Activities. Texas Tech recognizes the construction Contractor as the permit Operator having day-to-day operational control of those activities at the project site which are necessary to ensure compliance with a SW3P. Texas Tech will provide the Contractor with a complete and comprehensive SW3P.
- 2.11.1 The Contractor shall implement, maintain, and keep current the SW3P. The Contractor shall comply with the Texas Commission for Environmental Quality (TCEQ) General Permit and submit to TCEQ 48 hours prior to commencement of soil disturbing work a TCEQ Notice of Intent (NOI) to

obtain permit coverage. Display the NOI and the Construction Site Notice with appropriate information at the prime site entrance to the construction site and provide a copy of the NOI to the appropriate Municipal Separate Storm Sewer System (MS4) operator. Replace the NOI with the approved TCEQ permit when received. Prior to commencement of construction activities provide Texas Tech copies of the NOI and Construction Site Notice and provide a copy of the permit, when received.

2.11.2 The Contractor shall, at all times, keep a copy of the SW3P, the Construction Site Notice, the NOI, and/or the Permit at the job site. The contractor shall update the SW3P as necessary to reflect current and changing site conditions and keep maintenance logs, inspection reports, and records related to compliance with the SW3P. The Contractor shall conduct inspections as required by TCEQ General Permit and the SW3P, and maintain inspection records at the job site

2.11.3 The Contractor shall submit a Notice of Change (NOC) to TCEQ when required.

2.11.4 Upon completion of all soil disturbing activities at the site and a uniform perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on the unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures the Contractor shall notify Texas Tech that it intends to file with TCEQ a Notice of Termination (NOT) and provide to Texas Tech a copy of the proposed NOT. When approved by Texas Tech, the Contractor shall submit the NOT to TCEQ and provide a copy to Texas Tech.

2.11.5 The Contractor shall provide copies or originals of all records including the SW3P, NOI, Permit, NOT, Construction Site Notice, inspection reports, maintenance logs and records to Texas Tech.

Article 3. General Responsibilities of Owner and Contractor

3.1 Owner's General Responsibilities. Owner is the entity identified as such in the Contract and referred to throughout the Contract Documents as if singular in number.

3.1.1 Preconstruction Conference. Prior to, or concurrent with, the issuance of Notice to Proceed with construction, a conference will be convened for attendance by Owner, Contractor, A/E and appropriate Subcontractors. The purpose of the conference is to establish a working understanding among the parties as to the Work, the operational conditions at the Project Site, and general administration of the Project. Topics include communications, schedules, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, maintaining required records and all other matters of importance to the administration of the Project and effective communications between the Project team members.

3.1.2 Owner's Designated Representative. Prior to the start of construction, Owner will identify Owner's Designated Representative (ODR), who has the express authority to act and bind Owner to the extent and for the purposes described in the various Articles of the Contract, including responsibilities for general administration of the Contract.

3.1.2.1 Unless otherwise specifically defined elsewhere in the Contract Documents, ODR is the single point of contact between Owner and Contractor. Notice to ODR, unless otherwise noted, constitutes notice to Owner under the Contract.

3.1.2.2 All directives on behalf of Owner will be conveyed to Contractor and A/E by ODR in writing. Contractor shall only accept directions to modify or change the work set forth in the drawings and specifications from the ODR.

3.1.2.3 Owner will furnish or cause to be furnished, free of charge, the number of complete sets of the Drawings, Specifications, and addenda as provided in the Supplementary General Conditions or Special Conditions.

3.1.2.4 Instructions affecting the Contract Sum, Contract Time or contract interpretation, shall be confirmed expeditiously in writing with copies furnished to the Design Professional, the ODR and the Contractor by the party issuing the instruction.

3.1.3 Owner Supplied Materials and Information.

3.1.3.1 Owner will furnish to Contractor those surveys describing the physical characteristics, legal description, limitations of the Site, Site utility locations, and other information used in the preparation of the Contract Documents.

3.1.3.2 Owner will provide information, equipment, or services under Owner's control to Contractor with reasonable promptness.

3.1.4 Availability of Lands. Owner will furnish, as indicated in the Contract, all required rights to use the lands upon which the Work occurs. This includes rights-of-way and easements for access and such other lands that are designated for use by Contractor. Contractor shall comply with all Owner identified encumbrances or restrictions specifically related to use of lands so furnished. Owner will obtain and pay for easements for permanent structures or permanent changes in existing facilities, unless otherwise required in the Contract Documents.

3.1.4.1 If Texas Tech fails to furnish these lands, rights of way or easements in a timely manner, Contractor may make a claim under Article 9.9.

3.1.5 Limitation on Owner's Duties.

3.1.5.1 Owner will not supervise, direct, control or have authority over or be responsible for Contractor's means, methods, technologies, sequences or procedures of construction or the safety precautions and programs incident thereto. Owner is not responsible for any failure of Contractor to comply with laws and regulations applicable to the Work. Owner is not responsible for the failure of Contractor to perform or furnish the Work in accordance with the Contract Documents. Except as provided in Section 2.5, Owner is not responsible for the acts or omissions of Contractor, or any of its Subcontractors, suppliers or of any other person or organization performing or furnishing any of the Work on behalf of Contractor.

3.1.5.2 Owner will not take any action in contravention of a design decision made by A/E in preparation of the Contract Documents, when such actions are in conflict with statutes under which A/E is licensed for the protection of the public health and safety.

3.1.6 The foregoing listing is in addition to the specific duties and authority of Texas Tech and the ODR found in the Contract.

3.2 Role of Architect/Engineer. Unless specified otherwise in the Contract between Owner and Contractor, A/E shall provide general administration services for Owner during the construction phase of the project. Written correspondence, requests for information, and Shop Drawings/submittals shall be directed to A/E for action. A/E has the authority to act on behalf of Owner to the extent provided in the Contract Documents, unless otherwise modified by written instrument, which will be furnished to Contractor by ODR, upon request.

3.2.1 Site Visits.

3.2.1.1 A/E will make visits to the Site at intervals as provided in the A/E's Contract with Owner, to observe the progress and the quality of the various aspects of Contractor's executed Work and report findings to Owner.

3.2.1.1.1 **Based on information obtained during such visits and observations, Design Professional shall determine, in general, if the Work is proceeding in accordance with the Contract Documents. Design Professional shall not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work, unless otherwise noted. The Design Professional's efforts will be directed toward providing Texas Tech a greater degree of confidence that the completed Work shall conform generally to the Contract Documents. On the basis of such visits and on-**

site observations, Design Professional shall keep Texas Tech informed of the progress of the Work and shall endeavor to guard Texas Tech against defective Work. Design Professional visits and on-site observations are subject to all the limitations on Design Professional's authority and responsibility set forth in §3.2.3.

3.2.1.2 A/E has the authority to interpret Contract Documents and inspect the Work for compliance and conformance with the Contract. Except as referenced in Paragraph 3.1.5.2, Owner retains the sole authority to accept or reject Work and issue direction for correction, removal, or replacement of Work.

3.2.2 Clarifications and Interpretations. It may be determined that clarifications or interpretations of the Contract Documents are necessary. Upon direction by ODR, such clarifications or interpretations will be provided by A/E consistent with the intent of the Contract Documents. A/E will issue these clarifications with reasonable promptness to Contractor as A/E's supplemental instruction ("ASI") or similar instrument. If Contractor believes that such clarification or interpretation justifies an adjustment in the Contract Sum or the Contract Time, Contractor shall so notify Owner in accordance with the provisions of Article 11.

3.2.3 Limitations on Architect/Engineer Authority. A/E is not responsible for:

3.2.3.1 Contractor's means, methods, techniques, sequences, procedures, safety, or programs incident to the Project, nor will A/E supervise, direct, control or have authority over the same;

3.2.3.2 The failure of Contractor to comply with laws and regulations applicable to the furnishing or performing the Work;

3.2.3.3 Contractor's failure to perform or furnish the Work in accordance with the Contract Documents; or

3.2.3.4 Acts or omissions of Contractor, or of any other person or organization performing or furnishing any of the Work.

3.2.4 No instruction affecting the Design Professional's design liability shall be issued without the Design Professional's prior written consent.

3.2.5 The duties listed above are in addition to other duties, responsibilities and actions to be undertaken by Design Professional as specified in other Articles of the Contract.

3.3 Contractor's General Responsibilities. Contractor is solely responsible for implementing

the Work in full compliance with all applicable laws and the Contract Documents and shall supervise and direct the Work using the best skill and attention to assure that each element of the Work conforms to the Contract requirements. Contractor is solely responsible for all construction means, methods, techniques, safety, sequences, coordination and procedures.

3.3.1 Project Administration. Contractor shall provide Project administration for all Subcontractors, vendors, suppliers, and others involved in implementing the Work and shall coordinate administration efforts with those of A/E and ODR in accordance with these general conditions and other provisions of the Contract, and as outlined in the pre-construction conference.

3.3.2 Contractor's Management Personnel. Contractor shall employ a competent person or persons who will be present at the Project Site during the progress of the Work to supervise or oversee the work. The competent persons are subject to the approval of ODR. Contractor shall not change approved staff during the course of the project without the written approval of ODR unless the staff member leaves the employment of Contractor. Contractor shall provide additional quality control, safety and other staff as stated in the Supplementary General Conditions.

3.3.3 Labor. Contractor shall provide competent, suitably qualified personnel to survey, lay-out, and construct the Work as required by the Contract Documents and maintain good discipline and order at the Site at all times.

3.3.3.1 SEX OFFENDER REGISTRATION. Contractor agrees to provide the following notice to all of its employees and subcontractors who may work on any campus of Texas Tech University System:

ALL SEX OFFENDERS ARE REQUIRED TO REGISTER WITH LOCAL LAW ENFORCEMENT AUTHORITIES UNDER CHAPTER 62 OF THE TEXAS CODE OF CRIMINAL PROCEDURE AND WHO INTEND TO WORK OR CARRY ON A VOCATION (FULL-TIME OR PART-TIME) ON ANY CAMPUS OF THE TEXAS TECH UNIVERSITY SYSTEM FOR A CONSECUTIVE PERIOD EXCEEDING FOURTEEN (14) DAYS OR FOR AN AGGREGATE PERIOD EXCEEDING THIRTY (30) DAYS IN A CALENDAR YEAR. SEX OFFENDERS ARE REQUIRED TO REGISTER (OR VERIFY REGISTRATION) WITH THE TEXAS TECH POLICE DEPARTMENT IN ACCORDANCE WITH ARTICLE 62.153 OF THE TEXAS CODE OF CRIMINAL PROCEDURE WITHIN 7 DAYS OF BEGINNING WORK ON ANY CAMPUS OF THE TEXAS TECH UNIVERSITY SYSTEM. IN ADDITION, SUCH SEX OFFENDERS ARE REQUIRED TO NOTIFY THE TEXAS TECH POLICE DEPARTMENT WITHIN SEVEN (7) DAYS OF TERMINATING WORK ON ANY CAMPUS OF TEXAS TECH UNIVERSITY SYSTEM. FOR ADDITIONAL INFORMATION, PLEASE

**CONTACT THE TEXAS TECH POLICE DEPARTMENT, 2901
4TH ST., LUBBOCK, TX 79409, 806-742-3931.**

3.3.4 Services, Materials, and Equipment. Unless otherwise specified, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities, incidentals, and services necessary for the construction, performance, testing, start-up, inspection and completion of the Work.

3.3.4.1 The Contractor or Construction Manager at Risk may use, at no cost, the existing Texas Tech campus utility infrastructure to perform the work, including construction, startup testing, and commissioning. The Contractor or Construction Manager at Risk shall be responsible for all other utility costs including connection charges. In all cases, the Contractor or Construction Manager at Risk shall be responsible for utility costs related to all job-site offices.

3.3.4.2 The Contractor shall provide, without extra charge, all incidental items required as a part of the Work, even though not particularly specified or indicated in the Contract. If the Contractor has good reason for objection to the use of a material, appliance, or method of construction as shown or specified, the Contractor shall register its objections with Texas Tech in writing in sufficient time to resolve the issue without delaying the Work; otherwise, it shall proceed with the Work with the understanding that a satisfactory job is required.

3.3.5 Contractor General Responsibility. For Owner furnished equipment or material that will be in the care, custody, and control of Contractor, Contractor is responsible for damage or loss.

3.3.6 Non-Compliant Work. Should A/E and/or ODR identify Work as non-compliant with the Contract Documents, A/E and/or ODR shall communicate the finding to Contractor, and Contractor shall correct such Work at no additional cost to the Owner. The approval of Work by either A/E or ODR does not relieve Contractor from the obligation to comply with all requirements of the Contract Documents.

3.3.6.1 The approval of Work by either the Design Professional or ODR does not relieve the Contractor from compliance with all requirements of the Contract Documents where such requirements are not judged at the time of observation of the Work due to work sequences by the Contractor or the lack of time to judge the performance characteristics of the particular Work item.

3.3.7 Subcontractors. Contractor shall not employ any Subcontractor, supplier or other person or organization, whether initially or as a substitute, against whom Owner shall have reasonable objection. Owner will communicate such objections in

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writing within ten (10) days of receipt of Contractor's intent to use such Subcontractor, supplier, or other person or organization. Contractor is not required to employ any Subcontractor, supplier or other person or organization to furnish any of the work to whom Contractor has reasonable objection. Contractor shall not substitute Subcontractors without the acceptance of Owner.

3.3.7.1 All Subcontracts and supply contracts shall be consistent with and bind the Subcontractors and suppliers to the terms and conditions of the Contract Documents including provisions of the Contract between Contractor and Owner.

3.3.7.2 Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor. Require all Subcontractors, suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with Owner only through Contractor. Contractor shall furnish to Owner a copy, at Owner's request, of each first-tier subcontract promptly after its execution. Contractor agrees that Owner has no obligation to review or approve the content of such contracts and that providing Owner such copies in no way relieves Contractor of any of the terms and conditions of the Contract, including, without limitation, any provisions of the Contract which require the Subcontractor to be bound to Contractor in the same manner in which Contractor is bound to Owner.

3.3.7.3 Contractor shall enter into written agreements with all Subcontractors and suppliers which specifically bind the Subcontractors and suppliers to the applicable terms and conditions of the Contract Documents for the benefit of Texas Tech and the Design Professional. Texas Tech reserves the right to specify that certain requirements shall be adhered to by all Subcontractors and suppliers as indicated in other portions of the Contract Documents and these requirements shall be made a part of the agreement between Contractor and Subcontractor or supplier.

3.3.8 Continuing the Work. Contractor shall carry on the Work and adhere to the progress schedule during all disputes, disagreements, or alternative resolution processes with Owner. Contractor shall not delay or postpone any Work because of pending unresolved disputes, disagreements or alternative resolution processes, except as Owner and Contractor may agree in writing.

3.3.9 Cleaning. Contractor shall at all times, keep the Site and the Work clean and free from accumulation of waste materials or rubbish caused by the construction activities under the Contract. Contractor shall ensure that the entire Project is thoroughly cleaned prior to requesting Substantial Completion inspection and, again, upon completion of the Project prior to the final inspection.

3.3.10 Acts and Omissions of Contractor, its Subcontractors and Employees. Contractor shall be responsible for acts and omissions of his employees and all its Subcontractors, their agents and employees. Owner may, in writing, require Contractor to remove from the Project any of Contractor's or its Subcontractor's employees whom ODR finds to be careless, incompetent, unsafe, uncooperative, disruptive, or otherwise objectionable.

3.3.11 Indemnification of Owner. Contractor covenants and agrees to FULLY INDEMNIFY and HOLD HARMLESS, Owner and the elected and appointed officials, employees, officers, directors, volunteers, and representatives of Owner, individually or collectively, from and against any and all costs, claims, liens, damages, losses, expenses, fees, fines, penalties, proceedings, actions, demands, causes of action, liability and suits of any kind and nature, including but not limited to, personal or bodily injury, death or property damage, made upon Owner directly or indirectly arising out of, resulting from or related to Contractor's activities under this Contract, including any acts or omissions of Contractor, or any agent, officer, director, representative, employee, consultant or the Subcontractor of Contractor, and their respective officers, agents, employees, directors and representatives while in the exercise of performance of the rights or duties under this Contract. The indemnity provided for in this paragraph does not apply to any liability resulting from the negligence of the Owner, its officers or employees, separate contractors or assigned contractors, in instances where such negligence causes personal injury, death or property damage. IN THE EVENT CONTRACTOR AND OWNER ARE FOUND JOINTLY LIABLE BY A COURT OF COMPETENT JURISDICTION, LIABILITY WILL BE APPORTIONED COMPARATIVELY IN ACCORDANCE WITH THE LAWS OF THE STATE OF TEXAS, WITHOUT WAIVING ANY GOVERNMENTAL IMMUNITY AVAILABLE TO THE STATE UNDER TEXAS LAW AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW.

3.3.11.1 The provisions of this indemnification are solely for the benefit of the parties hereto and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

3.3.11.2 Contractor shall promptly advise Owner in writing of any claim or demand against Owner or against Contractor which involves Owner and known to Contractor and related to or arising out of Contractor's activities under this Contract.

3.3.11.3 The Contractor's duty to promptly advise of claims or demands also applies to claims or demands against the ODR, Texas Tech's Representative, Project Manager and Design Professional.

3.3.12 Ancillary Areas. Operate and maintain operations and associated storage areas at the site of the Work in accordance with the following:

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- 3.3.12.1 Confine all Contractor operations, including storage of materials and employee parking upon the Site of Work, to areas designated by Owner.
- 3.3.12.2 Contractor may erect, at its own expense, temporary buildings that will remain its property. Remove such buildings and associated utility service lines upon completion of the Work, unless Contractor requests and Owner provides written consent that it may abandon such buildings and utilities in place.
- 3.3.12.3 Use only established roadways or construct and use such temporary roadways as may be authorized by Owner. Do not allow load limits of vehicles to exceed the limits prescribed by appropriate regulations or law. Provide protection to road surfaces, curbs, sidewalks, trees, shrubbery, sprinkler systems, drainage structures and other like existing improvements to prevent damage and repair any damage thereto at the expense of Contractor.
- 3.3.12.4 Owner may restrict Contractor's entry to the Site to specifically assigned entrances and routes.
- 3.3.13 Separate Contracts. Owner reserves the right to award other contracts in connection with other portions of the Project under these same or substantially similar contract conditions, including those portions related to **indemnification**, insurance and waiver of subrogation. Owner reserves the right to perform operations related to the Project with Owner's own forces.
- 3.3.13.1 When separate contracts are awarded for different portions of the Project, "the Contractor" in the Contract Documents in each case shall be the Contractor who signs each separate Contract. The Contractor shall cooperate with the separate contractors and Texas Tech's own forces. This Contractor shall properly connect and coordinate its work with the work of the separate contractors as defined in these Contract Documents. If any part of this Contractor's work depends for proper execution or proper results on the work of any of the separate contractors, the Contractor shall inspect and promptly report in writing to the ODR any visually apparent discrepancies or defects found in such other work that render it unsuitable for such proper execution and results. Failure of this Contractor to so inspect and report the visually apparent discrepancies or defects shall constitute an acceptance of the separate contractor's work as fit and proper to receive the Contractor's Work, except as to defects which may develop in the separate contractor's work after the execution of this Contractor's work.**

- 3.3.13.2** Should this Contractor cause damage to the Work or property of any separate contractor on the Project, this Contractor shall, upon due written notice, endeavor to settle with the separate contractor by agreement. If such separate contractor does not settle with this Contractor, Texas Tech shall initiate a dispute resolution process and each party to the dispute shall be financially accountable for any damages or loss based on their proportionate fault determined by the dispute resolution process.
- 3.3.13.3** Texas Tech shall provide for coordination of the activities of Texas Tech's own forces and of each separate contractor with the Work of this Contractor, who shall cooperate with them. This Contractor shall participate with other separate contractors and Texas Tech in reviewing the respective construction schedules, when directed to do so. This Contractor shall make any revisions to its construction schedule as necessary, after receiving Texas Tech's instructions.
- 3.3.14 Under a system of separate contracts, the conditions described herein continue to apply except as may be amended by change order.
- 3.3.15 Contractor shall cooperate with other contractors or forces employed on the Project by Owner, including providing access to Site and Project information as requested.
- 3.3.16 Owner shall be reimbursed by Contractor for costs incurred by Owner which are payable to a separate contractor because of delays, improperly timed activities, or defective construction by Contractor. Owner will equitably adjust the Contract by Change Order for costs incurred by Contractor because of delays, improperly timed activities, damage to the Work or defective construction by a separate contractor.
- 3.3.17** This Contractor shall afford Texas Tech, the Design Professional, the separate contractors and Texas Tech's own forces, as necessary, with the reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work.
- 3.3.18** The Contractor shall comply with applicable Texas Law, including the Texas Occupations Code, relating to the required licensing of heating, ventilating and air conditioning contractors, fire sprinkler systems contractors, materials, suppliers, and/or laborers respectively.
- 3.3.19** Construction of Temporary Project Signage. The Contractor is responsible for fabricating, locating and installing temporary construction project signage on the site. The standards for the exterior project signage are detailed in the Project Specifications.
- 3.3.20** Protection of Existing Facilities. The Contractor shall take precautions to protect existing facilities and features within the designated construction limits and along the access to the construction site. After materials,

equipment and machinery are installed, the Contractor shall properly protect all work until substantial completion is issued by Texas Tech and the Design Professional. Any damages incurred as a result of the Contractor's negligence shall be repaired by the Contractor without cost to Texas Tech, whether the repair is made with the Contractor's own materials and labor or by others under his directions.

