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SECTION 01 00 90 –GENERAL INFORMATION AND REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. GENERAL DESCRIPTION OF WORK REQUIRED IN THIS CONTRACT: The work shall consist of providing all labor, equipment, supplies and materials to perform the following in the hatchery's 1,375 SqFt Residence #2 (#341- White Cinder Block House)-(Asset #10006233) which was originally constructed in 1961 and the associated 400SqFt detached garage/storage building:
1. To replace all the electrical wiring and electrical equipment to upgrade the residence to the 2017 National Electric Code (NEC),
 2. To replace all the domestic water piping and all sanitary sewer piping to upgrade the residence to the latest Plumbing Code,
 3. To replace the existing tank-type hot water heater with a new instantaneous tank-less water heater,
 4. To replace all communication wiring and outlet terminal equipment,
 5. Remove and existing gypsum walls, ceiling and trim which shall include proper abating asbestos and lead paint materials, and
 6. Replace all walls, ceiling, trim and etc that were removed for accessing and replacing the existing electrical wiring and plumbing which shall include all finishes and painting to return the residence back to habitable conditions. This shall include reinstalling existing kitchen cabinetry and other similar items, which were also removed for the electrical wiring and plumbing replacement work.
 7. All work shall comply with the specifications and as shown on the drawings herein.
- B. NOTE - NEW PLUMBING REQUIREMENT: After the drawings were Finalized and Stamped, it was confirmed that the residence has ONE Hose bib that needs to be added to the required plumbing work as follows:
1. Delete Note #14 on Drawing P-3.
 2. Add NEW Note #14 on Drawing P-3 as follows: "Remove and Replace one existing, exterior, freeze proof hose-bibs faucets and the associated piping at the same location. The Hose-Bib is on the Southwest exterior wall under the Office window.
 3. The new associated piping shall be PEX.
- C. WORK LOCATION: The address of the work is at the Inks Dam NFH, 345 Clay Young Road, Burnet Texas 78611.
- D. SITE VISIT: Contractors shall visit project site and inspect existing conditions prior to submitting quotes. One site visit will be schedule thru the Contracting Officer before bidding- See Federal Acquisition Regulation (FAR) clause 52.236-27 "Site Visit". Contact Jeff Conway - Hatchery Manager, 512-793-2474, to be placed on the list for the scheduled site visit.
- E. PROJECT CONTACTS: Refer to Federal Acquisition Regulation and main Contract Solicitation parts for assigned project points of contact and their contact information.

1.2 PERFORMANCE TIME and LIQUIDATED DAMAGES:

- A. The residence is currently inhabited and the government will provide temporary housing for the current residents along with storage units for their personal property for duration of the project so the contractor will have unrestricted access to the residence to perform the specified work during normal hatchery hours of operation.
- B. As a result, the total performance time for this contract is 45 calendar days from when the Notice to Proceed is issued which is anticipated to be at the first of the month. The performance time shall include detailed technical materials submittal approvals, material and equipment acquisition, installation, testing, adjusting, reporting, clean-up, final inspection and project closeout. The actual Notice to Proceed date can be negotiable but must be agreeable to the current residents, the contractor and the on-site government personnel.
- C. Liquidated damages will be assessed after the period of performance expires at a rate \$300/day.
- D. Refer to Paragraph 3.2 B below, for anticipated normal hatchery access hours for construction work activities. Coordinate with the hatchery manager, CI and COR for requesting any variance in the hatchery's established work hours.
- E. It is anticipated that Residence #3 shall be totally complete before a Notice to Proceed will be given for Residence #2 work.

1.3 REFERENCES

- A. Referenced Specifications/Standards with Abbreviations and/or Acronyms: Wherever the following acronyms are used in these specifications or on the drawings, they are to be construed the same as the respective expressions represented. Copies of the referenced specifications/standards referred to herein may be procured by the Contractor.
- B. See individual contract specification for referenced Standards and or Specifications.

1.4 CODE COMPLIANCE: Refer to individual contract specification sections and drawings for specific required Codes applicable to this project.

1.5 PROJECT SCOPE OF WORK: Refer to drawings and individual project technical specifications.

- A. INSTALLER QUALIFICATION: Refer to drawings and individual project technical specifications for specific installer qualifications requirements.