Article 4. Historically Underutilized Business (HUB) Subcontracting Plan

- 4.1. General Description. The purpose of the Historically Underutilized Business (HUB) program is to promote equal business opportunities for economically disadvantaged persons (as defined by Tex. Gov't Code, Chapter 2161) to contract with the State of Texas in accordance with the goals specified in the State of Texas Disparity Study. The HUB program annual procurement utilization goals are defined in 34 T.A.C. § 20.13(b).
 - 4.1.1. State agencies are required by statute to make a good faith effort to assist HUBs in participating in contract awards issued by the State. 34 T.A.C. § 20.13(b) outlines the State's policy to encourage the utilization of HUBs in State contracting opportunities through race, ethnic and gender neutral means.
 - 4.1.2. A Contractor who contracts with the State in an amount of \$100,000 or greater is required to make a good faith effort to award subcontracts to HUBs in accordance with 34 T.A.C. § 20.14(a)(2)(A) by submitting a HUB subcontracting plan within twenty-four (24) hours after the bid or response is due and complying with the HUB subcontracting plan after it is accepted by Owner and during the term of the Contract.
- 4.2. Compliance with Approved HUB Subcontracting Plan. Contractor, having been awarded this Contract in part by complying with the HUB program statute and rules, hereby covenants to continue to comply with the HUB program as follows:
 - 4.2.1. Prior to adding or substituting a Subcontractor, promptly notify Owner in the event a change is required for any reason to the accepted HUB subcontracting plan.
 - 4.2.2. Conduct the good-faith effort activities required and provide Owner with necessary documentation to justify approval of a change to the approved HUB subcontracting plan.
 - 4.2.3. Cooperate in the execution of a Change Order or such other approval of the change in the HUB subcontracting plans as Contractor and Owner may agree to.
 - 4.2.4. Maintain and make available to Owner upon request business records documenting compliance with the accepted HUB subcontracting plan.
 - 4.2.5. Upon receipt of payment for performance of Work, submit to Owner a compliance report, in the format required by Owner that demonstrates

Contractor's performance of the HUB subcontracting plan.

4.2.6. Progress Assessment Report (PAR): monthly compliance reports to Owner (contracting agency), verifying their compliance with the HUB subcontracting plan, including the use/expenditures they have made to Subcontractors. (The PAR is available at:

<http://www.window.state.tx.us/procurement/prog/hub/hub-forms/progressassessmentrpt.xls>).

4.2.7. Promptly and accurately explain and provide supplemental information to Owner to assist in Owner's investigation of Contractor's good-faith effort to fulfill the HUB subcontracting plan and the requirements under 34 T.A.C. § 20.14(a)(1).

4.3. Failure to Demonstrate Good-Faith Effort. Upon a determination by Owner that Contractor has failed to demonstrate a good-faith effort to fulfill the HUB subcontracting plan or any Contract covenant detailed above, Owner may, in addition to all other remedies available to it, report the failure to perform to the Comptroller of Public Accounts, Texas Procurement and Support Services Division, Historically Underutilized Business Program and may bar Contractor from future contracting opportunities with Owner.

Article 5. Bonds and Insurance

5.1 Construction Bonds. Contractor is required to tender to Owner, prior to commencing the Work, performance and payment bonds, as required by Tex. Gov't Code, Chapter 2253. On Construction Manager-at-Risk and Design-Build Projects the Owner shall require a security bond, as described in Subsection 5.1.2 below.

5.1.1 Bond Requirements. Each bond shall be executed by a corporate surety or sureties authorized to do business in the State of Texas and acceptable to Owner, on Owner's form, and in compliance with the relevant provisions of the Texas Insurance Code. If any bond is for more than ten (10) percent of the surety's capital and surplus, Owner may require certification that the company has reinsured the excess portion with one or more reinsurers authorized to do business in the State. A reinsurer may not reinsure for more than ten (10) percent of its capital and surplus. If a surety upon a bond loses its authority to do business in the State, Contractor shall, within thirty (30) days after such loss, furnish a replacement bond at no added cost to Owner.

5.1.1.1 A Performance bond is required if the Contract Sum is in excess of \$100,000. The performance bond is solely for the protection of Owner. The performance bond is to be for the Contract Sum to guarantee the faithful performance of the Work in accordance with the Contract Documents. The form of the bond shall be approved by the Office of the Attorney General of Texas. The performance bond shall be effective through Contractor's warranty period.

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5.1.1.2 A Payment bond is required if the Contract price is in excess of \$25,000. The payment bond is to be for the Contract Sum and is payable to Owner solely for the protection and use of payment bond beneficiaries. The form of the bond shall be approved by the Office of the Attorney General of Texas.

5.1.1.3 The Bonding Company is required to provide, clearly and prominently displayed on the face of all payment and performance bonds, the Company name, physical address, mailing address, area code and telephone number and the toll-free telephone number maintained by the Texas Department of Insurance under Texas Insurance Code §521.052. The Bonding Company is required to provide a statement indicating that the surety's address can be obtained by calling the toll-free number.

5.1.1.4 Bond submitted that do not comply with these requirements must be promptly resubmitted with the correct information provided. Texas Tech reserves the right to disqualify bid proposals based on noncompliant bonds submission

5.1.2 Security Bond. The security bond provides protection to Owner if Contractor presents an acceptable guaranteed maximum price ("GMP") to Owner and 1) fails to execute the GMP; or 2) fails to deliver the required payment and performance bonds within the time period stated below.

5.1.3 When Bonds Are Due

5.1.3.1 Security bonds are due within ten (10) days of signing a Construction Manager-at-Risk or Design-Build Contract.

5.1.3.2 Payment and performance bonds are due within ten (10) days of Contractor's receipt of a fully executed GMP on a Construction Manager-at-Risk project or the Contract Sum for a Design-Build project, or within ten (10) days of Contractor's receipt of a fully executed Contract on competitively bid or competitive sealed proposal projects.

5.1.4 Power of Attorney. Each bond shall be accompanied by a valid power of attorney (issued by the surety company and attached, signed and sealed with the corporate embossed seal, to the bond) authorizing the attorney-in-fact who signs the bond to commit the company to the terms of the bond, and stating any limit in the amount for which the attorney can issue a single bond.

5.1.5 Bond Indemnification. The process of requiring and accepting bonds and making claims there under shall be conducted in compliance with Tex. Gov't Code, Chapter 2253. IF FOR ANY REASON A STATUTORY PAYMENT OR PERFORMANCE BOND IS NOT HONORED BY THE SURETY, CONTRACTOR SHALL FULLY INDEMNIFY AND HOLD OWNER HARMLESS OF AND FROM ANY COSTS, LOSSES, OBLIGATIONS OR LIABILITIES IT INCURS AS A RESULT.

5.1.6 Furnishing Bond Information. Owner shall furnish certified copies of the payment bond and the related Contract to any qualified person seeking copies who complies with Tex. Gov't Code § 2253.026.

5.1.7 Claims on Payment Bonds. Claims on payment bonds must be sent directly to Contractor and his surety in accordance with Tex. Gov't Code § 2253.041. All payment bond claimants are cautioned that no lien exists on the funds unpaid to Contractor on such Contract, and that reliance on notices sent to Owner may result in loss of their rights against Contractor and/or his surety. Owner is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no such responsibility because of any representation by any agent or employee.

5.1.8 Payment Claims when Payment Bond not Required. The rights of Subcontractors regarding payment are governed by Tex. Prop. Code §§ 53.231 – 53.239 when the value of the Contract between Owner and Contractor is less than \$25,000.00. These provisions set out the requirements for filing a valid lien on funds unpaid to Contractor as of the time of filing the claim, actions necessary to release the lien and satisfaction of such claim.

5.1.9 Sureties. A surety shall be listed on the US Department of the Treasury's Listing of Approved Sureties maintained by the Bureau of Financial Management Service (FMS), www.fms.treas.gov/c570, stating companies holding Certificates of

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Authority as acceptable sureties on Federal bonds and acceptable reinsuring companies (FMS Circular 570).

5.1.9.1 Each bond shall be executed by a corporate surety or corporate sureties that are on the approved list of the United States Department of Treasury, Fiscal Service (Dept. Circular 570 latest edition) "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies," Sections 9304 through 9308 of Title 31 of the United States Code, as amended or modified. Surety Companies Acceptable on Federal Bonds and duly authorized to do business in the State of Texas, on forms approved by the Attorney General of Texas. All sureties must be acceptable to Texas Tech. Attorneys-in-fact who sign Proposal / Bid Bonds or Contract Bonds must file with each bond a certified and effectively dated copy of their power of attorney.

5.2 Insurance Requirements. Contractor shall carry insurance in the types and amounts indicated in this Article for the duration of the Contract. The insurance shall be evidenced by delivery to Owner of certificates of insurance executed by the insurer or its authorized agent stating coverages, limits, expiration dates and compliance with all applicable required provisions. Upon request, Owner, and/or its agents, shall be entitled to receive without expense, copies of the policies and all endorsements. Contractor shall update all expired policies prior to submission for monthly payment. Failure to update policies shall be reason for withholding of payment until renewal is provided to Owner.

5.2.1 Contractor shall provide and maintain all insurance coverage with the minimum amounts described below until the end of the warranty period unless otherwise stated in Supplementary General Conditions or Special Conditions. Failure to maintain insurance coverage, as required, is grounds for suspension of Work for cause pursuant to Article 14.

5.2.2 Coverage shall be written on an occurrence basis by companies authorized and admitted to do business in the State of Texas and rated A- or better by A.M. Best Company or similar rating company or otherwise acceptable to Owner.

5.2.2.1 Insurance Coverage Required by Texas Tech

5.2.2.1.1 Workers' Compensation. Insurance with limits as required by the Texas Workers' Compensation Act, with the policy endorsed to provide a waiver of subrogation as to Owner, employer's liability insurance of not less than:

\$1,000,000 each accident;

\$1,000,000 By disease each employee; and

\$1,000,000 By disease policy limit.

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5.2.2.1.2 **Commercial General Liability Insurance.** Including premises, operations, independent contractor's liability, products and completed operations and contractual liability, covering, but not limited to, the liability assumed under the indemnification provisions of this Contract, fully insuring Contractor's liability for bodily injury (including death) and property damage with a minimum limit of:

\$1,000,000 per occurrence;

\$2,000,000 general aggregate;

\$2,000,000 products and completed operations aggregate; and

Coverage shall be on an "occurrence" basis. **Claims made forms are not acceptable.**

The policy shall include coverage extended to apply to completed operations and explosion, collapse, and underground hazards. The policy shall include endorsement CG2503**1185** Amendment of Aggregate Limits of Insurance (per Project) or its equivalent.

If the Work involves any activities within fifty (50) feet of any railroad, railroad protective insurance as may be required by the affected railroad, written for not less than the limits required by such railroad.

5.2.2.1.3 Asbestos Abatement Liability Insurance, including coverage for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos containing materials. *This requirement applies if the Work or the Project includes asbestos containing materials.

The combined single limit for bodily injury and property damage will be a minimum of \$1,000,000 per occurrence.

*Specific requirement for claims-made form: Required period of coverage will be determined by the following formula: continuous coverage for life of the Contract, plus one (1) year (to provide coverage for the warranty period), and an extended discovery period for a minimum of five (5) years which shall begin at the end of the warranty period.

Employer's liability limits for asbestos abatement will be:

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\$500,000 each accident;

\$500,000 disease each employee; and

\$1,000,000 disease policy limit.

If this Contract is for asbestos abatement only, the all-risk builder's risk or all-risk installation floater is not required.

- 5.2.2.1.4 Comprehensive Automobile Liability Insurance, covering owned, hired, and non-owned vehicles, with a minimum combined single limit for bodily injury (including death) and property damage of \$1,000,000 per occurrence. No aggregate shall be permitted for this type of coverage.

Such insurance is to include coverage for loading and unloading hazards.

- 5.2.2.1.5 All-Risk Builder's Risk Insurance, if applicable (or all-risk installation floater for instances in which the project involves solely the installation of material and/or equipment). Coverage shall be all-risk, including, but not limited to, fire, extended coverage, vandalism and malicious mischief, theft and, if applicable, flood, earth movement and named storm, **include terrorism coverage per TRIA 2002**. Builder's risk and installation floater limits shall be equal to 100 percent of the Contract Sum plus, if any, existing property and Owner-furnished equipment specified by Owner. The policy shall be written jointly in the names of Owner and Contractor. Subcontractors shall be named as additional insureds. The policy shall have endorsements as follows:

5.2.2.1.5.1 This insurance shall be specific as to coverage and not contributing insurance with any permanent insurance maintained on the property.

5.2.2.1.5.2 This insurance shall not contain an occupancy clause suspending or reducing coverage should Owner partially occupy the Site and before the parties have determined Substantial Completion.

5.2.2.1.5.3 Loss, if any, shall be adjusted with and made payable to Owner as trustee for the insureds as their interests may appear. Owner shall be named as loss payee.

5.2.2.1.5.4 For renovation projects or projects that involve

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portions of Work contained within an existing structure, refer to Supplementary General and Special Conditions for possible additional builder's risk insurance requirements.

- 5.2.2.1.5.5 For Owner furnished equipment or materials that will be in care, custody or control of Contractor, Contractor will be responsible for damage and loss.
- 5.2.2.1.5.6 For those properties located within a Tier 1 or 2 windstorm area, named storm coverage must be provided with limits specified by Owner.
- 5.2.2.1.5.7 For those properties located in flood prone areas, flood insurance coverage must be provided with limits specified by Owner.
- 5.2.2.1.5.8 Builder's risk insurance policy shall remain in effect until Substantial Completion.

5.2.2.1.6 "Umbrella" Liability Insurance. Contractor shall obtain, pay for and maintain umbrella liability insurance during the Contract term, insuring Contractor for an amount of not less than amount specified in the Supplementary General Conditions or Special Conditions that provides coverage at least as broad as and applies in excess and follows form of the primary liability coverages required hereinabove. The policy shall provide "drop down" coverage where underlying primary insurance coverage is **lacking or** limits are insufficient or exhausted.

- 5.2.2.1.6.1 The Contractor shall provide, at a minimum, the following Coverage Limits:**
 - a. When Contract Amount equals less than \$5,000,000, an Umbrella Policy of \$1,000,000.**
 - b. When Contract Amount equals or exceeds \$5,000,000, an Umbrella Policy of \$5,000,000.**

5.2.3 Policies must include the following clauses, as applicable:

- 5.2.3.1 This insurance shall not be canceled, materially changed, or non-renewed except after thirty (30) days written notice has been given to Owner.
- 5.2.3.2 It is agreed that Contractor's insurance shall be deemed primary with respect to any insurance or self insurance carried by Owner for liability arising out of operations under the Contract with Owner.

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- 5.2.3.3 Owner, its officials, directors, employees, representatives, and volunteers are added as additional insureds as respects operations and activities of, or on behalf of the named insured performed under Contract with Owner. The additional insured status must cover completed operations as well. This is not applicable to workers' compensation policies.
- 5.2.3.4 A waiver of subrogation in favor of Owner shall be provided in all policies.
- 5.2.4 Without limiting any of the other obligations or liabilities of Contractor, Contractor shall require each Subcontractor performing work under the Contract, at Subcontractor's own expense, to maintain during the term of the Contract, the same stipulated minimum insurance including the required provisions and additional policy conditions as shown above. As an alternative, Contractor may include its Subcontractors as additional insureds on its own coverage as prescribed under these requirements. Contractor's certificate of insurance shall note in such event that Subcontractors are included as additional insureds and that Contractor agrees to provide workers' compensation for Subcontractors and their employees. Contractor shall obtain and monitor the certificates of insurance from each Subcontractor in order to assure compliance with the insurance requirements. Contractor must retain the certificates of insurance for the duration of the Contract plus five (5) years and shall have the responsibility of enforcing these insurance requirements among its Subcontractors. Owner shall be entitled, upon request and without expense, to receive copies of these certificates.
- 5.2.5 Workers' compensation insurance coverage must meet the statutory requirements of Tex. Lab. Code § 401.011(44) and specific to construction projects for public entities as required by Tex. Lab. Code § 406.096.
- 5.2.6 **The furnishing of the above listed insurance coverage, as may be modified by Supplementary General Conditions or Special Conditions, must be tendered prior to execution of the Contract, and in no event later than ten (10) days from Notice of Award. Failure to provide the insurance in a timely fashion may result in loss of Contractor's bid bond. *The Contractor shall not commence the Work until it has obtained all required insurance and "certificates of insurance" and copies of all policies and endorsements have been filed with and reviewed by Texas Tech. Acceptance of this information by Texas Tech shall not relieve or decrease the Contractor's liability.***

Article 6. Construction Documents, Coordination Documents, and Record Documents

6.1 Drawings and Specifications.

6.1.1 Copies Furnished. Contractor will be furnished, free of charge, the number of complete sets of the Drawings, Specifications, and Addenda as provided in the Supplementary General Conditions or Special Conditions. Additional complete sets of Drawings and Specifications, if requested, will be furnished at reproduction cost to the one requesting such additional sets. Electronic copies of such documents will be provided to Contractor without charge.

6.1.1.1 Contractor will be furnished free of charge twenty (20) paper sets of the Contract Drawings and Specifications and two (2) electronic sets before on-site work commences.

6.1.2 Ownership of Drawings and Specifications. All Drawings, Specifications and copies thereof furnished by A/E are to remain A/E's property. These documents are not to be used on any other project, and with the exception of the Contract record set and electronic versions needed for warranty operations, are to be returned to the A/E upon request, following completion of the Work **unless otherwise specified in the Design Professional Contract.**

6.1.2.1 The A/E grants Texas Tech a royalty-free, non-exclusive license in the Drawings, Specifications and other documents prepared for the Project by the A/E and its subcontractor(s). Texas Tech shall retain copies, including reproducible copies, of the Project documentation and Texas Tech, its employees, agents and subcontractor(s) are free to use the documents, however, they may not be sold or otherwise transferred to other parties without the A/E's consent.

6.1.3 Interrelation of Documents. The Contract Documents as referenced in the Contract between Owner and Contractor are complimentary, and what is required by one shall be as binding as if required by all.

6.1.4 Resolution of Conflicts in Documents. Where conflicts may exist within the Contract Documents, the documents shall govern in the following order: (a) Change Orders, addenda, and written amendments to the Contract; (b) the Contract; (c) Drawings; (d) Specifications (but Specifications shall control over Drawings as to quality of materials); and (e) other Contract Documents. Among other categories of documents having the same order of precedence, the term or provision that includes the latest date shall control. Contractor shall notify A/E and ODR for resolution of the issue prior to executing the Work in question.

- 6.1.4.1 **All discrepancies or conflicts either in the figures, in the Drawings, or in the Specifications, the matter shall be promptly submitted to the A/E and Texas Tech. The A/E shall promptly make a recommendation in writing within ten (10) days. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. If the discrepancy or conflict is not brought to Texas Tech's attention in a timely manner, the Contractor shall perform the Work based on the higher quality or quantity provided for in the above-referenced documents.**
- 6.1.4.2 **In the event of conflict among the Drawings, the large scale Drawings prevail over the small scale drawings.**
- 6.1.4.3 **In the event of conflict between Drawings and Specifications, the Specifications shall prevail. In the event of conflict among provisions of Specifications, using the CSI format, what is called for in the division of the predominant discipline will govern inconsistent provisions found elsewhere.**
- 6.1.5 Contractor's Duty to Review Contract Documents. In order to facilitate its responsibilities for completion of the Work in accordance with and as reasonably inferable from the Contract Documents, prior to commencing the Work, Contractor shall examine and compare the Contract Documents, information furnished by Owner, relevant field measurements made by Contractor and any visible or reasonably anticipated conditions at the Site affecting the Work. This duty extends throughout the construction phase prior to commencing each particular work activity and/or system installation.
- 6.1.6 Discrepancies and Omissions in Drawings and Specifications.
- 6.1.6.1 Promptly report to ODR and to A/E the discovery of any apparent error, omission or inconsistency in the Contract Documents prior to execution of the Work.
- 6.1.6.2 It is recognized that Contractor is not acting in the capacity of a licensed design professional, unless it is performing as a Design-Build firm.
- 6.1.6.3 It is further recognized that Contractor's examination of Contract Documents is to facilitate construction and does not create an affirmative responsibility to detect errors, omissions or inconsistencies or to ascertain compliance with applicable laws, building codes or regulations, unless it is performing as a Design-Build firm or a Construction Manager-at-Risk.
- 6.1.6.4 When performing as a Design-Build firm, Contractor has sole responsibility for discrepancies, errors, and omissions in the Drawings and Specifications.

6.1.6.5 When performing as a Construction Manager-at-Risk, Contractor has a shared responsibility with A/E for discovery and resolution of discrepancies, errors, and omissions in the Contract Documents. In such case, Contractor's responsibility pertains to review, coordination, and recommendation of resolution strategies within budget constraints.

6.1.6.5.1 Clarification(s) of project scope shall be requested from the A/E in the form of Requests for Information (RFI). Failure to consult with Texas Tech or A/E does not release the Contractor from their contracted responsibilities to complete the work to Texas Tech's satisfaction.

6.1.6.5.1.1 Texas Tech shall provide the requested information to the Contractor. If the solution prompts changes to the Contract Sum or Contract Time, the Contract shall be adjusted under Article 11.

6.1.6.6 Contractor has no liability for errors, omissions, or inconsistencies unless Contractor knowingly failed to report a recognized problem to Owner or the Work is executed under a Design-Build or Construction Manager-at-Risk Contract as outlined above. Should Contractor fail to perform the examination and reporting obligations of these provisions, Contractor is responsible for avoidable costs and direct and/or consequential damages.

6.2 Requirements for Record Documents. Contractor shall:

6.2.1 Maintain at the Site one copy of all Drawings, Specifications, addenda, approved submittals, Contract modifications, and all Project correspondence. Keep current and maintain Drawings and Specifications in good order with postings and markings to record actual conditions of Work and show and reference all changes made during construction. Provide Owner and A/E access to these documents.

6.2.2 Maintain this record set of Drawings and Specifications which reflect the actual field conditions and representations of the Work performed, whether it be directed by addendum, Change Order or otherwise. Make available all records prescribed herein for reference and examination by Owner and its representatives and agents.

6.2.3 Update the Record Documents at least monthly prior to submission of periodic partial pay estimates. Failure to maintain current Record Documents constitutes cause for denial of a progress payment otherwise due.

6.2.4 Prior to requesting Substantial Completion inspection Contractor shall furnish a copy of its marked-up Record Documents and a preliminary copy of each

instructional manual, maintenance and operating manual, parts catalog, wiring diagrams, spare parts, specified written warranties and like publications, or parts for all installed equipment, systems, and like items and as described in the Contract Documents.

- 6.2.5 Once determined acceptable by ODR with input from A/E, provide one (1) reproducible copy and one (1) electronic media copy of all Record Documents, unless otherwise required by the Supplementary General Conditions or Special Conditions.
- 6.2.6 Contractor shall be responsible for updating the Record Documents for all Contractor initiated documents and changes to the Contract Documents due to coordination and actual field conditions, including RFIs.
- 6.2.7 A/E shall be responsible for updating the Record Documents for any addenda, Change Orders, A/E supplemental instructions and any other alterations to the Contract Documents generated by A/E or Owner.

6.3 Other Information Provided to Contractor.

- 6.3.1 **Texas Tech may provide Contractor with information, reports, pictures or other items which are not contained within the Contract Documents, but which Contractor shall review and use pursuant to 6.1.5.**

Article 7. Construction Safety

- 7.1 General. It is the duty and responsibility of Contractor and all of its Subcontractors to be familiar with, enforce and comply with all requirements of Public Law No. 91-596, 29 U.S.C. § 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto. Contractor shall prepare a safety plan specific to the Project and submit it to ODR and A/E prior to commencing Work. In addition, Contractor and all of its Subcontractors shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property to protect them from damage, injury or loss and erect and maintain all necessary safeguards for such safety and protection.
- 7.2 Notices. Contractor shall provide notices as follows:
 - 7.2.1 Notify owners of adjacent property including those that own or operate utility services and/or underground facilities, and utility owners, when prosecution of the Work may affect them or their facilities, and cooperate with them in the protection, removal, relocation and replacement, and access to their facilities and/or utilities.
 - 7.2.2 Coordinate the exchange of material safety data sheets (MSDSs) or other hazard communication information required to be made available to or exchanged

between or among employers at the site in connection with laws and regulations. Maintain a complete file of MSDSs for all materials in use on site throughout the construction phase and make such file available to Owner and its agents as requested.

- 7.3 Emergencies. In any emergency affecting the safety of persons or property, Contractor shall act to minimize, mitigate, and prevent threatened damage, injury or loss.
- 7.3.1 Have authorized agents of Contractor respond immediately upon call at any time of day or night when circumstances warrant the presence of Contractor to protect the Work or adjacent property from damage or to take such action pertaining to the Work as may be necessary to provide for the safety of the public.
- 7.3.2 Give ODR and A/E prompt notice of all such events.
- 7.3.3 If Contractor believes that any changes in the Work or variations from Contract Documents have been caused by its emergency response, promptly notify Owner within seventy-two (72) hours of the emergency response event.
- 7.3.4 Should Contractor fail to respond, Owner is authorized to direct other forces to take action as necessary and Owner may deduct any cost of remedial action from funds otherwise due Contractor.
- 7.4 Injuries. In the event of an incident or accident involving outside medical care for an individual on or near the Work, Contractor shall notify ODR and other parties as may be directed promptly, but no later than twenty-four (24) hours after Contractor learns that an event required medical care.
- 7.4.1 Record the location of the event and the circumstances surrounding it, by using photography or other means, and gather witness statements and other documentation which describes the event.
- 7.4.2 Supply ODR and A/E with an incident report no later than thirty-six (36) hours after the occurrence of the event. In the event of a catastrophic incident (one (1) fatality or three (3) workers hospitalized), barricade and leave intact the scene of the incident until all investigations are complete. A full set of incident investigation documents, including facts, finding of cause, and remedial plans shall be provided within one (1) week after occurrence, unless otherwise directed by legal counsel. Contractor shall provide ODR with written notification within one week of such catastrophic event if legal counsel delays submission of full report.

- 7.5 Environmental Safety. Upon encountering any previously unknown potentially hazardous material, or other materials potentially contaminated by hazardous material, Contractor shall immediately stop work activities impacted by the discovery, secure the affected area, and notify ODR immediately.
- 7.5.1 Bind all Subcontractors to the same duty.
- 7.5.2 Upon receiving such notice, ODR will promptly engage qualified experts to make such investigations and conduct such tests as may be reasonably necessary to determine the existence or extent of any environmental hazard. Upon completion of this investigation, ODR will issue a written report to Contractor identifying the material(s) found and indicate any necessary steps to be taken to treat, handle, transport or dispose of the material.
- 7.5.3 Owner may hire third-party Contractors to perform any or all such steps.
- 7.5.4 Should compliance with ODR's instructions result in an increase in Contractor's cost of performance, or delay the Work, Owner will make an equitable adjustment to the Contract Sum and/or the time of completion, and modify the Contract in writing accordingly.
- 7.5.5 The Contractor shall comply with, and require all Subcontractors to comply with the Texas Health and Safety Code's provisions relating to the installation of hazardous materials in public buildings, as well as the Texas Asbestos Health Protection Act: Tex. Occ. Code, Chapter 1954. The Contractor shall be responsible for ensuring that all Material Safety Data Sheets (MSDS) are on site and readily accessible before initiating installation of new construction materials.**
- 7.5.6 The Contractor shall be responsible for preventing the accumulation of wastes which create hazardous conditions. The protocols and responsibilities of the Contractor to ensure environmental protection and safety at Texas Tech differ from the protocols and responsibilities defined for construction projects associated with Texas Tech University Health Sciences Center (TTUHSC). For clarification, the procedures indicated below are inclusive of the standard protocol(s) defined for implementation on all Texas Tech construction projects. Protocols associated with environmental protection and safety of TTUHSC construction projects are indicated in TTUHSC Standards and associated with the protocols in 7.8-7.11.**
- 7.6 Trenching Plan. When the project requires excavation which either exceeds a depth of four (4) feet, or results in any worker's upper body being positioned below grade level, Contractor is required to submit a trenching plan to ODR prior to commencing trenching operations unless an engineered plan is part of the Contract Documents. The plan is required to be prepared and sealed by a professional engineer registered in the State of

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Texas, and hired or employed by Contractor or Subcontractor to perform the work. Said engineer cannot be anyone who is otherwise either directly or indirectly engaged on this project.

- 7.6.1 All trench excavations shall be performed in full compliance with OSHA Regulations. It is the Contractor's responsibility to comply with any additional requirements resulting from any pre-construction conference relating to coordination of geotechnical investigation subjects.**
- 7.6.2 Texas State Law (Underground Facility Damage Prevention and Safety Act: Tex. Util. Code, Chapter 251) requires Contractors submit all required notifications to the authorities having jurisdiction two working days prior to commencement of all excavation site work. It is the Contractor's responsibility to inform Texas Excavation Safety System (1-800-DIG-TESS or 811) about all planned excavations and provide adequate notice. The Contractor is required to coordinate identification of underground facilities with the Design Professional, and a designated representative of Texas Tech, and site mark approximate locations prior to planned excavation.**
- 7.6.3 When required, the Contractor shall submit a trenching plan that is approved and sealed by a professional engineer registered in the State of Texas and employed by the Contractor. Said engineer cannot be anyone who is pre-employed on this Project by Texas Tech. Receipt of the plan is a prerequisite to the start of trenching.**

The regulation identified as 29 CFR (Code of Federal Regulations) Subpart P – Excavations, consisting of sections 1926.650 through 1926.652 with Appendices A through F, of the OSHA Health and Safety Regulations, as amended or modified, are by this reference made a part of the Specifications. The Contractor shall meet and comply with this regulation and all other applicable safety standards that have been adopted by government agencies that have jurisdiction over this Project.

It is the sole duty and responsibility of the Contractor, not Texas Tech, to determine the specific applicability of the designed trench safety systems to each field condition and to make inspections of the trench safety systems. The Contractor shall maintain a permanent record of inspections.

THE CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS TEXAS TECH, ITS EMPLOYEES AND AGENTS, THE ODR, DESIGN PROFESSIONALS OF RECORD, THE PROJECT MANAGER AND TEXAS TECH'S REPRESENTATIVE FROM ANY AND ALL DAMAGES, COSTS (INCLUDING, WITHOUT LIMITATION, LEGAL FEES AND EXPENSES, COURT COSTS, AND THE COST OF INVESTIGATION), JUDGMENTS, AND CLAIMS BY ANYONE FOR INJURY OR DEATH OF PERSONS RESULTING FROM THE COLLAPSE OR FAILURE OF TRENCHES CONSTRUCTED UNDER THIS CONTRACT AND CAUSED

**BY NEGLIGENCE OF THE CONTRACTOR, ITS EMPLOYEES,
AGENTS, OR SUBCONTRACTORS.**

7.7 Volatile Waste By-Products. The Contractor shall store volatile wastes in covered metal containers which will be required to be removed from the project site daily. The Contractor shall conduct cleaning and disposal operations in compliance with local ordinances and environmental protection regulations and ensure adequate exhausting of volatile or noxious substances while working in occupied areas. The Contractor shall ensure that all contractors, subcontractors, tradesmen, suppliers and laborers do not burn or bury rubbish and waste materials on the project site or dispose of volatile wastes through the storm or sanitary drainage system.

7.8 Hazardous Contaminates. Soil or other materials to be imported for use on any Texas Tech University System Project must meet the Requirements set forth by the US Environmental Protection Agencies Resource Conservation and Recovery Act (EPA RCRA) Regulation as stated under 40 CFR 261.24.

This covers the Toxicity Characteristic for the listed chemicals. The testing of the soil or other materials will show these constituents through the TCLP testing method (metals and pesticides), BTEX testing method (volatile organic compounds), and TPH testing method (Total Petroleum Hydrocarbon). Other variables may come into consideration and depending on the source of the soil material we may require other tests as necessary.

The link to the maximum concentration of contaminants for the toxicity characteristic is

<http://www.gpo.gov/fdsys/granule/CFR-2011-title40-vol26/CFR-2011-title40-vol26-sec261-24>.

If upon discovery of these hazardous contaminants, the Contractor is responsible for notifying Texas Tech and providing their intent for removal of the contaminants.

7.9 Some metal components may have inherently hazardous characteristics or contain hazardous characteristics. The metals of interest are the eight listed by the Resource Conservation and Recovery Act (RCRA): arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The Contractor is responsible for following all Environmental Protection Agency Laws when disposing of these potentially hazardous metals to prevent leaching and contamination of underground water supplies.

Upon discovery of these metals, the Contractor is responsible for disclosing to Texas Tech their intent for removal of the metal components. The Contractor may retain the metal for reuse, or otherwise accept the metal components as salvageable property. The items may also be sent to a metal's recycler. Whichever option is chosen, the Contractor must inform Texas Tech of their intentions, in writing, prior to the start of the project. The Contractor must indicate their proposed method for disposal or recycle. If the recycling option is elected, the types and quantities of

materials recycled must be reported to Texas Tech by providing copies of the weight tickets from the recycler.

If the recycling method is chosen, The Contractor is permitted to retain all recycling fees collected from their abatement work associated with project demolition or scheduled project materials removal, however, Texas Tech will not award additional compensation to the Contractor for their efforts associated with the removal of hazardous metal components from Texas Tech facilities or properties.

- 7.9 **Disposal of Fluorescent Lamps:** Some lamp tubes in fluorescent light fixtures may have materials inside them that would be classed as a hazardous waste. The Contractor is responsible for following all Environmental Protection Agency Laws when disposing of these potentially hazardous materials to prevent further depletion of the ozone and atmosphere. Texas Tech requires the Contractor inform them in writing of their intention for removal and disposal of the hazardous waste materials. The options detailed below are acceptable means acknowledged by Texas Tech for the removal and/or recycle of hazardous gases:

7.9.1. If the Contractor intends to retain light fixtures for reuse, or otherwise accept the fixtures as salvageable property, the Contractor must inform Texas Tech of their intention, in writing, prior to the start of the project. In this case, there is no hazardous waste issue.

7.9.2. If the Contractor does not wish to retain the light fixtures as salvageable property, the Contractor will be required to carefully remove the fluorescent lamps and ballasts from the light fixtures so as not to break any fluorescent lamps and place them in containers provided by the Texas Tech. The containers shall be stored in a location and manner to prevent spillage, tampering, damage or exposure to weather or other potentially detrimental conditions. Upon notification of the completion of the collection process, Texas Tech will schedule for pick up of the containers and make proper disposition of them. The remainder of the light fixture shall be recycled by the Contractor as a painted metal surface.

- 7.10 **PCB Light Ballasts.** The Texas Department of Health will not authorize the disposal of light ballasts containing PCB's or small PCB capacitors in municipal landfills. If a light ballast is not labeled "No PCB's", then it must be considered as having PCB's and must be disposed of as follows:

7.10.1 If, upon acknowledgement from Texas Tech the Contractor intends to retain the light fixture for reuse, or otherwise accept the fixtures as salvageable property, there are no hazardous waste requirements. Before removing the light ballasts from the campus, the Contractor shall provide a letter, addressed to Texas Tech stating their intention to reuse or recycle the light ballast.

7.10.2 Light fixtures that are not accepted for salvage by the Contractor are to have

the ballast removed by the Contractor and returned to Texas Tech for recycle/disposal/salvage or reuse. All such ballasts will be placed in Contractor-provided open-top 55-gallon metal drums (DOT / UN reference marking 1A2/Y1.2/100) by the Contractor and delivered to Texas Tech for disposal as directed by the Project Manager at the time of the Pre-construction Conference. The remainder of the light fixture shall be recycled by the Contractor as a painted metal surface.

7.10.3. For the purpose of construction projects at Texas Tech all fluorescent lamps associated with renovations or maintenance construction projects of Texas Tech facilities shall be considered to contain hazardous materials.

7.11 Fire Protection Procedures. Contractor shall maintain compliance with all Life/Safety Code requirements throughout the duration of the Construction Contract and take precautions to prevent potential fire hazards at the jobsite. Contractor shall adhere to the preventative fire protection procedures of the authorities having jurisdiction (Texas Tech Fire Marshals) and instruct all associated subcontractors, skilled tradesmen, contractors, material men, suppliers and/or laborers of the procedures for preventative fire measures.

7.12 All campuses of the Texas Tech System are designated 'Smoke Free' environments. Due to State health, sanitation and safety regulations, tobacco products are not permitted to be consumed by construction personnel in any Texas Tech facilities, occupied or unoccupied, including mechanical and other service spaces within the Texas Tech System. Care shall also be taken to avoid smoking near outside air intakes. The General Contractor shall be responsible for enforcing this policy on the construction site.

7.13 The Contractor shall not operate Owner's existing equipment. When operation is necessary to accomplish the work of the Contract, the Contractor shall notify the Project Manager who will arrange for Texas Tech personnel to operate the equipment.

Article 8. Quality Control

8.1 Materials & Workmanship. Contractor shall execute Work in a good and workmanlike matter in accordance with the Contract Documents. Contractor shall develop and provide a quality control plan specific to this Project and acceptable to Owner. Where Contract Documents do not specify quality standards, complete and construct all Work in compliance with generally accepted construction industry standards. Unless otherwise specified, incorporate all new materials and equipment into the Work under the Contract.

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- 8.1.1 Texas Tech reserves the right to inspect, at their sources or on the Project site or any off-site storage location, all materials, supplies or services not manufactured or performed within the Contractor's on-site facility. Such inspection shall not constitute acceptance, nor shall it replace a Contractor's responsibility to furnish acceptable materials.
- 8.1.2 **Materials Procurement.** The Contractor shall order and schedule delivery of materials expeditiously to avoid delays in construction and maintain the Critical Path Schedule for project delivery. If an item is found to be unavailable, Contractor shall notify the Design Professional immediately to permit mutual selection of suitable substitute(s). If Contractor fails to order materials in ample time to avoid delays in construction, an approved material shall be substituted at no extra cost to Texas Tech. Or, at the Design Professional's discretion, approval of a substitute will be given only upon agreement by the Contractor to remove substituted material at a later date agreeable to Texas Tech, and replace it at Contractor's expense with material originally specified. Such approval shall be subject to the same terms as for "Substitutions".
- 8.1.3 **Intent of Contract Documents.** It is not the intent of the Specifications or Contract Documents to limit materials, equipment or fixtures to the product of any particular manufacturer. Where definite materials, equipment and/or fixtures have been specified by name, manufacturer or catalog number, it has been done to set a definite standard and a reference for comparison as to quality, application, physical conformity, and other characteristics. It is Texas Tech's or Design Professional's intention to not discriminate against or prevent any dealer, jobber or manufacturer from furnishing materials, equipment, and/or fixtures which meet or exceed the characteristics of the specified items. Substitution of materials shall not be made without prior written approval from the Design Professional and Texas Tech. The Contractor shall clearly mark submittals of materials that are different than those indicated in the Drawings and/or Specifications.
- 8.1.4 Materials required to match existing work and not otherwise specified, shall be equal to the existing work in quality, color and finish. Workmanship and installation shall be comparable to adjacent existing work. Texas Tech shall be the sole authority in the determination of an acceptable match.
- 8.1.5 **Manufacturer's Instruction.** All manufacturer's articles, materials and equipment shall be applied, installed, connected, erected, secured, used, cleaned, and put in operation as recommended, instructed, directed or specified by the manufacturer, for the specified type of installation.
- 8.1.6 **Trade Name Specifications.** Reference to items specified by trade name are made as a basis of quality and function. Equivalent items may be used instead; however, the right of determining such quality shall remain with Texas Tech's ODR. The terms "similar to", "approved", "or equal" or

similar phrases shall be interpreted similarly.