1.6 SITE CONDITIONS

- A. Asbestos Survey: An asbestos survey was conducted in 1999; refer to specification and drawings for specific contract requirements.

- B. Lead Paint Survey: A lead-based paint survey was conducted in 1999; refer to specification and drawings for specific contract requirements
- C. Non-potable water and electric power for construction is available in limited quantities. Contractor shall make any arrangements necessary for the use of water and/or electrical power. Contractor shall provide drinking water and sanitary services / “Porta-Potties” for employee use for duration of the contract.
- D. Provide notice to Fish Hatchery Manager for his/her approval at least 72 hours in advance of any requested power outage.
- E. EXISTING UNDERGROUND SURVEYS- Contractor shall conduct the following underground surveys to locate and mark any exiting underground utilities or water lines before performing any earth excavations or earth moving operations around the work site associated with the contract’s work execution:
 - 1. Utility Locator Service: Notify local utility locator serving the Project area to locate and mark known utilities around the work site.
 - 2. Contractor shall perform an underground survey for existing underground metallic pipe-lines, warning tapes, and electrical circuits before beginning any earth excavations or moving operations around the work site.
 - 3. Contractor shall inquire and consult with hatchery personnel to identify any known underground utility, service, electrical, phone, and etc. before beginning any earth excavations or moving operations around the work site.
- F. Existing property not indicated for demolition, shall be protected. All damage caused by Contractor’s activities shall be repaired by the Contractor at no additional cost to the Government.
- G. BEFORE PERFORMING ANY ON-SITE MODIFICATION to the existing (electrical, control, mechanical, plumbing) systems, the contractor shall witness the current operational condition of the various systems and note any malfunctioning equipment in the building. The government’s designated construction inspector (CI) shall demonstrate the operations of the various existing systems. This demonstration shall be documented in the CI’s daily log along with documenting any specific operational problems or existing condition issues. Both, the contractor’s designated on-site representative and the government CI shall sign the daily log agreeing to the current operation conditions. The government inspector shall provide copies of the signed daily log to the contractor, the Contracting Officer (CO), the hatchery manager, and the Contracting Officer’s Representative (COR) before disturbing the existing system.
- H. PROTECTION OF EXISTING LANDSCAPE: Protect all vegetation inside and outside work limits. All rutting caused by Contractor activities shall be filled and contoured to match adjacent areas. Areas damaged by Contractor activities shall be repaired at no addition cost to the government.
- I. This is a NON SMOKING facility. Contractor personnel are not allowed to smoke on FWS property. Smoking is only allowed in contractor’s personal vehicles and all trash generated from such activities must be removed from FWS grounds.

1.7 SUBMITTALS

A. SUBMITTAL PROCEDURES AND REQUIREMENTS AFTER AWARD:

1. All Submittals, technical data for materials and supplies to be provided under the contract, Request for Information (RFI), and Request for Contract Changes, shall be delivered to the governments designated Contracting Officer (CO) and/or Contracting Officer's Representative (COR) at U.S. Fish and Wildlife Service, Region 2, Division of Engineering, P.O. Box 1306, Albuquerque, NM 87103-1306. The designated COR will be assigned by the CO as part of the Contract Award Package along with their contact information.
2. Contractor shall email electronic (PDF) submittal drawings, specification, shop drawings and etc, to the designated government COR for review, comment, and approval. After reviewing the submittals, the CO/COR will return the appropriate electronic (PDF) comments and approvals by email to the contractor's designated project manager. Contractor shall be responsible for distributing the government's review, comments and approvals to his suppliers and sub-contractors.
3. Submittals shall come directly from the Contractor with their stamp and signature of approval; submittals will not be accepted from sub-contractors or suppliers.
4. Do not commence with work which requires review of any submittals until receipt of returned submittals with an acceptable action. Do not allow submittals without an acceptable action marking to be used for the project.
5. There will be no approval of technical data submittals prior to contract award.
6. All Technical Product Data, Description and Shop Drawings shall be submitted to the designated Contracting Officer's Representative (COR) for review and approval before ordering or installing equipment. Submittals will be evaluated based on the contract requirements stated in the specifications and/or on the drawings. Refer to specification sections for submittals required. Unapproved equipment may not be accepted.
7. Each Technical Submittal shall have an appropriately filled out USFWS Submittal Transmittal Form (#REN-021) which will serve as a submittal summary and tracking device. The form will be provided as part of the Contract Award Package.
8. Each Technical Submittal shall be highlighted to clearly show contract compliance requirements and what options or features will be provided.
9. APPROVALS: Approval of the technical submittals is an indication that the Contractor's submittals have been reviewed and that there are no exceptions taken, except as noted. Approval of deviations shall apply only to those deviations or omissions from the requirements of the drawings and specifications that are specifically brought to the Contracting Officer's attention in writing. After an item has received an approval and a substitution is necessary, resubmit the new substitute item for a new approval. Approval of submittals does not relieve the Contractor of errors, omissions, or from complying with the Contract's requirements.
10. REVIEW TIME: Allow at least 10 WORKING DAYS for review, plus transmittal time back and forth.
11. The Technical Submittal process SHALL NOT BE USED for Requesting Information (RFI) or clarification. Contractor shall submit separate written RFI's to both the CO and the COR in a form which will allow for a formal written response from the CO and/or COR. Each RFI shall have a separate identifying number and date.
12. The Technical Submittal process SHALL NOT BE USED for requesting changes or price changes to the contract. Refer to FAR Clauses for Contract Change procedures.

B. PROJECT CLOSEOUT SUBMITALS

1. Test and Inspection Reports: Submit to the designated COR all contract specified inspections/witnessing reports, tests result documentation and/or commissioning test results before requesting final inspection. Refer to individual specification sections for required inspection, test, and reports.
2. Operation and Maintenance Manual: Submit two copies of Operation and Maintenance Manuals to the CI which shall include product approved technical cut sheets and sequence of operations for the new equipment's maintenance and operating instructions.
3. Project Warrantees:
 - a. All project construction shall be provided with a one-year warranty in accordance with FAR 52.246-21
 - b. In addition to the standard one year construction warranty, provide the specifically specified extended manufacturer's written warranty.

1.8 QUALITY ASSURANCE:

- A. Qualifications: The contractor shall be a licensed GENERAL Contractor having successfully completed five projects of similar complexity and scope within the past three years.
- B. Codes and Standards: The work shall comply with codes and standards applicable to each type of work and as listed in the individual specification sections. This contract incorporates materials, applications, and tests by reference, with the same force and effect as if they were given in full text.
- C. Conflict: Where a conflict occurs between reference documents, drawings, and project specifications, refer to the FAR's and the Contracting office for resolution.
- D. Product basis: Where specifications or drawings call out a specific product or manufacturer, it is understood that an equal or better product is acceptable, as approved in the submittal process.

PART 2 - PRODUCTS – NOT USED- REFER TO SPECIFIC TECHNICAL SPECIFICATIONS FOR ALL NEW EQUIPMENT AND MATERIALS

PART 3 - EXECUTION

3.1 PROJECT MEETINGS:

- A. Preconstruction Conference: Telephone conference call is anticipated.
- B. Progress Meetings: To be held at the project site as required.
- C. Inspections:
 1. Contractor shall perform and maintain records of their construction inspection to ensure their own construction quality assurance and contract compliance. Refer to FAR 52.246
 2. The government's on-site construction inspector (CI) and/or COR will conduct routine inspections to monitor the contracts progress. Inspection of items of work by the CI will not relieve the Contractor of the requirement to meet project specifications. The CI shall

be informed 24 hours in advance of work requiring his observation. After being informed in advance the CI's non-attendance shall not prohibit the Contractor from proceeding with work in the CI's absence.

3. For final inspection, notify the COR in writing at least 14 working days before the completion date so the Government can schedule final inspection. The superintendent shall be present during the final inspection.
4. Notify COR and CI ten working days in advance of anticipated date for equipment start-up and operational tests.
5. Notify COR and CI ten working days in advance of anticipated date for final inspections.