- 8.1.7 **Labels.** Manufacturer's or designations, grade marking, fire ratings, etc., will be permitted and are required on certain components of the Work. These items shall be placed in concealed, but accessible locations. Absolutely no labels advertising any manufacturer or trade name will be permitted on exposed portions of components without written authorization from the Design Professional.
- 8.1.8 **Materials Storage.** The Contractor will be allowed space on the grounds for the storage of materials, but the Contractor shall provide all necessary enclosures, doors and locks, and shall be solely responsible for the safekeeping of all materials, tools, etc., stored therein. Such storage facilities shall be moved when so directed by the Design Professional at the Contractor's expense. After completion of the work, storage facilities and all connected utilities shall be completely removed and all materials taken from the premises.
- 8.1.9 **Reference Standards.** For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes. The date of the standard is that in effect as of the bid date, except when a specific date is specified. Obtain copies of standards when required by Contract Documents. Maintain a copy at job site during progress of the specific work.
- 8.1.9.1 Reference to standards, codes, Specifications, recommendations and regulations refer to the latest edition or printing prior to date of issue of the Contract Documents.
- 8.1.9.2 Applicable portions of standards listed that are not in conflict with Contract Documents are hereby made a part of the Specifications.
- 8.1.9.3 Modifications or exceptions to standards shall be considered as amendments and unmodified portions shall remain in full effect. In cases of discrepancies between standards, the more stringent requirements shall govern.
- 8.1.9.4 Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
- 8.1.9.5 Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.

8.1.10 **Building Codes and Standards.** Design, materials and construction shall conform with applicable requirements of the most current adopted editions by the local municipality (unless noted otherwise) but are not limited to the following published documents:

International Building Code (IBC);
International Energy Conservation Code (IECC);
International Fire Code (IFC) (edition adopted by the State Fire Marshall);
International Plumbing Code (IPC);
International Electrical Code Administration Provisions (IECAP);
NFPA 101, Life Safety Code and all referenced codes (edition adopted by State Fire Marshall);
National Fire Protection Association (NFPA) Codes and Standards (edition adopted by the State Fire Marshall);
National Electric Code (NEC);
ANSI/ASME A17.1 Safety Code for Elevators and Escalators (edition adopted by TDLR);
ANSI A136.1 Standards for Safe Use of Lasers;
United States Environmental Protection Agency regulations;
ASHRAE Standard 90A, B, & C-Energy Conservation in New Building Design;
United States Department of Health, Public Health Service regulations and guidelines;
Sheet Metal and Air Conditioning Contractor's National Association (SMACNA);
State Energy Conservation Office (SECO);
Biosafety in Microbiological and Biomedical Laboratories (BMBL), HHS Publication No. (CDC) 21-112;
State statues regulating, but not limited to the following:
Asbestos
Boilers
Control of Radiation
Energy Consumption
Fire Escapes
Fire Alarms
Plumbing Fixtures
Texas Accessibility Standards of the Architectural Barriers Act;
Americans with Disabilities Act (ADA);-
Accessibility Guidelines for Buildings and Facilities;
United States Department of Labor Occupational Safety and Health Administration (OSHA) regulations;
Texas Commission on Environmental Quality (TCEQ);
FM Global recommendations and approvals for roof systems and fire protection systems; and
TTUS Operating Policies and Procedures.

8.1.11 **Materials and workmanship specified by reference to number, symbol, or title of a specific standard such as commercial standard, a Federal Specification, a trade association standard, or other similar standard, shall comply with requirements in latest revision thereof and with any amendment or supplement thereto in effect on the date of origin of the Project's Contract Documents. Such standard, except as modified herein, shall have full force and effect as though printed in the specifications. Referenced standards from the publications of those organizations and governmental entities listed in Section 01095 REFERENCE STANDARDS attachment of this document apply to this construction contract.**

8.1.12 **In instances of conflict between the building codes and standards mentioned above, the Code or Standard having the more stringent requirement(s) shall govern over the other codes and/or standards. All standards derived from conformance with the building codes and standards documents listed in the REFERENCE STANDARDS attachment shall be considered as comprehensively included in the Contract Sum. Requests for additional compensation by the Contractor to resolve code discrepancies will not be permitted for changes to make the work comply with the regulations of the documents mentioned previously. Nothing in the Construction Documents should be construed by the Contractor as a permit to perform work not in conformance with the aforementioned building codes and standards.**

8.1.13 **Contractor Quality Control. Contractor is responsible for controlling the quality of the Work as set forth in the Contract Documents.**

8.2 Testing.

8.2.1 Owner is responsible for coordinating and paying for routine and special tests required to confirm compliance with quality and performance requirements, except as stated below or otherwise required by the Contract Documents. Contractor shall provide the following testing:

8.2.1.1 Any test of basic material or fabricated equipment included as part of a submittal for a required item in order to establish compliance with the Contract Documents.

8.2.1.2 Any test of basic material or fabricated equipment offered as a substitute for a specified item on which a test may be required in order to establish compliance with the Contract Documents.

8.2.1.3 Preliminary, start-up, pre-functional and operational testing of building equipment and systems as necessary to confirm operational compliance with requirements of the Contract Documents.

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8.2.1.4 All subsequent tests on original or replaced materials conducted as a result of prior testing failure.

8.2.2 All testing shall be performed in accordance with standard test procedures by an accredited laboratory, or special consultant as appropriate, acceptable to Owner. Results of all tests shall be provided promptly to ODR, A/E, and Contractor.

8.2.3 Non-Compliance (Test Results). Should any of the tests indicate that a material and/or system does not comply with the Contract requirements, the burden of proof remains with Contractor, subject to:

8.2.3.1 Contractor selection and submission of the laboratory for Owner acceptance.

8.2.3.2 Acceptance by Owner of the quality and nature of tests.

8.2.3.3 All tests taken in the presence of A/E and/or ODR, or their representatives.

8.2.3.4 If tests confirm that the material/systems comply with Contract Documents, Owner will pay the cost of the test.

8.2.3.5 If tests reveal noncompliance, Contractor will pay those laboratory fees and costs of that particular test and all future tests, of that failing Work, necessary to eventually confirm compliance with Contract Documents.

8.2.3.6 Proof of noncompliance with the Contract Documents will make Contractor liable for any corrective action which ODR determines appropriate, including complete removal and replacement of non-compliant work or material.

8.2.3.7 The A/E and Texas Tech may refuse consideration of further samples of the same brand or make for testing. Previous approval may be withdrawn and such material or equipment may be subject to removal and replacement by Contractor at his expense with material or equipment meeting specification requirements.

8.2.3.8 Contractor's Testing. Nothing contained herein is intended to imply that the Contractor does not have the right to have tests performed on any material at any time for its own information and job control so long as Texas Tech is not charged for costs or forced to rely upon such tests when appraising quality of materials. Any modification of, or elaboration on, these test procedures which may be included for specific materials under their respective specification sections shall take precedence over these procedures.

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8.2.4 Notice of Testing. Contractor shall give ODR and A/E timely notice of its readiness and the date arranged so ODR and A/E may observe such inspection, testing, or approval.

8.2.5 Test Samples. Contractor is responsible for providing Samples of sufficient size for test purposes and for coordinating such tests with their Work Progress Schedule to avoid delay.

8.2.5.1 **Materials to be tested include, but are not limited to, the following:**

8.2.5.1.1 Concrete and foundations.

8.2.5.1.2 Structural members.

8.2.5.1.3 Structural member connections.

8.2.5.1.4 Soils and bases.

8.2.5.1.5 Bituminous material

8.2.5.1.6 Roofing systems.

8.2.5.1.7 Mortar, grout, and masonry products.

8.2.5.1.8 Fireproofing

8.2.5.1.9 Waterproofing

8.2.6 Covering Up Work. If Contractor covers up any Work without providing Owner an opportunity to inspect, Contractor shall, if requested by ODR, uncover and recover the work at Contractor's expense.

8.3 Submittals.

8.3.1 Contractor's Submittals. Contractor shall submit with reasonable promptness consistent with the Project schedule and in orderly sequence all Shop Drawings, Samples, or other information required by the Contract Documents, or subsequently required by Change Order. Prior to submitting, Contractor shall review each submittal for general compliance with Contract Documents and approve submittals for review by A/E and Owner by an approval stamp affixed to each copy. Submittal data presented without Contractor's stamp will be returned without review or comment, and any delay resulting from failure is Contractor's responsibility.

8.3.1.1 Contractor shall within twenty-one (21) days of the effective date of the Notice To Proceed with construction, submit to ODR and A/E, a submittal

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schedule/register, organized by specification section, listing all items to be furnished for review and approval by A/E and Owner. The list shall include Shop Drawings, manufacturer's literature, certificates of compliance, materials Samples, materials colors, guarantees, and all other items identified throughout the Specifications.

- 8.3.1.2 Contractor shall indicate the type of item, Contract requirements reference, and Contractor's scheduled dates for submitting the item along with the requested dates for approval answers from A/E and Owner. The submittal register shall indicate the projected dates for procurement of all included items and shall be updated at least monthly with actual approval and procurement dates. Contractor's Submittal Register must be reasonable in terms of the review time for complex submittals. Contractor's submittal schedule must be consistent with the Work Progress Schedule and identify critical submittals. Show and allow a minimum of fifteen (15) days duration after receipt by A/E and ODR for review and approval. If re-submittal required, allow a minimum of an additional fifteen (15) days for review. Submit the updated Submittal Register with each request for progress payment. Owner may establish routine review procedures and schedules for submittals at the preconstruction conference and/or elsewhere in the Contract Documents. If Contractor fails to update and provide the Submittal Register as required, Owner may, after seven (7) days notice to Contractor withhold a reasonable sum of money that would otherwise be due Contractor.
- 8.3.1.3 Contractor shall coordinate the Submittal Register with the Work Progress Schedule. Do not schedule Work requiring a submittal to begin prior to scheduling review and approval of the related submittal. Revise and/or update both schedules monthly to ensure consistency and current project data. Provide to ODR the updated Submittal Register and schedule with each application for progress payment. Refer to requirements for the Work Progress Schedule for inclusion of procurement activities therein. Regardless, the Submittal Register shall identify dates submitted and returned and shall be used to confirm status and disposition of particular items submitted, including approval or other action taken and other information not conveniently tracked through the Work Progress Schedule.
- 8.3.1.4 By submitting Shop Drawings, Samples or other required information, Contractor represents that it has determined and verified all applicable field measurements, field construction criteria, materials, catalog numbers and similar data; and has checked and coordinated each Shop Drawing and Sample with the requirements of the Work and the Contract Documents.
- 8.3.1.5 **Texas Tech may establish routine review procedures and schedules for submittals at the preconstruction conference. All submittals will be subject to review by Texas Tech and routine review procedures**

shall be in accordance with those established by Texas Tech at a pre-construction conference held at the start of the Work. Items on which submittals are required are listed in the Specifications, but failure to list an item does not exempt the Contractor from being required to submit information on such items if requested by the Design Professional, Texas Tech and/or ODR.

8.3.1.6 Contractor shall submit four (4) copies of the submittal register and submittal schedule. The schedule shall be structured and list submittal items in numerical order of Specification Division numbers. Identify each submittal in list with an item number, Specification Division number, name of product, and type of submittal (shop drawing, product data, or sample).

8.3.1.7 Submittals defined include Conditions of Site reports, Contractor's Construction Schedule(s), Contractor's Submittal Schedule(s), Product Data, Shop Drawings, Samples and Options Selections, Integrated Drawings, Field Reports, Certificates of Compliance, Project Photographs, Reproducible Mylar Sepias 'as built' drawings, Requests for Information (RFI) and Change Requests (CR). The number of copies of each item for review will be determined in the Pre-Construction meeting. Upon receipt of the submittals, shop drawings, samples manufacturer's information and other documentation, the Design Professional will review items for accuracy and conformance to the project construction documents, within the allocated time frame agreed to by the Design Professional and Texas Tech.

8.3.1.7.1 Distribution of copies to A/E, Texas Tech and all contractors', subcontractor's, suppliers, manufacturers, etc. is to be provided by the Contractor.

8.3.2 Review of Submittals. A/E and ODR review is only for conformance with the design concept and the information provided in the Contract Documents. Responses to submittals will be in writing. The approval of a separate item does not indicate approval of an assembly in which the item functions. The approval of a submittal does not relieve Contractor of responsibility for any deviation from the requirements of the Contract unless Contractor informs A/E and ODR of such deviation in a clear, conspicuous, and written manner on the submittal transmittal and at the time of submission, and obtains Owner's written specific approval of the particular deviation.

8.3.2.1 Contractor's Responsibilities. Contractor's responsibility for errors and omissions in submittals is not relieved by the Design Professional's and Texas Tech's reviews of submittals. Contractor's responsibility for deviations in submittals from requirements of Construction Documents is not relieved by the Design Professional's and Texas Tech's reviews of submittals, unless Design Professional and Texas Tech give written acceptance of specific deviations. The Contractor must provide notice to the Design Professional, in writing at time of submission, of deviations in submittals from requirements of Contract Documents, including, if applicable, notification of changes in the Work as required by Article 3 of the Uniform General Conditions and Supplementary General Conditions.

8.3.2.2 The A/E will note discrepancies, substitutions and inaccuracy. Upon receipt of items related to interior finishes, the A/E will be required to forward those items immediately to Texas Tech's ODR, prior to the A/E's review, so that interior finishes reviews are expedited by Texas Tech. Once the A/E has completed formal review and stamped individual submittals for review, the A/E will retain two copies for their files and forward the remainder to Texas Tech for review and approval. Texas Tech will review all items received within two-weeks of receipt and return to the A/E for transmittal back to the Contractor. On the date of receipt of reviewed correspondence from the A/E, the Contractor will be required to acknowledge receipt by informing Texas Tech's ODR that correspondence for review has been received.

8.3.3 Correction and Resubmission. Contractor shall make any corrections required to a submittal and resubmit the required number of corrected copies promptly so as to avoid delay, until submittal approval. Direct attention in writing to A/E and ODR, when applicable, to any new revisions other than the corrections requested on previous submissions.

8.3.4 Limits on Shop Drawing Review. Contractor shall not commence any Work requiring a submittal until review of the submittal under Subsection 8.3.2. Construct all such work in accordance with reviewed submittals. Comments incorporated as part of the review in Subsection 8.3.2 of Shop Drawings and Samples is not authorization to Contractor to perform extra work or changed work unless authorized through a Change Order. A/E's and ODR's review, if any, does not relieve Contractor from responsibility for defects in the Work resulting from errors or omissions of any kind on the submittal, regardless of any approval action.

8.3.4.1 Shop Drawings will be marked with Texas Tech's project name, project number, and pages numbered consecutively. Each detail and drawing will give reference to appropriate sheet and detail number from Contract Documents. Shop Drawings shall be complete in every

respect, bound in sets, and accompanied by letter of transmittal listing numbers and dates of all drawings submitted. Prior to the Design Professional's review, Shop Drawings shall be reviewed by Contractor and shall bear his stamp stating drawing has been checked for conformance with the Contract Documents, pending the Design Professional's review. Any drawings submitted without Contractor's stamp will not be considered. If shop drawings show variations from requirements of Contract because of standard shop practice or other reason, Contractor shall make mention of such variation in his letter of transmittal. The Contractor will not be relieved of responsibility for executing the work in accordance with the Contract even though such Shop Drawings have been reviewed. Shop Drawings will not be considered approved unless the Contractor, Design Professional and Texas Tech's stamps appear on them.

8.3.4.1.1 If the Contractor considers any correction indicated on the revised Shop Drawings to constitute a change to the Contract Drawings or Specification, notice as required under Article 11 et. seq. herein, and the extension thereof in the Special Conditions, shall be promptly given to Texas Tech.

8.3.5 No Substitutions Without Approval. ODR and A/E may receive and consider Contractor's request for substitution when Contractor agrees to reimburse Owner for review costs and satisfies the requirements of this section. If Contractor does not satisfy these conditions, ODR and A/E will return the request without action except to record noncompliance with these requirements. Owner will not consider the request if Contractor cannot provide the product or method because of failure to pursue the Work promptly or coordinate activities properly. Contractor's request for a substitution may be considered by ODR and A/E when:

8.3.5.1 The Contract Documents do not require extensive revisions; and

8.3.5.2 Proposed changes are in keeping with the general intent of the Contract Documents and the design intent of A/E and do not result in an increase in cost to Owner; and

8.3.5.3 The request is timely, fully documented, properly submitted and one or more of the following apply:

8.3.5.3.1 Contractor cannot provide the specified product, assembly or method of construction within the Contract Time;

8.3.5.3.2 The request directly relates to an "or-equal" clause or similar language in the Contract Documents;

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- 8.3.5.3.3 The request directly relates to a “product design standard” or “performance standard” clause in the Contract Documents;
- 8.3.5.3.4 The requested substitution offers Owner a substantial advantage in cost, time, energy conservation or other considerations, after deducting additional responsibilities Owner must assume;
- 8.3.5.3.5 The specified product or method of construction cannot receive necessary approval by an authority having jurisdiction, and ODR can approve the requested substitution;
- 8.3.5.3.6 Contractor cannot provide the specified product, assembly or method of construction in a manner that is compatible with other materials and where Contractor certifies that the substitution will overcome the incompatibility;
- 8.3.5.3.7 Contractor cannot coordinate the specified product, assembly or method of construction with other materials and where Contractor certifies they can coordinate the proposed substitution; or
- 8.3.5.3.8 The specified product, assembly or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.

8.3.6 Unauthorized Substitutions at Contractor’s Risk. Contractor is financially responsible for any additional costs or delays resulting from unauthorized substitution of materials, equipment or fixtures other than those specified. Contractor shall reimburse Owner for any increased design or contract administration costs resulting from such unauthorized substitutions.

8.3.6.1 **Substitutions of any materials other than those specifically called for shall be submitted to the Design Professional and Texas Tech for approval. All substitutions must be approved by the Design Professional and Texas Tech in writing. For this purpose the Contractor shall submit to the Design Professional within 35 calendar days after execution of the contract, a typewritten list containing a description of each proposed substitute item or material. Sufficient data, drawings, samples, literature or other detailed information as will demonstrate to the Design Professional that the proposed substitute is equal in quality and utility to the material specified shall be appended to this list. The Design Professional will approve, after receiving written concurrence from Texas Tech, in writing, such proposed substitutions as are, in the Design Professional’s opinion, equal in quality and utility to the times or materials specified. Such approval shall not relieve the Contractor from complying with the**

requirements of the Drawings and Specifications, and the Contractor shall be responsible at his own expense for any changes resulting from his proposed substitutions which affect other parts of the work. Failure of the Contractor to submit proposed substitutions for approval in the manner described and within the time prescribed shall be sufficient cause for disapproval by the Design Professional of any substitutions otherwise proposed. Whenever catalog numbers and specific brands or trade names are not followed by the designation "or equal" or used in conjunction with a designated material, product, or service mentioned in these specifications, no substitutions will be approved.

8.3.7 **Product Data.** Product Data will be marked with Texas Tech's project name, project number, and pages numbered consecutively. Clearly mark each copy to identify pertinent materials, products, or models. Show dimensions and clearances required. Show performance characteristics and capacities. Show wiring diagrams and controls. Product data includes standard information on materials, products and systems; not specifically prepared for this project, other than the designation of selections from among available choices printed therein. Product Data shall be submitted at one time in sufficient copies to the Design Professional for approval and transmittal to Texas Tech for review.

8.3.7.1 The Contractor shall submit Material Safety Data Sheets (MSDS) for all materials provided, installed, and/or utilized in this Project for review by the Design Professional and Texas Tech or its designated representative. The Contractor will not be permitted to bring any material(s) onto Texas Tech University System property until the Design Professional and Texas Tech have reviewed such MSDS information and are satisfied the materials(s) are in compliance with applicable laws, ordinances, regulations, and policies. The A/E's and ODR's review of MSDS information shall not constitute acceptance, nor shall it release the Contractor from its obligation to furnish acceptable materials.

8.3.8 **Samples.** Samples will be marked with Texas Tech's project name and project number and include a label indicating generic name of item, manufacturer's name and model number, brand name, supplier's name and the subcontractor's name for which material is intended. Contractor shall accompany each shipment of samples with a transmittal referencing project for which intended and listing sample data enumerated above for each sample transmitted, and referencing samples to appropriate contract drawing sheet or to Specification Division. Approval of any sample will be only for characteristics or for uses named in such approval and for no other. Approval of a sample shall not be taken to change or modify any Contract requirements. When a material has been approved, no change in brand or make will be permitted. Materials and products on the job to be installed in the project shall be in original containers and bear the original labels of

approved samples. The Design Professional and Texas Tech, at their sole discretion, may retain certain approved samples for reference and catalog. Contractor shall submit color samples in same manner as for material samples and in one package at one time.