3.2 SEQUENCING AND SCHEDULING WORK

- A. Work Schedule: The schedule shall be submitted at the pre-work conference. When requested, submit an updated schedule within 3 calendar days. As a minimum, the estimated start and completion dates shall be shown on the schedule.
- B. The Contractor's normal work schedule shall be 7:30 a.m. to 4:00 p.m., Monday through Friday. No work shall be performed on Saturdays, Sundays, or federal holidays, unless authorized in writing by the Contracting Officer.

3.3 PROJECT AS-BUILT RECORD DRAWINGS:

- A. As the job progresses, continuously maintain as-built drawings of the work. The changes shall be noted legibly in red pencil or red ink. These drawings shall be submitted to the COR prior to final inspection. Should final inspection reveal changes in the Project not so noted on the As-Built Drawings, the Contractor shall record these changes on the As-Built Drawings within 3 working days. Deliver completed As-Built Drawings to the COR at final inspection and before requesting final payment.

3.4 SAFETY:

- A. SAFETY PLAN: Contractor shall submit, for approval before any work is conducted on site, a safety and a quality assurance plan for the project. Plans shall be site specific for this project. The safety plan shall address all OSHA personnel safety equipment and clothing to be worn on the construction site.
- B. SUPERINTENDENT RESPONSIBILITY: Contractor's on-site superintendent shall ensure all personnel (including all sub contractors) comply with the approved safety plan/manual. In addition, the Superintendent shall ensure compliance with all applicable state and local safety codes and regulations including but not limited to Occupational Safety and Health Administration regulations, 29 CFR, Part 1926.
- C. MSDS's : Contractor shall maintain copies of all the Material Safety Data Sheets for all materials on the construction site for the duration of the contract.
- D. DISPOSAL OF DEBRIS: Demolition debris shall be removed from the project site and disposed of in a legal disposal site by the Contractor. Contractor shall pay all fees required for disposal.

- E. Work areas shall be roped off to alert unauthorized personnel to work in progress.

3.5 DELIVERY, STORAGE, AND HANDLING:

- A. Delivery: Protect products incorporated into the work from damage while in transit to the site. Products must be delivered in original unopened containers with manufacturer's name, brand designation, and contents legibly indicated. The containers shall bear the referenced specification number, type, and class as applicable.
- B. Contractor shall be responsible for providing all equipment and labor required for offloading/unloading all equipment and supplies to be provided under the contract. Contractor shall also inspect and accept all equipment and supplies delivered to the site. The government will not perform any offloading, inspection and accepting for the contractor.
- C. Storage: Provide temporary storage facilities for products. Storage shall comply with the manufacturer's instructions. The storage area shall permit access for inspection and handling.
- D. Handling: Loading and unloading of products shall be protected from damage. Damaged products shall be replaced with new products; repairs shall not be acceptable.

3.6 PAYMENTS:

- A. Payments shall be made in accordance with procedures outline in FAR 52.232-27.
- B. Construction progress payments will be made on a monthly basis based on the work completed per the approved Schedule of Values, as agreed to by the Construction Inspector and the Superintendent or Project Manager.
- C. Retainage will not be implemented unless the Contracting Officer determines that construction progress and/or quality are not satisfactory.

3.7 SPECIFIC WORK REQUIREMENTS – REFER TO SPECIFIC TECHNICAL SPECIFICATIONS.

END OF STATEMENT OF WORK

SECTION 02 82 13 – ASBESTOS REMOVAL

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall remove and dispose asbestos containing material in all areas shown on the project plans and with the cutting and removal of any gypsum board.
- B. The OWNER does not have an Asbestos Containing Material Abatement Plan. The CONTRACTOR shall be required to submit a complete Asbestos Containing Material Abatement Plan.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The CONTRACTOR shall conform to all appurtenant federal, state and local regulations, rules, criteria, ordinances, including but not limited to: ANSI, ASTM, CFR, CGA, EPA, NFPA, NIOSH, UL, regarding performance of asbestos abatement.