8.4 Field Mock-up.

8.4.1 Mock-ups shall be constructed prior to commencement of a specified scope of work to confirm acceptable workmanship.

8.4.1.1 As a minimum, field mock-ups shall be constructed for roofing systems, exterior veneer / finish systems, glazing systems, and any other Work requiring a mock-up as identified throughout the Contract Documents. Mock-ups for systems not part of the Project scope shall not be required.

8.4.1.2 Mock-ups may be incorporated into the Work if allowed by the Contract Documents and if acceptable to ODR. If mock-ups are freestanding, they shall remain in place until otherwise directed by Owner.

8.4.1.3 Contractor shall include field mock-ups in their Work Progress Schedule and shall notify ODR and A/E of readiness for review sufficiently in advance to coordinate review without delay.

8.4.1.4 **Mock-ups samples shall be submitted as required by the Specification Division. The approved mock-up samples shall be dated, initialed by persons present for approval, clearly identified, and remains protected on the job site until project completion and acceptance. Contractor's failure to protect and maintain the approved samples shall not relieve him from the responsibility of furnishing and installing finish brick, pavers, or mock-ups to the satisfaction of Texas Tech's ODR.**

8.4.1.5 **All proposed substitution of materials, equipment or fixtures shall be presented through the submittal process.**

8.5 Inspection During Construction.

8.5.1 Contractor shall provide sufficient, safe, and proper facilities, including equipment as necessary for safe access, at all reasonable times for observation and/or inspection of the Work by Owner and its agents.

8.5.2 Contractor shall not cover up any Work with finishing materials or other building components prior to providing Owner and its agents an opportunity to perform an Inspection of the Work.

8.5.2.1 Should corrections of the Work be required for approval, Contractor shall not cover up corrected Work until Owner indicates approval.

8.5.2.2 Contractor shall provide notification of at least five (5) working days or otherwise as mutually agreed, to ODR of the anticipated need for a cover-up inspection. Should ODR fail to make the necessary inspection within the agreed period, Contractor may proceed with cover-up Work, but is not relieved of responsibility for Work to comply with requirements of the Contract Documents.

8.5.3 Owner Quality Assurance.

8.5.3.1 Texas Tech will make visits to the site to confirm Project progress and quality of the Work, conduct inspections and tests and to determine if the Work is proceeding in accordance with the Contract Documents. The Contractor shall provide sufficient, safe and proper facilities at all reasonable times for observation and/or inspection of the Work by the authorized representatives of Texas Tech.

8.5.3.2 Texas Tech, ODR, or the Design Professional may employ one or more special inspectors to provide inspections during construction on the types of work listed under Section 1704 of the International Building Code.

8.6 Condemnation and Removal of Defective Work.

8.6.1 The ODR has the authority to reject and condemn Work, which does not meet the requirements of the Contract Documents and to order such work removed and replaced in accordance with paragraph 8.6.2 et. seq. hereof. The approval of a work item by the ODR does not relieve the Contractor from compliance with the Contract Documents where such requirements are not judged at the time of observation of the Work due to work sequences by the contractor or the lack of time to judge the performance characteristics of the particular work item. Failure of the ODR to reject the Work does not relieve the Contractor from the responsibility to correctly perform the Work in accordance with the Contract Documents.

8.6.2 If any materials or Work furnished under this Contract are condemned by Texas Tech, the Contractor shall, after notice from Texas Tech, proceed to remove materials, whether worked or unworked, and to take down all portions of the Work condemned. Contractor shall make good all Work damaged or destroyed by the removal and replacement process.

8.6.3 Upon notice of condemnation, the Contractor may request to prove to Texas Tech, at Contractor's sole cost, that the Work should be accepted because it meets performance, and other relevant standards. Texas Tech shall respond to Contractor's showing of proof in writing.

8.6.4 Should work be identified by either the Design Professional and/or ODR as

not being in compliance with the Contract Documents, such work shall be corrected by the Contractor at its expense. The approval of work by either the Design Professional and/or the ODR, or their failure to reject work, does not relieve the Contractor from compliance with all requirements of the Contract Documents.

8.6.5 The Contractor shall, without charge, replace any material or correct any workmanship found by Texas Tech not to conform to the Contract requirements, unless in the public interest Texas Tech consents in writing to accept such material or workmanship with an appropriate adjustment in the Contract Sum. The Contractor shall promptly correct all Work rejected by Texas Tech as defective or as failing to conform to the Contract Documents, whether observed before or after the Date of Substantial Completion or Final Inspection and acceptance and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work.

8.6.6 If the Contractor does not promptly replace rejected material or correct rejected workmanship, Texas Tech may, 1) by contract or otherwise, replace such material or correct such workmanship and charge the cost thereof to the Contractor, 2) terminate the Contractor's employment, or 3) take any action Texas Tech deems appropriate.

Article 9. Construction Schedules

- 9.1 Contract Time. **TIME IS AN ESSENTIAL ELEMENT OF THE CONTRACT.** The Contract Time is the time between the dates indicated in the Notice to Proceed for commencement of the Work and for achieving Substantial Completion. The Contract Time can be modified only by Change Order. Failure to achieve Substantial Completion within the Contract Time as otherwise agreed to in writing will cause damage to Owner and may subject Contractor to liquidated damages as provided in the Contract Documents. If Contractor fails to achieve Final Completion in a reasonable time after Substantial Completion, Contractor shall be responsible for Owner's additional inspection, project management, and maintenance cost to the extent caused by Contractor's failure to achieve Final Completion.
- 9.2 Notice to Proceed. Owner will issue a Notice to Proceed which shall state the dates for beginning Work and for achieving Substantial Completion of the Work.
- 9.3 Work Progress Schedule. Refer to Supplementary General Conditions or Special Conditions for additional schedule requirements. Unless indicated otherwise in those documents, Contractor shall submit their initial Work Progress Schedule for the Work in relation to the entire Project not later than twenty-one (21) days after the effective date of the Notice to Proceed to ODR and A/E. Unless otherwise indicated in the Contract Documents, the Work Progress Schedule shall be computerized Critical Path Method (CPM) with fully editable logic. This initial schedule shall indicate the dates for starting and completing the various aspects required to complete the Work, including **submittals,**

mobilization, procurement, installation, testing, inspection, delivery of Close-out Documents and acceptance of all the Work of the Contract. When acceptable to Owner, the initially accepted schedule shall be the Baseline Schedule for comparison to actual conditions throughout the Contract duration.

9.3.1 Schedule Requirements. Contractor shall submit electronic and paper copy of the initial Work Progress Schedule reflecting accurate and reliable representations of the planned progress of the Work, the Work to date if any, and of Contractor's actual plans for its completion. Contractor shall organize and provide adequate detail so the schedule is capable of measuring and forecasting the effect of delaying events on completed and uncompleted activities.

9.3.1.1 Contractor shall re-submit initial schedule as required to address review comments from A/E and ODR until such schedule is accepted as the Baseline Schedule.

9.3.1.2 Submittal of a schedule, schedule revision or schedule update constitutes Contractor's representation to Owner of the accurate depiction of all progress to date and that Contractor will follow the schedule as submitted in performing the Work.

9.3.1.3 **The Work Progress Schedule shall take account of the time required for the preparation and review of required Shop Drawings and Submittals. If required by the Special Conditions, the Contractor shall also submit a separate Submittal Schedule, correlated with the Work Progress Schedule that shows the dates the Contractor intends to make the required submittals.**

9.3.2 Schedule Updates. Contractor shall update the Work Progress Schedule and the Submittal Register monthly, as a minimum, to reflect progress to date and current plans for completing the Work, while maintaining original schedule as Baseline Schedule and submit paper and electronic copies of the update to A/E and ODR as directed, but as a minimum with each request for payment. Owner has no duty to make progress payments unless accompanied by the updated Work Progress Schedule. Show the anticipated date of completion reflecting all extensions of time granted through Change Order as of the date of the update. Contractor may revise the Work Progress Schedule when in Contractor's judgment it becomes necessary for the management of the Work. Contractor shall identify all proposed changes to schedule logic to Owner and to A/E via an executive summary accompanying the updated schedule for review prior to final implementation of revisions into a revised Baseline Schedule. Schedule changes that materially impact Owner's operations shall be communicated promptly to ODR and shall not be incorporated into the revised Baseline Schedule without ODR's consent.

9.3.3 The Work Progress Schedule is for Contractor's use in managing the Work and submittal of the schedule, and successive updates or revisions, is for the information of Owner and to demonstrate that Contractor has complied with

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requirements for planning the Work. Owner's acceptance of a schedule, schedule update or revision constitutes Owner's agreement to coordinate its own activities with Contractor's activities as shown on the schedule.

9.3.3.1 Acceptance of the Work Progress Schedule, or update and/or revision thereto does not indicate any approval of Contractor's proposed sequences and duration.

9.3.3.2 Acceptance of a Work Progress Schedule update or revision indicating early or late completion does not constitute Owner's consent, alter the terms of the Contract, or waive either Contractor's responsibility for timely completion or Owner's right to damages for Contractor's failure to do so.

9.3.3.3 Contractor's scheduled dates for completion of any activity or the entire Work do not constitute a change in terms of the Contract. Change Orders are the only method of modifying the Substantial Completion Date(s) and Contract Time.

9.3.4 **In accordance with the approved Critical Path Schedule, the Contractor shall coordinate the work specified under all Divisions herein. This coordination shall be done so that interferences will be avoided and provisions will be made sufficiently in advance of need to accommodate all of the Work required to complete the project.**

9.4 Ownership of Float. Unless indicated otherwise in the Contract Documents, Contractor shall develop its schedule, pricing, and execution plan to provide a minimum of ten (10) percent total float at acceptance of the Baseline Schedule. Float time contained in the Work Progress Schedule is not for the exclusive benefit of Contractor or Owner, but belongs to the Project and may be consumed by either party as needed on a first-used basis.

9.5 Completion of Work. Contractor is accountable for completing the Work within the Contract Time stated in the Contract, or as otherwise amended by Change Order.

9.5.1 If, in the judgment of Owner, the work is behind schedule and the rate of placement of work is inadequate to regain scheduled progress to insure timely completion of the entire work or a separable portion thereof, Contractor, when so informed by Owner, shall immediately take action to increase the rate of work placement by:

9.5.1.1 An increase in working forces.

9.5.1.2 An increase in equipment or tools.

9.5.1.3 An increase in hours of work or number of shifts.

9.5.1.4 Expedite delivery of materials.

9.5.1.5 Other action proposed if acceptable to Owner.

9.5.2 Within ten (10) days after such notice from ODR, Contractor shall notify ODR in writing of the specific measures taken and/or planned to increase the rate of progress. Contractor shall include an estimate as to the date of scheduled progress recovery and an updated Work Progress Schedule illustrating Contractor's plan for achieving timely completion of the Project. Should ODR deem the plan of action inadequate, Contractor shall take additional steps or make adjustments as necessary to its plan of action until it meets with ODR's approval.

9.6 Modification of the Contract Time.

9.6.1 Delays and extension of time as hereinafter described are valid only if executed in accordance with provisions set forth in Article 11.

9.6.2 When a delay defined herein as excusable prevents Contractor from completing the Work within the Contract Time, Contractor is entitled to an extension of time. Owner will make an equitable adjustment and extend the number of days lost because of excusable delay or Weather Days, as measured by Contractor's progress schedule. All extensions of time will be granted in calendar days. In no event, however, will an extension of time be granted for delays that merely extend the duration of non-critical activities, or which only consume float without delaying the project Substantial Completion date(s).

9.6.2.1 A "Weather Day" is a day on which Contractor's current schedule indicates Work is to be done, and on which inclement weather and related site conditions prevent Contractor from performing seven (7) continuous hours of Work between the hours of 7:00 a.m. and 6:00 p.m. Weather days are excusable delays. When weather conditions at the site prevent work from proceeding, Contractor shall immediately notify ODR for confirmation of the conditions. At the end of each calendar month, submit to ODR and A/E a list of Weather Days occurring in that month along with documentation of the impact on critical activities. **The "Weather Days" claimed shall be compared to the weather day allowances included in the Special Conditions, and any day in excess of the stated number of normal weather days shall be allowed as an additional day.** Based on confirmation by ODR, any time extension granted will be issued by Change Order. If Contractor and Owner cannot agree on the time extension, Owner may issue a ULCO (as defined in 11.9) for fair and reasonable time extension.

9.6.2.1.1 **"Inclement weather" as used herein means unusually severe weather that is beyond the normal weather recorded and expected for the locality and/or the seasons or seasons of the year. Normal weather shall be determined based on records**

National Weather Service Forecast Office.

9.6.2.2 Excusable Delay. Contractor **is may be** entitled to an equitable adjustment of the Contract Time, issued via change order, for delays caused by the following:

9.6.2.2.1 Errors, omissions and imperfections in design, which A/E corrects by means of changes in the Drawings and Specifications.

9.6.2.2.2 Unanticipated physical conditions at the Site, which A/E corrects by means of changes to the Drawings and Specifications or for which ODR directs changes in the Work identified in the Contract Documents.

9.6.2.2.3 Changes in the Work that effect activities identified in Contractor's schedule as "critical" to completion of the entire Work, if such changes are ordered by ODR or recommended by A/E and ordered by ODR.

9.6.2.2.4 Suspension of Work for unexpected natural events (sometimes called "acts of God"), civil unrest, strikes or other events which are not within the reasonable control of Contractor.

9.6.2.2.5 Suspension of Work for convenience of ODR, which prevents Contractor from completing the Work within the Contract Time.

9.6.3 Contractor's relief in the event of such delays is the time impact to the critical path as determined by analysis of Contractor's schedule. In the event that Contractor incurs additional direct costs because of the excusable delays other than described in Subparagraph 9.6.2.2.4 and within the reasonable control of Owner, the Contract price and Contract Time are to be equitably adjusted by Owner pursuant to the provisions of Article 11.

9.7 No Damages for Delay. Contractor has no claim for monetary damages for delay or hindrances to the work from any cause, including without limitation any act or omission of Owner.

9.8 Concurrent Delay. When the completion of the Work is simultaneously delayed by an excusable delay and a delay arising from a cause not designated as excusable, Contractor may not be entitled to a time extension for the period of concurrent delay.

9.9 Other Time Extension Requests. Time extensions requested in association with changes to the Work directed or requested by Owner shall be included with Contractor's proposed costs for such change. Time extensions requested for inclement weather are covered by Paragraph 9.6.2.1 above. If Contractor believes that the completion of the Work is delayed by a circumstance other than for changes directed to the Work or weather, they

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shall give ODR written notice, stating the nature of the delay and the activities potentially affected, within five (5) days after the onset of the event or circumstance giving rise to the excusable delay. Contractor shall provide sufficient written evidence to document the delay. In the case of a continuing cause of delay, only one claim is necessary. State claims for extensions of time in numbers of whole or half days.

9.9.1 Within ten (10) days after the cessation of the delay, Contractor shall formalize its request for extension of time in writing to include a full analysis of the schedule impact of the delay and substantiation of the excusable nature of the delay. All changes to the Contract Time or made as a result of such claims is by Change Order, as set forth in Article 11.

9.9.2 No extension of time releases Contractor or the Surety furnishing a performance or payment bond from any obligations under the Contract or such a bond. Those obligations remain in full force until the discharge of the Contract.

9.9.3 Contents of Time Extension Requests. Contractor shall provide with each Time Extension Request a quantitative demonstration of the impact of the delay on project completion time, based on the Work Progress Schedule. Contractor shall include with Time Extension Requests a reasonably detailed narrative setting forth:

9.9.3.1 The nature of the delay and its cause; the basis of Contractor's claim of entitlement to a time extension.

9.9.3.2 Documentation of the actual impacts of the claimed delay on the critical path indicated in Contractor's Work Progress Schedule, and any concurrent delays.

9.9.3.3 Description and documentation of steps taken by Contractor to mitigate the effect of the claimed delay, including, when appropriate, the modification of the Work Progress Schedule.

9.9.4 Owner's Response. Owner will respond to the Time Extension Request by providing to Contractor written notice of the number of days granted, if any, and giving its reason if this number differs from the number of days requested by Contractor.

9.9.4.1 Owner will not grant time extensions for delays that do not affect the Contract Substantial Completion date.

9.9.4.2 Owner will respond to each properly submitted Time Extension Request within fifteen (15) days following receipt. If Owner cannot reasonably make a determination about Contractor's entitlement to a time extension within that time, Owner will notify Contractor in writing. Unless otherwise agreed by Contractor, Owner has no more than fifteen (15) additional days to prepare a final response. If Owner fails to respond within forty-five (45) days from the date the Time Extension Request is

received, Contractor is entitled to a time extension in the amount requested.

9.9.4.3 Such an Extension of Time is effective on the date ODR notice is received by the Contractor, but a Change Order reflecting the Extension of Time shall be executed by the parties in accordance with Article 11.

9.10 Failure to Complete Work Within the Contract Time. TIME IS AN ESSENTIAL ELEMENT OF THE CONTRACT. Contractor's failure to substantially complete the Work within the Contract Time or to achieve Substantial Completion as required will cause damage to Owner. These damages shall be liquidated by agreement of Contractor and Owner, in the amount per day as set forth in the Contract Documents.

9.11 Liquidated Damages. Owner may collect liquidated damages due from Contractor directly or indirectly by reducing the Contract Sum in the amount of liquidated damages stated in the Supplementary General Conditions or Special Conditions.

9.11.1 Should the Contractor fail to complete the Work within the Contract period, including all officially approved extensions thereto, Texas Tech may collect from the Contractor or deduct from any funds owed the Contractor an amount equaling the damages caused by such delay. Damages shall include those specifically enumerated in the Contract Documents, such as liquidated damages, as well as any others authorized by law, including the cost of additional administrative, Design Professional, and ODR's expenses.

Article 10. Payments

10.1 Schedule of Values. Contractor shall submit to ODR and A/E for acceptance a Schedule of Values accurately itemizing material and labor for the various classifications of the Work based on the organization of the specification sections and of sufficient detail acceptable to ODR. The accepted Schedule of Values will be the basis for the progress payments under the Contract.

10.1.1 No progress payments will be made prior to receipt and acceptance of the Schedule of Values, provided in such detail as required by ODR, and submitted not less than twenty-one (21) days prior to the first request for payment. The Schedule of Values shall follow the order of trade divisions of the Specifications and include itemized costs for general conditions, costs for preparing close out documents, fees, contingencies, and Owner cash allowances, if applicable, so that the sum of the items will equal the Contract price. As appropriate, assign each item labor and/or material values, the subtotal thereof equaling the value of the work in place when complete.

10.1.1.1 Owner requires that the Work items be inclusive of the cost of the Work items only. Any contract markups for overhead and profit, general

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conditions, etc., shall be contained within separate line items for those specific purposes which shall be divided into at least two (2) lines, one (1) for labor and one (1) for materials.

10.1.2 Contractor shall retain a copy of all worksheets used in preparation of its bid or proposal, supported by a notarized statement that the worksheets are true and complete copies of the documents used to prepare the bid or proposal. Make the worksheets available to ODR at the time of Contract execution. Thereafter Contractor shall grant Owner during normal business hours access to said copy of worksheets at any time during the period commencing upon execution of the Contract and ending one year after final payment.

10.1.3 The Contractor shall not change the Schedule of Values or breakdown of the Contract Price once the Schedule of Values has been approved. Changes can only be made with written approval from the ODR.

10.1.4 All expended contingencies will be tracked on the Schedule of Values.

10.2 Progress Payments. Contractor will receive periodic progress payments for Work performed, materials in place, suitably stored on Site, or as otherwise agreed to by Owner and Contractor. Payment is not due until receipt by ODR or his designee of a correct and complete Pay Application in electronic and/or hard copy format as set forth in Supplementary General Conditions, Special Conditions, and certified by A/E. Progress payments are made provisionally and do not constitute acceptance of work not in accordance with the Contract Documents. Owner will not process progress payment applications for Change Order Work until all parties execute the Change Order.