1.3 QUALITY ASSURANCE

- A. All asbestos abatement shall be performed by properly licensed and insured firms. The CONTRACTOR shall submit the proposed asbestos abatement firm's qualifications to the OWNER.
- B. The CONTRACTOR shall prepare and submit written safety, accident prevention, and response plans prior to initiating work.
- C. The CONTRACTOR shall submit evidence that all personnel, firms, testing laboratories etc. engaged in asbestos abatement are qualified.
- D. The CONTRACTOR shall engage the services of an independent testing and inspection firm who shall monitor the Asbestos Abatement Contractor during all phases of the abatement work. The independent inspection and testing firm shall have full access to the affected work area; and shall prepare reports summarizing the status of work on a regular basis. The independent firm shall conduct all inspections, testing and reports as required by the applicable regulatory agency.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

- A. All personnel performing asbestos abatement work shall be properly protected. Personnel of other trades not engaged in asbestos abatement activities shall not be exposed at any time to airborne concentrations of asbestos. Building heating, ventilation, and air conditioning (HVAC) shall be shut down and capped and temporary HVAC provided prior to initiation of the work. The CONTRACTOR shall immediately suspend work in the affected work area in the event airborne concentrations exceed allowable concentrations as defined by applicable regulatory agency.

3.2 CLEANUP AND DISPOSAL

- A. The abated asbestos regulated work area shall be properly cleaned by collecting, packing and storing all gross contamination as required by the applicable regulatory agency. The CONTRACTOR shall submit written certification that the affected area is safe before unrestricted entry will be permitted.
- B. All asbestos waste resulting from the abatement work shall become the property of the abatement contractor and shall be disposed as required by the applicable regulatory agency.
- C. The CONTRACTOR shall provide completed final copies of the records certifying that all waste materials have been properly disposed of.

END OF SECTION

SECTION 07 21 16 - INSULATION

PART 1 - GENERAL

1.1 THE SUMMARY

- A. Provide fiberglass batt thermal insulation for exterior envelope assemblies as shown on the drawings or specified herein, all in accordance with the contract documents.
- B. Provide cellulose insulation as shown on the drawings or specified herein, all in accordance with the contract documents.
- C. Material and installation shall conform to applicable building code requirements of all authorities having jurisdiction.

1.2 REFERENCES

- A. Materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or end use:
 - 1. American Society for Testing of Materials (ASTM):
 - 2. ASTM C423 Test Method for Sound Absorption Coefficient by the Reverberation Room Method.
 - 3. ASTM C518 Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter.
 - 4. ASTM C665 Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 5. ASTM C1320 Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
 - 6. ASTM E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
 - 7. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials.
 - 8. ASTM E119 Test Methods for Fire Tests of Building Construction and Materials.
 - 9. ASTM C739 Standard Specification for Cellulosic Fiber Loose-Fill Insulation
 - 10. ASTM 1015 Standard Practice for Installation of Cellulosic and Mineral Fiber Loose Fill Insulation
 - 11. ASTM C1149 Standard Specification for Self-Supported Spray Applied Cellulosic Thermal Insulation
 - 12. ASTM C1497 Standard Specification for Cellulosic Fiber Stabilized Insulation
 - 13. Code of Federal Regulations (CFR)
 - 14. 16 CFR Part 460 Labeling and Advertising of Home Insulation (commonly known as the FTC R-Value Rule)

15. 16 CFR Part 1209 Interim Safety Standard for Cellulose Insulation (Consumer Products Safety Commission standard for cellulose insulation)

1.3 SUBMITTALS

- A. Product Data: Submit data on product characteristics, performance criteria, and limitations, including installation instructions.
- B. Sustainable Design: Submit manufacturer's sustainable design certifications as specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original packaging.
- B. Store and protect products in accordance with manufacturer's instructions. Store in a dry indoors location. Protect insulation materials from moisture and soiling.
- C. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- D. Do not install insulation that has been damaged or wet. Remove it from jobsite.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Thermal Batt Insulation: Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
 1. Owens Corning
 2. Johns Manville
 3. Approved Equal
- B. Cellulose Thermal Acoustical Insulation: Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
 1. Owens Corning
 2. Greenfiber
 3. Approved Equal

2.2 MATERIALS

- A. Thermal Batt Insulation
 1. ASTM C 665, Type II, Class C preformed formaldehyde free glass fiber batt type, paper faced one side.
 - a. ICC Building Code Construction Classification: III, IV, V.

- b. Perm Rating: 1 perm maximum per ASTM E96.
- c. Accessories: Provide accessories per insulating system manufacturer's recommendations, including the following:
- d. Tape: Polyethylene self-adhering type for faced insulation and bright aluminum self-adhering type for foil faced insulation.
- e. Insulation Fasteners: Impale clip of galvanized steel; type recommended by insulation manufacturer for particular use intended.
- f. Mechanical Insulation Fasteners: FM approved, corrosion resistant, size required to suit application.
- g. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- h. Spindle Fasteners: Corrosion-resistant wire spindles.
- i. Ventilation Baffles: Formed plastic, metal, or cardboard sized to fit full width of rafter spaces.

B. Cellulose Thermal Acoustical Insulation

- 1. Insulation shall be loose fill cellulose insulation.
- 2. Insulation shall conform with Consumer Products Safety Commission Interim Safety Standard 16 CFR Part 1209 and with the applicable ASTM material standard for the specific type of cellulose insulation.
- 3. Retention membranes, if required, shall conform with the requirements of the insulation manufacturer and building codes.

2.3 PERFORMANCE CRITERIA

A. Wood Frame Construction - Walls, R-Value: Per ASTM C518.

- 1. R-11, 3-1/2-inch (89mm) thickness, 15-inch (381mm) or 23-inch (584mm) width, 48-inch (1219mm) or 93-inch (2362mm) length.

B. Wood Frame Construction - Ceiling, R-Value: Specified R-value shall be based on manufacturer's coverage chart, developed in conformance with the requirements of 16 CFR Part 460.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which work of this section will be installed. Verify that adjacent materials are dry and ready to receive insulation. Verify mechanical and electrical services within walls have been tested and inspected. Verify preparatory work specified has been properly done, including, but not limited to free of debris, conduits and non-heat producing devices and that heat-producing devices and

elements that are not inherently fireproof are shielded such that insulation will be held 3" away.

- B. Provide written report listing conditions detrimental to performance of work in this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Thermal Batt Insulation

1. Comply with manufacturer's installation instructions and ASTM C1320.
2. Friction-fit blanket insulation in place, until the interior finish is applied. Install batts to fill entire stud cavity, with no gaps, voids, or areas of compression. If stud cavity is less than 8 feet in height, cut lengths to friction fit against floor and ceiling tracks. Walls with penetrations require that insulation be carefully cut to fit around outlets, junction boxes, and other irregularities.
3. Do not install insulation on top of or within 3 inches of recessed light fixtures unless the fixtures are approved for such use.
4. Within exterior wall framing, install insulation between pipes and backside of sheathing. Cut or split insulation material as required to fit around wiring and plumbing.
5. Where showers and bathtubs are located on exterior walls, install insulation and vapor retarder air barrier between units and exterior.
6. If eave ventilation baffles are required, install ventilation baffles at eaves to hold insulation down from roof sheathing and provide positive ventilation from eave to attic space.
7. Fluff insulation to full thickness for specified R-value before installation. Do not compress insulation in the cavity during installation, creating gaps or voids that could diminish thermal value.
8. Trim insulation neatly to fit spaces. Fill miscellaneous gaps and voids with insulation.
9. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
10. For batt insulation with factory-applied facing, install with vapor retarder membrane facing warm in the winter side of building spaces or as specified by local building code. Lap ends and side flanges of membrane over or between framing members. Tape to seal tears, cuts or misalignments in membrane.
11. Secure insulation in place using one of the following methods: Friction fit; staple or nail facing flanges in place as needed, tape in place, retain in place with spindle fasteners, retain in place with wire mesh secured to framing members.

B. Cellulose Thermal Acoustical Insulation

1. Contractor shall affix thickness markers labeled in inches or R-values with at least one marker per 300sf of attic area. Each marker shall face the attic access.

2. Contractor shall verify installed R-value with a bag count and shall provide a certificate indicating the number of bags installed and the installed R-value. The installer shall post the certificate in a conspicuous location where it is visible and readable from the attic access.
3. Continuity: at the owners or general contractor's discretion, and infrared thermographic inspection may be required. If the test proves the insulation is satisfactory, its cost will be borne by the owner. If the test shows discontinuity, its cost and the cost of achieving continuity shall be borne by the contractor.
4. It is recommended, but not within the scope of this specification, that blower door testing be done to verify that adequate air sealing has been done to assure the thermal performance of the building envelope.