10.2.1 Preliminary Pay Worksheet. Once each month that a progress payment is to be requested, the Contractor shall submit to A/E and ODR a complete, clean copy of a preliminary pay worksheet or preliminary pay application, to include the following:

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10.2.1.1 Contractor's estimate of the amount of Work performed, labor furnished and materials incorporated into the Work, using the established Schedule of Values;

10.2.1.2 An updated Work Progress Schedule including the executive summary and all required schedule reports;

10.2.1.3 HUB subcontracting plan Progress Assessment Report as required in Paragraph 4.2.5.1;

10.2.1.4 Such additional documentation as Owner may require as set forth in the Supplementary General Conditions or elsewhere in the Contract Documents;

10.2.1.5 Construction payment affidavit;

10.2.1.6 An estimate of the amount of Contractor billing for the next three (3) months; and

10.2.1.7 State of Texas Construction Voucher.

10.2.2 Contractor's Application for Payment. As soon as practicable, but in no event later than seven (7) days after receipt of the preliminary pay worksheet, A/E and ODR will meet with Contractor to review the preliminary pay worksheet and to observe the condition of the Work. Based on this review, ODR and A/E may require modifications to the preliminary pay worksheet prior to the submittal of an Application for Payment, and will promptly notify Contractor of revisions necessary for approval. As soon as practicable, Contractor shall submit its Application for Payment on the appropriate and completed form, reflecting the required modifications to the Schedule of Values required by A/E and/or ODR. Attach all additional documentation required by ODR and/or A/E, as well as an affidavit affirming that all payrolls, bills for labor, materials, equipment, subcontracted work and other indebtedness connected with Contractor's Application for Payment are paid or will be paid within the time specified in Tex. Gov't Code, Chapter 2251. No Application for Payment is complete unless it fully reflects all required modifications, and attaches all required documentation including Contractor's affidavit.

10.2.2.1 Contractor's Application for Payment shall be signed by a corporate officer or a representative specifically named by the Contractor.

10.2.3 Certification by Architect/Engineer. Within five (5) days or earlier following A/E's receipt of Contractor's formal Application for Payment, A/E will review the Application for Payment for completeness, and forward it to ODR. A/E will certify that the application is complete and payable, or that it is incomplete, stating in particular what is missing. If the Application for Payment is incomplete, Contractor shall make the required corrections and resubmit the

Application for Payment for processing.

10.3 Owner's Duty to Pay. Owner has no duty to pay the Contractor except on receipt by ODR of: 1) a complete Application for Payment certified by A/E; 2) Contractor's updated Work Progress Schedule; and 3) confirmation that Contractor's record documentation at the Site is kept current.

10.3.1 Payment for stored materials and/or equipment confirmed by Owner and A/E to be on-site or otherwise properly stored is limited to eighty-five (85) percent of the invoice price or eighty-five (85) percent of the scheduled value for the materials or equipment, whichever is less.

10.3.2 Retainage. Owner will withhold from each progress payment, as retainage, five (5) percent of the total earned amount, the amount authorized by law, or as otherwise set forth in the Supplementary General Conditions or Special Conditions. Retainage is managed in conformance with Tex. Gov't Code, Chapter 2252, Subchapter B.

10.3.2.1 Contractor shall provide written consent of its surety for any request for reduction or release of retainage.

10.3.2.2 At least sixty-five (65) percent of the Contract, or such other discrete Work phase as set forth in Subsection 12.1.6 or Work package delineated in the Contract Documents, must be completed before Owner can consider a retainage reduction or release.

10.3.2.3 Contractor shall not withhold retainage from their Subcontractors and suppliers in amounts that are any percentage greater than that withheld in its Contract with Owner under this subsection, unless otherwise acceptable to Owner.

10.3.2.4 **Upon Final Completion and Texas Tech's acceptance of all of the Work covered in the Contract Documents, Texas Tech will release the retainage to the Contractor, minus any amounts that Texas Tech is otherwise entitled to withhold.**

10.3.3 Price Reduction to Cover Loss. Owner may reduce any Application for Payment, prior to payment to the extent necessary to protect Owner from loss on account of actions of Contractor including, but not limited to, the following:

10.3.3.1 Defective or incomplete Work not remedied;

10.3.3.2 Damage to Work of a separate Contractor;

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10.3.3.3 Failure to maintain scheduled progress or reasonable evidence that the Work will not be completed within the Contract Time;

10.3.3.4 Persistent failure to carry out the Work in accordance with the Contract Documents;

10.3.3.5 Reasonable evidence that the Work cannot be completed for the unpaid portion of the Contract Sum;

10.3.3.6 Assessment of fines for violations of prevailing wage rate law; or

10.3.3.7 Failure to include the appropriate amount of retainage for that periodic progress payment.

10.3.3.8 **Failure to furnish all close-out documents as required by the Contract Documents.**

10.3.3.9 **For Contracts with a value of less than \$25,000 for which no payment bond is posted, receipt of written notice by Texas Tech of unpaid bills, filed in conformance with §53.232 et seq., Texas Property Code. Any funds so withheld shall be released to the Contractor if it furnishes a bond for release of lien as provided in §53.236, Texas Property Code.**

10.3.4 Title to all material and Work covered by progress payments transfers to Owner upon payment.

10.3.4.1 Transfer of title to Owner does not relieve Contractor and its Subcontractors of the sole responsibility for the care and protection of materials and Work upon which payments have been made until final acceptance, or the restoration of any damaged Work, or waive the right of Owner to require the fulfillment of all the terms of the Contract.

10.4 Progress Payments. Progress payments to Contractor do not release Contractor or its surety from any obligations under the Contract.

10.4.1 Upon Owner's request, Contractor shall furnish manifest proof of the status of Subcontractor's accounts in a form acceptable to Owner.

10.4.2 Pay estimate certificates must be signed by a corporate officer or a representative duly authorized by Contractor.

10.4.3 Provide copies of bills of lading, invoices, delivery receipts or other evidence of the location and value of such materials in requesting payment for materials.

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- 10.4.4 For purposes of Tex. Gov't Code § 2251.021(a)(2), the date the performance of service is complete is the date when ODR approves the Application for Payment.
- 10.5 Off-Site Storage. With prior approval by Owner and in the event Contractor elects to store materials at an off-site location, abide by the following conditions, unless otherwise agreed to in writing by Owner.
- 10.5.1 Store materials in a commercial warehouse meeting the criteria stated below.
- 10.5.2 Provide insurance coverage adequate not only to cover materials while in storage, but also in transit from the off-site storage areas to the Project Site. Copies of duly authenticated certificates of insurance, made out to insure the State agency which is signatory to the Contract, must be filed with Owner's representative.
- 10.5.3 Inspection by Owner's representative is allowed at any time. Owner's inspectors must be satisfied with the security, control, maintenance, and preservation measures.
- 10.5.4 Materials for this Project are physically separated and marked for the Project in a sectioned-off area. Only materials which have been approved through the submittal process are to be considered for payment.
- 10.5.5 Owner reserves the right to reject materials at any time prior to final acceptance of the complete Contract if they do not meet Contract requirements regardless of any previous progress payment made.
- 10.5.6 With each monthly payment estimate, submit a report to ODR and A/E listing the quantities of materials already paid for and still stored in the off-site location.
- 10.5.7 Make warehouse records, receipts and invoices available to Owner's representatives, upon request, to verify the quantities and their disposition.
- 10.5.8 In the event of Contract termination or default by Contractor, the items in storage off-site, upon which payment has been made, will be promptly turned over to Owner or Owner's agents at a location near the jobsite as directed by ODR. The full provisions of performance and payment bonds on this Project cover the materials off-site in every respect as though they were stored on the Project Site.
- 10.5.9 **Upon Owners request, Contractor shall submit photographs of the stored materials.**
- 10.6 Time for Payment by Contractor Pursuant to Tex. Gov't Code § 2255.022.
- 10.6.1 Contractor who receives a payment from a governmental entity shall pay Subcontractor the appropriate share of the payment not later than the tenth (10th) day after the date the vendor receives the payment.

10.6.2 The appropriate share is overdue on the eleventh (11th) day after the date Contractor receives the payment.

Article 11. Changes

11.1 Change Orders. A Change Order issued after execution of the Contract is a written order to Contractor, signed by **Owner**, Contractor, and A/E, authorizing a change in the Work or an adjustment in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time can only be changed by Change Order. A Change Order signed by Contractor indicates his agreement therewith, including the adjustment in the Contract Sum and/or the Contract Time. ODR may issue a written authorization for Contractor to proceed with Work of a Change Order in advance of final execution by all parties in accordance with Section 11.9.

11.1.1 Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, and the **Contingencies**, Contract Sum and the Contract Time will be adjusted accordingly. All such changes in the Work shall be authorized by **Change Directive**, Change Order or ULCO, and shall be performed under the applicable conditions of the Contract Documents. If such changes cause an increase or decrease in Contractor's cost of, or time required for, performance of the Contract, an equitable adjustment shall be made and confirmed in writing in a Change Order or a ULCO.

11.1.2 It is recognized by the parties hereto and agreed by them that the Specifications and Drawings may not be complete or free from errors, omissions and imperfections or that they may require changes or additions in order for the Work to be completed to the satisfaction of Owner and that, accordingly, it is the express intention of the parties, notwithstanding any other provisions in this Contract, that any errors, omissions or imperfections in such Specifications and Drawings, or any changes in or additions to same or to the Work ordered by Owner and any resulting delays in the Work or increases in Contractor's costs and expenses arising out of such errors, shall not constitute or give rise to any claim, demand or cause of action of any nature whatsoever in favor of Contractor, whether for breach of Contract, or otherwise; provided, however, that Owner shall be liable to Contractor for the sum stated to be due Contractor in any Change Order approved and signed by **all** parties, it being agreed hereby that such sum, together with any extension of time contained in said Change Order, shall constitute full compensation to Contractor for all costs, expenses and damages to Contractor, as permitted under Tex. Gov't Code, Chapter 2260.

11.1.3 Procedures for administration of Change Orders shall be established by Owner and stated in Supplementary General Conditions, Special Conditions, or elsewhere in the Contract Documents.

11.1.3.1 Effect of a Change Order. The execution of a Change Order by the

Owner, Contractor, and A/E constitutes the full, final and complete settlement of all claims with regard to the modifications contained in the Change Order for foreseeable impacts on the Contract Sum or the Contract Time; provided, however, that a Change Order may be reformed by a written modification signed by the Owner, Contractor, and the A/E for the limited purpose of correcting an error in computation.

11.1.3.2 Effect of a Unilateral Change Order conversion to a Change Order. The issuance of a ULCO does not prejudice any of the Contractor's rights to relief otherwise available under the Contract Documents. The Contractor may preserve such rights by submitting a written objection to the ULCO within 30 days of receipt of the ULCO. If the Contractor does not submit a written objection within that time, Contractor shall be deemed to have accepted the terms of the ULCO and the ULCO shall have the full force and effect of a Change Order.

11.1.3.3 Execution of Change Order. Not more than 45 days following the date of acceptance noted on the Change Directive (CD), or the deemed effective date pursuant to §11.7.6.1, but not later than the 90th day following the date of Substantial Completion, the Owner shall issue a Change Order, executed by the Owner and the Design Professional, attaching a copy of the accepted CD and incorporating it fully by reference. The Contractor shall execute the Change Order within 10 days of receipt of the executed Change Order.

11.1.4 No verbal order, verbal statement, or verbal direction of Owner or his duly appointed representative shall be treated as a change under this article or entitle Contractor to an adjustment.

11.1.5 Contractor agrees that Owner or any of its duly authorized representatives shall have access and the right to examine any directly pertinent books, documents, papers, and records of Contractor. Further, Contractor agrees to include in all its subcontracts a provision to the effect that Subcontractor agrees that Owner or any of its duly authorized representatives shall have access to and the right to examine any directly pertinent books, documents, papers and records of such Subcontractor relating to any claim arising from the Contract, whether or not the Subcontractor is a party to the claim. The period of access and examination described herein which relates to appeals under the Disputes article of the Contract, litigation, or the settlement of claims arising out of the performance of the Contract shall continue until final disposition of such claims, appeals or litigation.

11.1.6 Owner-Initiated Changes. The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions. When the Owner wishes to order changes in the Work, the Owner shall submit to the Contractor a Change Request (CR), consisting of a description of the request, including such Drawings and Specifications as are reasonably necessary to inform the Contractor of the nature of the change. Within 21 days of receipt of the Owner's CR, the Contractor shall submit a Change Proposal (CP) to the Owner, stating that the proposed change is a no-cost change, or proposing an adjustment in the Contract Sum, as provided under Article 11. Where an Owner-Initiated Change in the Work requires no increase in cost, the Owner shall issue and the Contractor shall execute a Change Directive (CD) documenting the change in scope of the Work that does not authorize a change in the Contract Sum.

11.1.7 Contractor-Initiated Changes. If the Contractor claims that it will incur additional cost or time because of any written instruction or interpretation of the Contract Documents, or instruction concerning the execution of the Work, issued by the Owner or the Design Professional, and constituting a constructive change in the scope or character of the Work, the Contractor may request a Change Order pursuant to this Article and, if appropriate, a Time Extension Request as provided by Article 9. When the Contractor considers that any written instruction or interpretation of the Contract Documents issued by the Owner or the A/E constitutes a change in the Work affecting the Contract Sum, the Contractor shall so notify the Owner as soon as possible, but not later than 15 days after receipt of the instruction or interpretation, and shall submit a CP to the Owner as soon as possible thereafter, but not later than 21 days after issuance of the notice. This CP shall contain a proposal for an adjustment in the Contract Sum, as provided under Article 11. The CP shall be accompanied by a copy of the writing containing the instruction or interpretation, evidence of the date the Contractor received the writing and an explanation of how the writing creates the need for a change, including all the changes as attributable to the schedule of values.

11.1.8 Commencement of Work. The Contractor shall not commence work on a change prior to receipt of a CD, or an ULCO, as set out in Article 11.

11.2 Unit Prices. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if the quantities originally contemplated are so changed in a Proposed Change Order that application of the agreed unit prices to the quantities of work proposed will cause substantial inequity to Owner or Contractor, the applicable unit prices shall be equitably adjusted as provided in the Supplementary General Conditions or Special Conditions or as agreed to by the parties and incorporated into a Change Order.

11.3 Claims for Additional Costs.

11.3.1 If Contractor wishes to make a claim for an increase in the Contract Sum not related to a requested change, they shall give Owner and A/E written notice thereof within twenty-one (21) days after the occurrence of the event giving rise to such claim, but, in any case before proceeding to execute the Work considered to be additional cost or time, except in an emergency endangering life or property in which case Contractor shall act in accordance with Subsection 7.2.1. No such claim shall be valid unless so made. If Owner and Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined as set forth under Article 15. Any change in the Contract Sum resulting from such claim shall be authorized by a Change Order or a ULCO.

11.3.2 If Contractor claims that additional cost is involved because of, but not limited to, 1) any written interpretation of the Contract Documents, 2) any order by Owner to stop the Work pursuant to Article 14 where Contractor was not at fault, or 3) any written order for a minor change in the Work issued pursuant to Section 11.4, Contractor shall make such claim as provided in Subsection 11.3.1.

11.3.3 Should Contractor or his Subcontractors fail to call attention of A/E to discrepancies or omissions in the Contract Documents, but claim additional costs for corrective Work after Contract award, Owner may assume intent to circumvent competitive bidding for necessary corrective Work. In such case,

11.3.3.1 Owner may choose to let a separate Contract for the corrective Work, or issue a ULCO to require performance by Contractor. Claims for time extensions or for extra cost resulting from delayed notice of patent Contract Document discrepancies or omissions will not be considered by Owner.

11.4 Minor Changes. A/E, with concurrence of ODR, will have authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time. Such changes shall be effected by written order which Contractor shall carry out promptly and record on as-built record documents.

11.5 Concealed Site Conditions. Contractor is responsible for visiting the Site and being familiar with local conditions such as the location, accessibility, and general character of the Site and/or building. If, in the performance of the Contract, subsurface, latent, or concealed conditions at the Site are found to be materially different from the information included in the Contract Documents, or if unknown conditions of an unusual nature are disclosed differing materially from the conditions usually inherent in Work of the character shown and specified, ODR and A/E shall be notified in writing of such conditions before they are disturbed. Upon such notice, or upon its own observation of such conditions, A/E, with the approval of ODR, will promptly make such changes in the Drawings and Specifications as they deem necessary to conform to the different conditions, and any increase or decrease in the cost of the Work, or in the time within which the Work is to be completed, resulting from such changes will be adjusted by

Change Directive or Change Order, subject to the prior approval of ODR.

- 11.6 Extension of Time. All changes to the Contract Time shall be made as a consequence of requests as required under Section 9.6, and as documented by Change Order as provided under Section 11.1.
- 11.7 Administration of Change Order Requests **and Change Directives**. All changes in the Contract shall be administered in accordance with procedures approved by Owner, and when required, make use of such electronic information management system(s) as Owner may employ.
- 11.7.1 Routine changes in the construction Contract shall be formally initiated by A/E by means of a ~~PCO~~ **CR** form detailing requirements of the proposed change for pricing by Contractor. This action may be preceded by communications between Contractor, A/E and ODR concerning the need and nature of the change, but such communications shall not constitute a basis for beginning the proposed Work by Contractor. Except for emergency conditions described below, approval of Contractor's cost proposal by A/E and ODR will be required for authorization (**Change Directive or Change Order**) to proceed with the Work being changed. Owner will not be responsible for the cost of Work changed without prior approval and Contractor may be required to remove Work so installed.
- 11.7.2 All proposed costs for changes **in the Work** must be supported by itemized accounting of material, equipment and associated itemized installation costs in sufficient detail, following the outline and organization of the established Schedule of Values, to permit analysis by A/E and ODR using current estimating guides and/or practices. Photocopies of Subcontractor and vendor proposals shall be furnished unless specifically waived by ODR. Contractor shall provide written response to a change request within twenty-one (21) days of receipt.
- 11.7.3 Any unexpected circumstance which necessitates an immediate change in order to avoid a delay in progress of the Work may be expedited by verbal communication and authorization between Contractor and Owner, with written confirmation following within twenty-four (24) hours. A limited scope not-to-exceed estimate of cost and time will be requested prior to authorizing Work to proceed. Should the estimate be impractical for any reason, ODR may authorize the use of detailed cost records of such work to establish and confirm the actual costs and time for documentation in a formal **Change Directive or Change Order**.
- 11.7.4 Emergency changes to save life or property may be initiated by Contractor alone (see Section 7.3) with the claimed cost and/or time of such work to be fully documented as to necessity and detail of the reported costs and/or time.
- 11.7.5 The method of incorporating approved Change Orders **or Change Directives** into the parameters of the accepted Schedule of Values must be coordinated and administered in a manner acceptable to ODR.

11.7.5.1 Owner will incorporate Change Orders and Change Directives into the Contract by formal amendment, signed by both parties.

11.7.6 Response to CP. As soon as possible, but not more than 21 days after receipt of any CP submitted by the Contractor, the ODR shall respond in writing by either (1) accepting the Contractor's proposal, (2) rejecting the same, (3) initiating negotiations with the Contractor concerning the proposed cost adjustment, or (4) requesting additional information. The ODR may also respond in writing by specifying that the change will cause the Contingency Allowance to be exceeded, and specifying that additional time is needed to process the change and receive necessary approvals. In those cases where Change work causes the Contingency Allowance to be exceeded, approval of the Owner will be necessary and approval of higher authority may be necessary. If such approvals are necessary, the Owner will have a least one hundred and twenty (120) additional calendar days to process such agreed changes.

11.7.6.1 Change Directive (CD). When agreement has been reached concerning the adjustment of cost, the ODR shall accept the Contractor's CP, or any subsequently revised CP issued pursuant to negotiation, by endorsing the CP "Accepted," with the date, and returning it to the Contractor. A CP that has been accepted is a Change Directive (CD). A CD is effective upon receipt and constitutes the Contractor's notice to proceed with the changed work, and entitles the Contractor to submit the adjusted cost of the Work on succeeding Pay Applications, as it is completed.

11.8 Pricing Change Order Work. The amounts that Contractor and/or its Subcontractor adds to a Change Order for profit and overhead will also be considered by Owner before approval is given. The amounts established hereinafter are the maximums that are acceptable to Owner.

11.8.1 For Work performed by its forces, Contractor will be allowed their actual costs for materials, the total amount of wages paid for labor, plus the total cost of State and Federal payroll taxes and of worker's compensation and comprehensive general liability insurance, plus additional bond and builders risk insurance cost if the change results in an increase in the premium paid by Contractor. To the total of the above costs, Contractor will be allowed to add a percentage as noted below to cover overhead and profit combined.

11.8.1.1 Allowable percentages for overhead and profit on any specific change shall not exceed fifteen (15) percent for the first \$10,000 of value for self-performed work or portion thereof, ten (10) percent for the second \$10,000 of value for self-performed work or portion thereof and seven and a half (7.5) percent for any value of the self-performed work that exceeds \$20,000.