END OF SECTION

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SECTION 09 29 00 – GYPSUM BOARD

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide gypsum board and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCES

- A. Where reference is made to any of the below, the revision in effect at the time of bid opening shall apply.

- B. American Society of Testing and Materials (ASTM):

| | |
|-------------|--|
| ASTM A 36 | Standard Specification for Carbon Structural Steel |
| ASTM A 653 | Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM C 36 | Standard Specification for Gypsum Wallboard |
| ASTM C 475 | Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board |
| ASTM C 518 | Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus |
| ASTM C 578 | Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation |
| ASTM C 645 | Standard Specification for Nonstructural Steel Framing Members |
| ASTM C 754 | Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products |
| ASTM C 840 | Standard Specification for Application and Finishing of Gypsum Board. |
| ASTM C 1325 | Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets |
| ASTM D 2626 | Standard Specification for Asphalt Saturated and Coated Organic Felt Base Sheet Used in Roofing |
| ASTM D 3273 | Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in and Environmental Chamber |
| ASTM E 84 | Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E 96 | Standard Test Method for Water Vapor Transmission of Materials |

| | |
|-------------|---|
| ASTM E 119 | Standard Test Methods for Fire Tests of Building Construction and Materials |
| ASTM E 136 | Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C |
| ASTM E 1677 | Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls |

C. Building Code: Refer to the Drawings to determine which Building Code applies. The applicable Building Code, defined by the Drawings, is referenced to herein as “the CODE.”

D. Federal Specifications:

QQ-W-461H Wire, Steel, Carbon (Round, Bare, and Coated)

E. Gypsum Association:

GA-203 Installation of Screw-Type Steel Framing Members to Receive Gypsum Board

GA-216 Recommended Specifications for the Application and Finishing of Gypsum Board

GA-253 Recommended Specification for the Application of Gypsum Sheathing.

GA-600 Fire Resistance Design Manual

F. Technical Association of Pulp and Paper Industry (TAPPI)

G. Underwriters Laboratories (UL): Fire Resistance Directory.

1.3 QUALITY ASSURANCE

A. Single Source Responsibility:

1. Gypsum board shall be provided by a single Manufacturer, each.
2. Framing and accessories shall be provided by a single Manufacturer, each.
3. Tape, adhesives, joint and finishing compounds shall be provided by a single Manufacturer, each.

B. Installer Qualifications:

1. A minimum of 5 years' experience in the successful completion of at least 5 projects of similar size and scope, employing similar products, materials, applications, and performance requirements.
2. Installers without these qualifications will not be accepted.

C. WORK of this Section shall conform to applicable portions of GA-203, GA-216, GA-253, and GA-600.

1.4 SPECIAL WARRANTY PROVISIONS

- A. Furnish Manufacturer's 5-year written warranty to cover defects in materials, products, and manufacturing workmanship.
- B. CONTRACTOR shall furnish separate, but concurrently running, 5-year written warranty to cover labor.
- C. Warranties shall be non-prorated for the entire warranty period.
- D. The term of the warranties shall begin on the date of Substantial Completion.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Gypsum board, framing, and appurtenances shall be recommended by the Manufacturer for the installation indicated.
- B. Gypsum board, framing, and appurtenances shall be suitable for, and compatible with, the required installation.
- C. Labeling and Certification: Fire rated materials shall bear testing agency labels and required fire classification numbers.

2.2 GYPSUM BOARD

- A. Manufacturer, or Equal:
 - 1. Subject to the requirements indicated. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
 - a. **GP Gypsum Corporation.**
 - b. **National Gypsum Company.**
 - c. **United Stated Gypsum Company.**
- B. Gypsum board shall comply with ASTM C 36.
- C. Gypsum board shall be 5/8-inches (16 mm) thick with rounded, tapered edges, unless otherwise indicated.
- D. Gypsum board shall be fire rated "Type X," unless otherwise indicated.

2.3 GYPSUM BOARD ACCESSORIES

- A. Tape, joint compound, and finishing compound shall comply with ASTM C 475, and shall be compatible with the gypsum board, as recommended by the gypsum board Manufacturer.
 - 1. Tape shall be fiberglass reinforcing tape.
- B. Adhesives for fastening gypsum board-to-gypsum board shall be in accordance with the printed recommendations of the gypsum board Manufacturer.