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- 11.8.2 For subcontracted Work each affected Subcontractor shall figure its costs, overhead and profit as described above for Contractor's Work, all Subcontractor costs shall be combined, and to that total Subcontractor cost Contractor will be allowed to add a maximum mark-up of ten (10) percent for the first \$10,000 of subcontracted Work value or portion thereof, seven and half (7.5) percent for the second \$10,000 of subcontracted Work value or portion thereof, and five (5) percent for any value of the subcontracted Work exceeding \$20,000.
- 11.8.3 On changes involving both additions and deletions, percentages for overhead and profit will be allowed only on the net addition. Owner does not accept and will not pay for additional Contract cost identified as indirect or consequential damages.
- 11.8.4 For Contracts based on a Guaranteed Maximum Price (GMP), the Construction Manager-at-Risk or Design Builder shall NOT be entitled to a percentage mark-up on any Change Order Work unless the Change Order increases the Guaranteed Maximum Price.
- 11.9 Unilateral Change Order (ULCO). Owner may issue a written ULCO directing a change in the Work prior to reaching agreement with Contractor on the adjustment, if any, in the Contract price and/or the Contract Time.
- 11.9.1 Owner and Contractor shall negotiate for appropriate adjustments, as applicable, to the Contract Sum or the Contract Time arising out of a ULCO. As the changed Work is performed, Contractor shall submit its costs for such Work with its Application for Payment beginning with the next Application for Payment within thirty (30) days of the issuance of the ULCO. The Parties reserve their rights as to the disputed amount, subject to Article 15.
- 11.10 Final Resolution of Changes. Upon execution of a Change Order and /or a ULCO by Owner, Contractor and A/E, all costs and time issues regarding that change are final and not subject to adjustment.
- 11.11 Contractor's Risk of Performance. Except as expressly provided in Article 11, the Contractor shall not be entitled to an increase in the Contract Sum or the Contract Time and shall bear full responsibility for all risks affecting the Contractor's cost of performance.**

Article 12. Project Completion and Acceptance

12.1 Closing Inspections.

12.1.1 Substantial Completion Inspection. When Contractor considers the entire Work or part thereof Substantially Complete, it shall notify ODR in writing that the Work will be ready for Substantial Completion inspection on a specific date. Contractor shall include with this notice Contractor's Punchlist to indicate that it has previously inspected all the Work associated with the request for inspection, noting items it has corrected and included all remaining work items with date scheduled for completion or correction prior to final inspection. The failure to include any items on this list does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents. If any of the items on this list prevents the Project from being used **or occupied** as intended, Contractor shall not request a Substantial Completion Inspection. Owner and its representatives will review the list of items and schedule the requested inspection, or inform Contractor in writing that such an inspection is premature because the Work is not sufficiently advanced or conditions are not as represented on Contractor's list.

12.1.1.1 Prior to the Substantial Completion inspection, Contractor shall furnish a copy of its marked-up Record Documents and a preliminary copy of each instructional manual, maintenance and operating manual, parts catalog, wiring diagrams, spare parts, specified written warranties, and like publications or parts for all installed equipment, systems, and like items as described in the Contract Documents. Delivery of these items is a prerequisite for requesting the Substantial Completion inspection.

12.1.1.2 On the date requested by Contractor, or as mutually agreed upon pending the status of the Open Items List, A/E, ODR, Contractor, and other Owner representatives as determined by Owner will jointly attend the Substantial Completion inspection, which shall be conducted by ODR or their delegate. If ODR determines that the Work is Substantially Complete, ODR will issue a Certificate of Substantial Completion to be signed by A/E, Owner, and Contractor establishing the date of Substantial Completion and identifying responsibilities for security and maintenance. A/E will provide with this certificate a list of Punchlist items (the pre-final Punchlist) for completion prior to final inspection. This list may include items in addition to those on Contractor's Punchlist, which the inspection team deems necessary to correct or complete prior to final inspection. If Owner occupies the Project upon determination of Substantial Completion, Contractor shall complete all corrective Work at the convenience of Owner, without disruption to Owner's use of the Project for its intended purposes.

12.1.2 Final Inspection. Contractor shall complete the list of items identified on the pre-final Punchlist prior to requesting a final inspection. Unless otherwise specified,

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or otherwise agreed in writing by the parties as documented on the Certificate of Substantial Completion, Contractor shall complete and/or correct all Work within thirty (30) days of the Substantial Completion date. Upon completion of the pre-final Punchlist work, Contractor shall give written notice to ODR and A/E that the Work will be ready for final inspection on a specific date. Contractor shall accompany this notice with a copy of the updated pre-final Punchlist indicating resolution of all items. On the date specified or as soon thereafter as is practicable, ODR, A/E and Contractor will inspect the Work. A/E will submit to Contractor a final Punchlist of open items that the inspection team requires corrected or completed before final acceptance of the Work.

12.1.2.1 Correct or complete all items on the final Punchlist before requesting Final Payment. Unless otherwise agreed to in writing by the parties, complete this work within seven (7) days of receiving the final Punchlist. Upon completion of the final Punchlist, notify A/E and ODR in writing stating the disposition of each final Punchlist item. A/E, Owner, and Contractor shall promptly inspect the completed items. When the final Punchlist is complete, and the Contract is fully satisfied according to the Contract Documents ODR will issue a certificate establishing the date of Final Completion. Completion of all Work is a condition precedent to Contractor's right to receive Final Payment.

12.1.2.2 **Representatives that may participate in Final Inspection include but are not limited to:**

12.1.2.2.1 The Design Professionals

12.1.2.2.2 The Contractor and Major Sub-Contractors

12.1.2.2.3 TTU, Angelo State University (ASU) and/or TTUHSC ODR's/ Construction Inspectors

12.1.2.2.4 TTU, ASU and/or TTUHSC Facilities Operation and Maintenance Representatives

12.1.2.2.5 Grounds Maintenance and The Landscape Architect

12.1.2.2.6 Custodial Operations

12.1.2.2.7 Others as required

12.1.2.3 **The A/E's final Punchlist from comments produced by the Final Inspection will be distributed as follows:**

12.1.2.3.1 Texas Tech's ODR and

12.1.2.3.2 Contractor

- 12.1.3 Annotation. Any Certificate issued under this Article may be annotated to indicate that it is not applicable to specified portions of the Work, or that it is subject to any limitation as determined by Owner.
- 12.1.4 Purpose of Inspection. Inspection is for determining the completion of the Work, and does not relieve Contractor of its overall responsibility for completing the Work in a good and competent fashion, in compliance with the Contract. Work accepted with incomplete Punchlist items or failure of Owner or other parties to identify Work that does not comply with the Contract Documents or is defective in operation or workmanship does not constitute a waiver of Owner's rights under the Contract or relieve Contractor of its responsibility for performance or warranties.
- 12.1.5 Additional Inspections.
- 12.1.5.1 If Owner's inspection team determines that the Work is not substantially complete at the Substantial Completion inspection, ODR or A/E will give Contractor written notice listing cause(s) of the rejection. Contractor will set a time for completion of incomplete or defective work acceptable to ODR. Contractor shall complete or correct all work so designated prior to requesting a second Substantial Completion inspection.
- 12.1.5.2 If Owner's inspection team determines that the Work is not complete at the final inspection, ODR or A/E will give Contractor written notice listing the cause(s) of the rejection. Contractor will set a time for completion of incomplete or defective work acceptable to ODR. Contractor shall complete or correct all Work so designated prior to again requesting a final inspection.
- 12.1.5.3 The Contract contemplates three (3) comprehensive inspections: the Substantial Completion inspection, the Final Completion inspection, and the inspection of completed final Punchlist items. The cost to Owner of additional inspections resulting from the Work not being ready for one or more of these inspections is the responsibility of Contractor. Owner may issue a ULCO deducting these costs from Final Payment. Upon Contractor's written request, Owner will furnish documentation of any costs so deducted. Work added to the Contract by Change Order after Substantial Completion inspection is not corrective Work for purposes of determining timely completion, or assessing the cost of additional inspections.
- 12.1.6 Phased Completion. The Contract may provide, or Project conditions may warrant, as determined by ODR, that designated elements or parts of the Work be completed in phases. Where phased completion is required or specifically agreed to by the parties, the provisions of the Contract related to closing inspections, occupancy, and acceptance apply independently to each designated element or part of the Work. For all other purposes, unless otherwise agreed by the parties in

writing, Substantial Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Substantial Completion certificate. Final Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Final Completion certificate.

12.2 Owner's Right of Occupancy. Owner may occupy or use all or any portion of the Work following Substantial Completion, or at any earlier stage of completion. Should Owner wish to use or occupy the Work, or part thereof, prior to Substantial Completion, ODR will notify Contractor in writing and identify responsibilities for security and maintenance. Work performed on the premises by third parties on Owner's behalf does not constitute occupation or use of the Work by Owner for purposes of this Article. All Work performed by Contractor after occupancy, whether in part or in whole, shall be at the convenience of Owner so as to not disrupt Owner's use of, or access to occupied areas of the Project.

12.2.1 Notice and Early Occupancy Proposal. If Texas Tech determines that substantial hardship will result if it is unable to occupy some portion of the Work prior to Substantial Completion, it shall so inform the Design Professional and the Contractor no less than thirty (30) days before the date Texas Tech wishes to occupy the Work, and designate those portions of the Work to be occupied and the uses to be made of the occupied premises. As soon as practicable, but not less than five (5) working days after receiving this notice, the Contractor shall make the designated portions of the Work available to the Design Professional and Texas Tech for observation. The Design Professional and Texas Tech shall observe the Work jointly with the Contractor. As soon as practicable, but not later than the third day next following the date of the inspection, the Design Professional shall prepare and submit to the ODR and the Contractor an Early Occupancy Proposal, specifying any Work that must be completed or corrected as well as any operation and maintenance manuals or other documentation necessary for the Work to be occupied by Texas Tech and used for the purposes designated by Texas Tech in its notice, and setting out the division of responsibility between Texas Tech and the Contractor for utilities, security, maintenance, insurance and liability for damage to the Work or damage arising from the condition of the Work. The Early Occupancy Proposal shall also specify whether the area to be occupied must be Substantially Complete before occupation, and shall specify the date for Substantial Completion of the Work to be occupied if other than the date previously specified by the Contract Documents.

12.2.2 Administration as Change Order. The Early Occupancy Proposal shall be administered as a Change Directive pursuant to the provisions of Article 11, except that the Contractor shall submit a Change Proposal (CP) as soon as possible, but not later than the seventh day following receipt of the Early Occupancy Proposal. All cost adjustments, including any increased costs of insurance, related to the Early Occupancy Proposal, shall be stated in the CP; any such relief not so requested shall be deemed waived. If the Early

Occupancy Proposal requires early Substantial Completion, the Contractor shall be entitled to an equitable cost adjustment for acceleration and impact costs, to be submitted pursuant to Article 11. If an early completion date is not required, the Contractor shall submit any claim for time extension as a Change in the Work and Change Directive. If by the date designated by the Owner as the proposed date of occupancy, the Owner and Contractor have not reached an agreement concerning adjustment of time or cost, or the division of responsibility for the occupied portions of the Work, the Owner may issue a ULCO.

12.2.3 Project Completion Administration with Early Occupancy. Where under the provisions of this Article the Contract Time is modified for any part of the Work due to early occupancy, then the provisions of Article 12 shall apply. All required documentation shall be furnished by the Contractor to the Owner on or before the date of occupation by the Owner.

12.3 Acceptance and Payment

12.3.1 Request for Final Payment. Following the certified completion of all work, including all final Punchlist items, cleanup, and the delivery of record documents, Contractor shall submit a certified Application for Final Payment and include all sums held as retainage and forward to A/E and ODR for review and approval.

12.3.2 Final Payment Documentation. Contractor shall submit, prior to or with the Application for Final Payment, final copies of all close out documents, maintenance and operating instructions, guarantees and warranties, certificates, Record Documents and all other items required by the Contract. Contractor shall submit evidence of return of access keys and cards, evidence of delivery to Owner of attic stock, spare parts, and other specified materials. Contractor shall submit consent of surety to Final Payment form and an affidavit that all payrolls, bills for materials and equipment, subcontracted work and other indebtedness connected with the Work, except as specifically noted, are paid, will be paid, after payment from Owner or otherwise satisfied within the period of time required by Tex. Gov't Code, Chapter 2251. Contractor shall furnish documentation establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of claims and liens arising out of the Contract. Contractor may not subsequently submit a claim on behalf of Subcontractor or vendor unless Contractor's affidavit notes that claim as an exception.

12.3.2.1 Prior to Final Payment, Contractor shall submit all project record documents including "As-Built" record documents. Project record documents include but are not limited to: Contract Drawings and Specifications, Addenda, Approved Shop Drawings, Change Order, negotiated changes, submittal registers, RFI registers, punchlist, field test reports and inspections, materials testing reports, field reports, approved submittal data, equipment operation and maintenance manuals, and warranty information.

- 12.3.2.2 **Prior to Final Payment, Contractor shall submit two (2) copies each of above to Design Professional for review and approval, one (1) copy of which shall be returned to Contractor approved or with instructions for changes. After approval, submit four (4) hardcopies and two (2) electronic copies to Design Professional who will forward three (3) hardcopies and one (1) electronic copies to Texas Tech Facilities Planning & Construction (FP&C) for distribution.**
- 12.3.2.3 **Label each document "PROJECT RECORD" and accompany each submittal with transmittal letter containing: date, project title, TTU/ASU/TTUHSC Facilities Management project number, Contractor's name and address, title of each record document, certification in writing that each document, as submitted, is complete and accurate, and signature of Contractor or his authorized representative.**
- 12.3.2.4 **All the above shall be submitted and approved prior to Final Payment to Contractor.**
- 12.3.2.5 **Failure to supply any of the above, and if Texas Tech must otherwise obtain this information and data, the costs for obtaining it will be deducted from the Contractor's Final Payment.**
- 12.3.2.6 **AS-BUILT DRAWINGS. Upon completion of construction and prior to Final Payment, Contractor shall provide Design Professional with clean, complete set of prints and CD marked to record actual construction showing all deviations from, additions to, or changes in Contract Drawings. A color copy of the final jobsite as-built drawings and specifications will be submitted to FP&C.**
- 12.3.2.7 **SPECIFICATIONS AND ADDENDA. Upon completion of construction and prior to Final Payment, Contractor shall provide Design Professional with a CD and a clean, complete set of Specifications, and Addenda, each Section marked to record the manufacturer, trade name, catalog number of each product, and item of equipment actually installed and any changes made by Change Order or Change Request or any other matters not originally specified on the Contract Documents.**
- 12.3.2.8 **OPERATING AND MAINTENANCE MANUALS AND INDEX. Prior to Final Payment, Contractor shall provide maintenance information and operations instructions for equipment and systems installed. Prepare operating and maintenance instructions for equipment, particular Mechanical and Electrical items that will require adjustment, servicing, or attention for its proper operation.**

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Provide the following data bound in a neat brochure including all approved fixture brochures, wiring diagrams, control diagrams, and directions; repair parts list of major equipment items including suppliers and companies servicing installed equipment; valve tag charts and diagrams; list of products incorporated in work, referenced to Specification Section if other than product specified. Provide and Index listing equipment referenced to Specification Sections

- 12.3.2.9 **Prior to Final Payment, Contractor shall provide Operating instructions for heating, cooling, and other mechanical systems necessary for Texas Tech to make full and efficient use of equipment including recommended maintenance and seasonal change-over procedures. Submit two (2) copies of instructions to Design Professional for review and approval, one (1) copy of which shall be returned to Contractor approved or with instructions for changes. After approval, submit three (3) copies of instructions covering equipment to Design Professional who will forward two (2) copies to Texas Tech for information and use.**
- 12.3.2.10 **APPROVED MECHANICAL AND ELECTRICAL SUBMITTAL DATA. Prior to Final Payment, Contractor shall provide three (3) copies of Mechanical and Electrical Submittal Data to Design Professional who will forward two (2) copies to Texas Tech for information and use.**
- 12.3.2.11 **ADDENDA AND NEGOTIATED CHANGES. Prior to Final Payment, Contractor shall provide three (3) copies of Addenda and Negotiated Changes to Design Professional who will forward two (2) copies to Texas Tech for information and use.**
- 12.3.2.12 **SYSTEMS DEMONSTRATIONS. After submission of written instructions and prior to Final Payment, Contractor shall furnish competent operation engineer or engineers at such time or times as directed by Design Professional to meet with Texas Tech representatives, to fully explain instructions and to demonstrate and fully familiarize Texas Tech or his representatives with equipment and phases of its operation and maintenance. Instructions shall be adequate to extent that Texas Tech's personnel may proceed with normal operations in a safe and efficient manner.**
- 12.3.2.13 **FINAL PAYMENT SUBMISSION. Submit three (3) copies of the following to Design Professional who will forward two (2) copies to the Texas Tech**
- 12.3.2.13.1 **Certificate of Substantial Completion (AIA Form G704)**

12.3.2.13.1.1 Certificate of Punch List Completion on Architect's letterhead with a copy of the punch list attached

12.3.2.13.2 Change Orders:

12.3.2.13.2.1 AIA form G701

12.3.2.13.2.2 Incorporates Change Letters and deducts remainder of the Allowance from Contract amount

12.3.2.13.2.3 All Change Letters, back-up material, and authorizations

12.3.2.13.3 Consent of Surety Company for Final Payment, AIA form G707

12.3.2.13.4 Submit State of Texas Construction Voucher marked ESTIMATE NO. _____, FINAL. Include HUB Vendors Subcontractor Payment Sheet indicating Final Submission.

12.3.3 Architect/Engineer Approval. A/E will review a submitted Application for Final Payment promptly but in no event later than ten (10) days after its receipt. Prior to the expiration of this deadline, A/E will either: 1) return the Application for Final Payment to Contractor with corrections for action and resubmission; or 2) accept it, note their approval, and send to Owner.

12.3.4 Offsets and Deductions. Owner may deduct from the Final Payment all sums due from Contractor. If the Certificate of Final Completion notes any Work remaining, incomplete, or defects not remedied, Owner may deduct the cost of remedying such deficiencies from the Final Payment. On such deductions, Owner will identify each deduction, the amount, and the explanation of the deduction on or by the twenty-first (21st) day after Owner's receipt of an approved Application for Final Payment. Such offsets and deductions shall be incorporated via a final Change Order, including a ULCO as may be applicable.

12.3.5 Final Payment Due. Final Payment is due and payable by Owner, subject to all allowable offsets and deductions, on the thirtieth (30th) day following Owner's approval of the Application for Payment. If Contractor disputes any amount deducted by Owner, Contractor shall give notice of the dispute on or before the thirtieth (30th) day following receipt of Final Payment. Failure to do so will bar any subsequent claim for payment of amounts deducted.

12.3.6 Effect of Final Payment. Final Payment constitutes a waiver of all claims by Owner, relating to the condition of the Work except those arising from:

12.3.6.1 Faulty or defective Work appearing after Substantial Completion (latent defects);

12.3.6.2 Failure of the Work to comply with the requirements of the Contract Documents;

12.3.6.3 Terms of any warranties required by the Contract, or implied by law; or

12.3.6.4 Claims arising from personal injury or property damage to third parties.

12.3.6.5 **The phrase “relating to the condition of the Work” as used herein means “relating to defects in materials and workmanship.”**

12.3.7 Waiver of Claims. Final payment constitutes a waiver of all claims and liens by Contractor except those specifically identified in writing and submitted to ODR prior to the application for Final Payment.

12.3.8 Effect on Warranty. Regardless of approval and issuance of Final Payment, the Contract is not deemed fully performed by Contractor and closed until the expiration of all warranty periods.

Article 13. Warranty and Guarantee

13.1 Contractor’s General Warranty and Guarantee. Contractor warrants to Owner that all Work is executed in accordance with the Contract, complete in all parts and in accordance with approved practices and customs, and of the required finish and workmanship. Contractor further warrants that unless otherwise specified, all materials and equipment incorporated in the Work under the Contract are new. Owner may, at its option, agree in writing to waive any failure of the Work to conform to the Contract, and to accept a reduction in the Contract price for the cost of repair or diminution in value of the Work by reason of such defect. Absent such a written agreement, Contractor’s obligation to perform and complete the Work in accordance with the Contract Documents is absolute and is not waived by any inspection or observation by Owner, A/E or others, by making any progress payment or final payment, by the use or occupancy of the Work or any portion thereof by Owner, at any time, or by any repair or correction of such defect made by Owner.

13.1.1 **In case of work performed by Subcontractors and where guarantees are required, the Contractor shall secure warranties from said Subcontractors addressed to and in favor of Texas Tech; deliver copies of same to Texas Tech upon completion of the Work; and guarantee and assume full responsibility for the full period of said warranties. Delivery of said guarantees shall not relieve the Contractor from any obligations assumed under any other provisions of the Contract. This warranty and guarantee is not the exclusive remedy of Texas Tech but is in addition to the general obligation of the Contractor to faithfully perform the Contract, and it in no way limits the responsibility of the Contractor for faulty materials or workmanship.**

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- 13.2 Warranty Period. Except as may be otherwise specified or agreed, Contractor shall repair all defects in materials, equipment, or workmanship appearing within one year from the date of Substantial Completion of the Work. If Substantial Completion occurs by phase, then the warranty period for that particular Work begins on the date of such occurrence, or as otherwise stipulated on the Certificate of Substantial Completion for the particular Work.
- 13.3 Limits on Warranty. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
- 13.3.1 Modification or improper maintenance or operation by persons other than Contractor, Subcontractors, or any other individual or entity for whom Contractor is not responsible, unless Owner is compelled to undertake maintenance or operation due to the neglect of Contractor.
 - 13.3.2 Normal wear and tear under normal usage after acceptance of the Work by Owner. **Includes Abuse.**
- 13.4 Events Not Affecting Warranty. Contractor's obligation to perform and complete the Work in a good and workmanlike manner in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of defective Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
- 13.4.1 Observations by Owner and/or A/E;
 - 13.4.2 Recommendation to pay any progress or final payment by A/E;
 - 13.4.3 The issuance of a certificate of Substantial Completion or any payment by Owner to Contractor under the Contract Documents;
 - 13.4.4 Use or occupancy of the Work or any part thereof by Owner;
 - 13.4.5 Any acceptance by Owner or any failure to do so;
 - 13.4.6 Any review of a Shop Drawing or sample submittal; or
 - 13.4.7 Any inspection, test or approval by others.
- 13.5 Separate Warranties. If a particular piece of equipment or component of the Work for which the Contract requires a separate warranty is placed in continuous service before Substantial Completion, the warranty period for that equipment or component will not begin until Substantial Completion, regardless of any warranty agreements in place between suppliers and/or Subcontractors and Contractor. ODR will certify the date of service commencement in the Substantial Completion certificate.

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- 13.5.1 In addition to Contractor's warranty and duty to repair, Contractor expressly assumes all warranty obligations required under the Contract for specific building components, systems and equipment.
- 13.5.2 Contractor may satisfy any such obligation by obtaining and assigning to Owner a complying warranty from a manufacturer, supplier, or Subcontractor. Where an assigned warranty is tendered and accepted by Owner which does not fully comply with the requirements of the Contract, Contractor remains liable to Owner on all elements of the required warranty not provided by the assigned warranty.
- 13.5.3 **WARRANTIES AND GUARANTEES. Prior to Final Payment, Contractor shall provide to the Design Professional three (3) hard copies and one (1) electronic copy of all warranties, guarantees, and bonds required in various sections of Specifications. Contractor shall submit to Design Professional three (3) hard copies and one (1) electronic copy of a warranty written on Contractor's letterhead and in form approved by Design Professional, for work material and equipment for a minimum period of one (1) year from Substantial Completion. For equipment and component parts of equipment put into service during progress of construction, warranty will begin at the Date of Substantial Completion. For items of work where acceptance is delayed materially beyond the Date of Substantial Completion, provide updated submittal within ten (10) days after acceptance listing the date of acceptance as the start of the warranty period. Where guarantees for periods beyond one (1) year from date of final acceptance of work are required, such guarantees shall be written, and three (3) hard copies and one (1) electronic copy furnished to the Design Professional, on Contractor's letterhead using following format:**

"GUARANTEE FOR

We hereby guarantee that the

_____ which we have installed on the campus of Texas Tech University/Texas Tech University Health Sciences Center/ASU, (insert "City"), has been done in accordance with the Drawings and Specifications, and that the work as installed will fulfill the requirements of the Guarantee included in the Specifications. We agree to repair or replace any or all of our work, together with any other adjacent work which may be displaced by so doing that may prove to be defective in its workmanship or materials within a period of (insert guarantee period) year(s) from date of acceptance of the above mentioned structure by the Regents of Texas Tech University/Texas Tech University Health Sciences Center/ASU, ordinary wear and tear and unusual abuse or neglect excepted.

In the event of our failure to comply with the above mentioned conditions within a reasonable time, which in no case shall be longer than thirty (30) days after being notified in writing by the Regents of Texas Tech University/Texas Tech University Health Science Center/ASU, we collectively or separately do hereby authorize the Regents of Texas Tech University to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefore upon demand."

Signed _____

Subcontractor and/or Supplier

Countersigned _____

Prime Contractor

Warranty and Guarantee periods shall commence on the date of the Certificate of Substantial Completion unless otherwise specified.

Form of Submittal. Bind in commercial quality 8-1/2" x 11" three-ring binders, with hardback, cleanable, plastic covers. Also include one (1) electronic copy. Label cover of each binder with typed or printed title "WARRANTIES, GUARANTEES AND BONDS", with title of Project; name, address and telephone number of Contractor; and name of responsible principal. List Table of Contents, neatly typed, in the sequence

of the Table of Contents of the Project manual, with each item identified with the number and title of the specification section in which specified, and the name of Product or work item. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

- 13.6 Correction of Defects. Upon receipt of written notice from Owner, or any agent of Owner designated as responsible for management of the warranty period, of the discovery of a defect, Contractor shall promptly remedy the defect(s), and provide written notice to Owner and designated agent indicating action taken. In case of emergency where delay would cause serious risk of loss or damage to Owner, or if Contractor fails to remedy within thirty (30) days, or within another period agreed to in writing, Owner may correct the defect and be reimbursed the cost of remedying the defect from Contractor or its surety.
- 13.7 Certification of No Asbestos Containing Materials or Work. Contractor shall ensure compliance with the Asbestos Hazard Emergency Response Act (AHERA– 40 C.F.R § 763-99(7)) from all Subcontractors and materials suppliers, and shall provide a notarized certification to Owner that all equipment and materials used in fulfillment of their Contract responsibilities are non Asbestos Containing Building Materials (ACBM). This certification must be provided no later than Contractor’s application for Final Payment.

Article 14. Suspension and Termination

- 14.1 Suspension of Work for Cause. Owner may, at any time without prior notice, suspend all or any part of the Work, if after reasonable observation and/or investigation, Owner determines it is necessary to do so to prevent or correct any condition of the Work, which constitutes an immediate safety hazard, or which may reasonably be expected to impair the integrity, usefulness or longevity of the Work when completed.
- 14.1.1 Owner will give Contractor a written notice of suspension for cause, setting forth the reason for the suspension and identifying the Work suspended. Upon receipt of such notice, Contractor shall immediately stop the Work so identified. As soon as practicable following the issuance of such a notice, Owner will initiate and complete a further investigation of the circumstances giving rise to the suspension, and issue a written determination of the findings.
- 14.1.2 If it is confirmed that the cause was within the control of Contractor, Contractor will not be entitled to an extension of time or any compensation for delay resulting from the suspension. If the cause is determined not to have been within the control of Contractor, and the suspension has prevented Contractor from completing the Work within the Contract Time, the suspension is an excusable

delay and a time extension will be granted through a Change Order.

14.1.3 Suspension of Work under this provision will be no longer than is reasonably necessary to remedy the conditions giving rise to the suspension.

14.2 Suspension of Work for Owner's Convenience. Upon seven (7) days written notice to Contractor, Owner may at any time without breach of the Contract suspend all or any portion of the Work for a period of up to thirty (30) days for its own convenience. Owner will give Contractor a written notice of suspension for convenience, which sets forth the number of suspension days for which the Work, or any portion of it, and the date on which the suspension of Work will cease. When such a suspension prevents Contractor from completing the Work within the Contract Time, it is an excusable delay. A notice of suspension for convenience may be modified by Owner at any time on seven (7) days written notice to Contractor. If Owner suspends the Work for its convenience for more than sixty (60) consecutive days, Contractor may elect to terminate the Contract pursuant to the provisions of the Contract.

14.3 Termination by Owner for Cause.

14.3.1 Upon written notice to Contractor and its surety, Owner may, without prejudice to any right or remedy, terminate the Contract and take possession of the Site and of all materials, equipment, tools, construction equipment, and machinery thereon owned by Contractor under any of the following circumstances:

14.3.1.1 Persistent or repeated failure or refusal, except during complete or partial suspensions of work authorized under the Contract, to supply enough properly skilled workmen or proper materials;

14.3.1.2 Persistent disregard of laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, including ODR;

14.3.1.3 Persistent failure to prosecute the Work in accordance with the Contract, and to ensure its completion within the time, or any approved extension thereof, specified in the Contract;

14.3.1.4 Failure to remedy defective work condemned by ODR;

14.3.1.5 Failure to pay Subcontractors, laborers, and material suppliers pursuant to Tex. Gov't Code, Chapter 2251;

14.3.1.6 Persistent endangerment to the safety of labor or of the Work;

14.3.1.7 Failure to supply or maintain statutory bonds or to maintain required insurance, pursuant to the Contract;

14.3.1.8 Any material breach of the Contract; or

14.3.1.9 Contractor's insolvency, bankruptcy, or demonstrated financial inability

to perform the Work.

14.3.2 Failure by Owner to exercise the right to terminate in any instance is not a waiver of the right to do so in any other instance.

14.3.3 Should Owner decide to terminate the Contract under the provisions of Section 14.3, it will provide to Contractor and its surety thirty (30) days prior written notice.

14.3.4 Should Contractor or its surety, after having received notice of termination, demonstrate to the satisfaction of Owner that Contractor or its surety are proceeding to correct such default with diligence and promptness, upon which the notice of termination was based, the notice of termination may be rescinded in writing by Owner. If so rescinded, the Work may continue without an extension of time.

14.3.5 If Contractor or its surety fails, after written notice from Owner to commence and continue correction of such default with diligence and promptness to the satisfaction of Owner within thirty (30) days following receipt of notice, Owner may arrange for completion of the Work and deduct the cost of completion from the unpaid Contract Sum.

14.3.5.1 This amount includes the cost of additional Owner costs such as A/E services, other consultants, and contract administration.

14.3.5.2 Owner will make no further payment to Contractor or its surety unless the costs to complete the Work are less than the Contract balance, then the difference shall be paid to Contractor or its surety. If such costs exceed the unpaid balance, Contractor or its surety will pay the difference to Owner.

14.3.5.3 This obligation for payment survives the termination of the Contract.

14.3.5.4 Owner reserves the right in termination for cause to take assignment of all the Contracts between Contractor and its Subcontractors, vendors, and suppliers. ODR will promptly notify Contractor of the contracts Owner elects to assume. Upon receipt of such notice, Contractor shall promptly take all steps necessary to effect such assignment.

14.3.5.5 When the Contract is terminated by Texas Tech for cause, the Contractor will not be entitled to recover loss of anticipated profits or incidental damages.

14.3.5.6 If Texas Tech sues the Contractor or Surety on account of failure to pay such difference in cost upon demand, the Contractor and Surety will pay all costs in connection therewith, including reasonable attorney's fees and expenses. These obligations for payment shall survive the termination of the Contract.

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- 14.4 Conversion to Termination for Convenience. In the event that any termination of Contractor for cause under Section 14.3 is later determined to have been improper, the termination shall automatically convert to a termination for convenience under Section 14.5 and Contractor's recovery for termination shall be strictly limited to the payments allowable under Section 14.5.
- 14.5 Termination for Convenience of Owner. Owner reserves the right, without breach, to terminate the Contract prior to, or during the performance of the Work, for any reason. Upon such an occurrence, the following shall apply:
- 14.5.1 Owner will immediately notify Contractor and A/E in writing, specifying the reason for and the effective date of the Contract termination. Such notice may also contain instructions necessary for the protection, storage or decommissioning of incomplete work or systems, and for safety.
- 14.5.2 Upon receipt of the notice of termination, Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due at that point in the Contract:
- 14.5.2.1 Stop all work.
- 14.5.2.2 Place no further subcontracts or orders for materials or services.
- 14.5.2.3 Terminate all subcontracts for convenience.
- 14.5.2.4 Cancel all materials and equipment orders as applicable.
- 14.5.2.5 Take action that is necessary to protect and preserve all property related to the Contract which is in the possession of Contractor.
- 14.5.3 When the Contract is terminated for Owner's convenience, Contractor may recover from Owner payment for all Work executed. Contractor may not claim lost profits on other work or lost business opportunities.
- 14.6 Termination By Contractor. If the Work is stopped for a period of ninety (90) days under an order of any court or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of Contractor or Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with Contractor, then Contractor may, upon thirty (30) additional days written notice to ODR, terminate the Contract and recover from Owner payment for all Work executed, but not lost profits on other work or lost business opportunities. If the cause of the Work stoppage is removed prior to the end of the thirty (30) day notice period, Contractor may not terminate the Contract.
- 14.7 Settlement on Termination. When the Contract is terminated for any reason, at any time

prior to one hundred eighty (180) days after the effective date of termination, Contractor shall submit a final termination settlement proposal to Owner based upon recoverable costs as provided under the Contract. If Contractor fails to submit the proposal within the time allowed, Owner may determine the amount due to Contractor because of the termination and pay the determined amount to Contractor.

14.7.1 All settlements on termination shall be administered as Change Orders as provided under Articles 11. If the Contractor and Texas Tech fail to agree on the settlement amount, the matter will be handled as a dispute through administrative procedures set for the in Article 15.

Article 15. Dispute Resolution

- 15.1 Except to the extent Texas Civil Practices and Remedies Code (TCP) Chapter 114 applies to this Contract, NEITHER THE EXECUTION OF THE CONTRACT, ANYTHING IN THESE UNIFORM GENERAL CONDITIONS AND SUPPLEMENTARY GENERAL CONDITIONS, NOR ANY CONDUCT OF ANY REPRESENTATIVE OF TEXAS TECH UNIVERSITY SYSTEM OR ITS COMPONENT INSTITUTIONS SHALL WAIVE OR BE CONSIDERED A WAIVER OF SOVEREIGN IMMUNITY TO SUIT.
- 15.2 Unresolved Contractor Disputes Less Than \$250,000 or to Which TCP) Chapter 114 Does Not Apply. If the Contractor has an unresolved breach of contract claim for less than \$250,000 (with the amount in controversy as determined under TCP) Chapter 114) or to which TCP) Chapter 114 does not otherwise apply, the dispute resolution process provided for in Tex. Gov't Code, Chapter 2260, shall be used by Contractor to attempt to resolve any claim for breach of Contract made by Contractor that is not resolved under procedures described throughout the Uniform General Conditions, Supplementary Conditions, or Special Conditions of the Contract. The following provisions apply to disputes required to be resolved under Tex. Gov't Code, Chapter 2260.
- 15.2.1 A Contractor's claim for breach of this Contract that the Parties cannot resolve in the ordinary course of business shall be submitted to the negotiation process provided in Government Code, Chapter 2260, Subchapter B. To initiate the process, the Contractor shall submit written notice, as required by Subchapter B, to the Vice Chancellor for Facilities Planning and Construction with an additional copy to the Vice Chancellor and General Counsel. Said notice shall also be given to all other representatives of Texas Tech and the Contractor who are otherwise entitled to notice under the Agreement. Compliance by the Contractor with Subchapter B is a condition precedent to the filing of a contested case proceeding under Government Code, Chapter 2260, Subchapter C.**
- 15.2.2 The contested case process provided in Government Code Chapter 2260, Subchapter C, shall be the Contractor's sole and exclusive process for**

seeking a remedy for an alleged breach of contract by Texas Tech if the Parties are unable to resolve their disputes in the ordinary course of business or under section 15.2.1 of this provision, UNLESS, after considering the recommendation of the Administrative Law Judge, the Legislature grants the Contractor consent to sue under Chapter 107 of the Civil Practices and Remedies Code.

15.2.3 Pursuant to Chapter 2260, the submission, processing and resolution of the Contractor's claim is governed by the published rules adopted by the Texas Attorney General's Office, as currently effective, hereafter enacted or subsequently amended.

15.3 Suits Under TCPRC Chapter 114. Interest on an award for breach of contract subject to TCPRC Chapter 114 shall not exceed the lesser of the amount due on overdue payments under Tex. Gov't Code Ch. 2251.025, or the post-judgment rate set forth in Tex. Fin. Code §304.003(c), or 10%. Service of citation and other required process must be made on the Texas Attorney General and the Texas Tech University System Vice Chancellor and General Counsel. The conditions of TCPRC §107.002 (4), (5), (6), (7), (9), (10), (11), and (12) apply to any suits against Owner under TCPRC Chapter 114.

15.4 Alternative Dispute Resolution Process. Owner may establish a dispute resolution process to be utilized in advance of that outlined in Tex. Gov't Code, Chapter 2260 or prior to filing a suit under TCPRC Chapter 114.

15.5 Nothing herein shall hinder, prevent, or be construed as a waiver of Owner's right to seek redress on any disputed matter in a court of competent jurisdiction.

15.6 Neither party will be entitled to recover attorney's fees under the Contract.

15.7 Neither the occurrence of an event nor the pendency of a claim under this provision constitutes grounds for the suspension of performance by the Contractor, in whole or in part.

Article 16. Miscellaneous

16.1 Supplementary General and Special Conditions. When the Work contemplated by Owner is of such a character that the foregoing Uniform General Conditions **and Supplementary General Conditions** of the Contract cannot adequately cover necessary and additional contractual relationships, the Contract may include Supplementary General and Special Conditions as described below:

16.1.1 Supplementary General Conditions may describe the standard procedures and requirements of contract administration followed by a contracting agency of the State. Supplementary General Conditions may expand upon matters covered by the Uniform General Conditions, where necessary, provided the expansion does not weaken the character or intent of the Uniform General Conditions. Supplementary General Conditions are of such a character that it is to be

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anticipated that a contracting agency of the State will normally use the same, or similar, conditions to supplement each of its several projects.

16.1.2 Special Conditions shall relate to a particular Project and be unique to that Project but shall not weaken the character or intent of the Uniform General Conditions.

16.2 Federally Funded Projects. On Federally funded projects, Owner may waive, suspend or modify any Article in these Uniform General Conditions which conflicts with any Federal statute, rule, regulation or procedure, where such waiver, suspension or modification is essential to receipt by Owner of such Federal funds for the Project. In the case of any Project wholly financed by Federal funds, any standards required by the enabling Federal statute, or any Federal rules, regulations or procedures adopted pursuant thereto, shall be controlling.

16.3 Internet-based Project Management Systems. At its option, Owner may administer its design and construction management through an Internet-based management system. In such cases, Contractor shall conduct communication through this media and perform all Project related functions utilizing this database system. This includes correspondence, submittals, Requests for Information, vouchers or payment requests and processing, amendment, Change Orders and other administrative activities.

16.3.1 Accessibility and Administration.

16.3.1.1 When used, Owner will make the software accessible via the Internet to all Project team members.

16.3.1.2 Owner shall administer the software.

16.3.2 Training. When used, Owner shall provide training to the Project team members.

16.4 WRITTEN NOTICE. Written notice shall be considered to have been duly given if delivered in person to the individual or member of the firm or to an officer of the entity for whom it is intended, or if delivered at or sent by registered or certified mail to the last business address known to one who is giving the notice. Notice is deemed effective when received. Written notice to Texas Tech shall be delivered to:

**Vice Chancellor for Facilities Planning and Construction
Texas Tech University System
Box 42014
Lubbock, Texas 79409-2014
1508 Knoxville Ave., Suite 103
Lubbock, Texas 79409
Phone No.: (806) 742-2116**

With an additional copy of any Notice of Termination or Notice of Claim to:

**Vice Chancellor and General Counsel
Texas Tech University System
1508 Knoxville Ave., Suite 309
Lubbock, Texas 79409
Phone No.: (806) 742-2155**

- 16.5 To the extent a Contract relates to a project as defined in Texas Government Code §2252.201(5) (a project to construct, remodel, or alter a building, structure, or infrastructure; to supply material for such a project; or to finance, refinance, or provide funds for such a project), and no exemption in Texas Government Code §2252.203 applies, any iron or steel product produced through a manufacturing process and used in the project that is the subject of a Contract must be produced in the United States (as defined in Texas Government Code §2252.201(4)).**
- 16.6 Pursuant to Texas Government Code §2270.001, the Vendor affirmatively states that it does not boycott Israel. Additionally, the Vendor shall not engage in a boycott of Israel during the term of an Agreement.**

End of Uniform General Conditions and Supplementary General Conditions.