- C. Concealed sealant shall be mastic type, non-shrinking, non-drying, non-migrating, and non-staining, approved for use by the gypsum board Manufacturer.
- D. Fasteners shall be corrosion resistant coated complying with the referenced standards.
 - 1. Screws shall be self-drilling, self-tapping, bugle head for use with power tools, length as recommended by Gypsum Association and the CODE.
 - a. Type "S" for board-to-sheet metal application.
 - b. Type "G" for board-to-board application.

PART 3 -- EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Site in Manufacturer's original, unopened packages, containers, or bundles with labels intact, which clearly identify contents.
- B. Store materials carefully in accordance with the Manufacturer's written instructions, in an area that is protected from deleterious elements, and in a manner that will prevent damage to the products.
 - 1. Store in dry, well-ventilated space, protected from moisture and humidity.
- C. Handle materials in strict accordance with Manufacturer's written instructions.

3.2 PREINSTALLATION CONFERENCE

- A. The WORK of the Section shall be carefully coordinated with the WORK of all other related trades including materials to be built into or applied on gypsum board and items requiring additional supports within partitions.
- B. The CONTRACTOR shall meet at the site with the installers of related WORK and review the coordination and sequencing of WORK to ensure that everything to be concealed by WORK of this Section has been accomplished, and that chases, access panels, openings, supplementary framing and blocking, and similar provisions have been completed.

3.3 PROJECT CONDITIONS

- A. Comply with Manufacturer's written instructions, referenced standards, for environmental conditions before, during, and after installation.
 - 1. Building and areas receiving gypsum board WORK shall be completely dried-in and adjoining materials shall be sufficiently dry before starting or continuing gypsum board installation.
 - 2. All windows, doors, roofing, and other waterproofing and weather proofing cladding and components of the building shell shall in place and complete.
 - 3. Gypsum board shall not be exposed to moisture, excessive or continuous humidity, or water at any time.

4. Maintain a minimum room temperature of 55 degrees F, during application of gypsum board and joint treatment until completely dry or occupied.
 5. Provide adequate ventilation as required.
- B. Protect surrounding WORK from damage that may result from operations under this Section.

3.4 INSPECTION

- A. The CONTRACTOR shall be totally responsible for the proper performance and completion of the WORK under this Section.
- B. Systems and components shall be inspected before installation.
1. Damaged or defective items shall be rejected and marked as such and shall be removed from the Site.
 2. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discoloration, or other surface imperfections on the finished units shall be rejected.
- C. The CONTRACTOR shall verify dimensions, tolerances, and method of attachment with adjacent WORK.
1. Examine substrates, areas, and conditions where gypsum board, framing, and appurtenances will be installed for compliance with the requirements for installation, taking into account tolerances, and other conditions affecting performance of installed gypsum board.
 2. Notify the OWNER in writing of conditions detrimental to the proper and timely completion of the WORK. Do not proceed with the WORK until unsatisfactory conditions have been corrected in an acceptable manner.
 3. Commencement of the installation by the CONTRACTOR shall indicate CONTRACTOR'S acceptance of the substrate, areas, and conditions.

3.5 PREPARATION

- A. Sequence installation properly with the installation and protection of other WORK, so that neither will be damaged by the installation of the other.

3.6 INSTALLATION – GENERAL

- A. Installation shall comply with the requirements of the Contract Documents, with the requirements of the CODE, with applicable references, and with Manufacturer's written instructions. Where a conflict occurs among these requirements, the more stringent shall apply, as directed by the OWNER.
1. Fire rated assemblies shall be installed in accordance with GA-600 and UL Fire Resistance Directory.
- B. The CONTRACTOR shall provide corrosion resistant fasteners, anchors, and shims required for a complete installation, and shall be secure, plumb, and true to line, allowing for required movement, including expansion and contraction.

- C. The CONTRACTOR shall provide separation of dissimilar materials to ensure no galvanic action occurs.
- D. Horizontal lines shall be level, and vertical lines shall be plumb.
- E. Coordinate location of concealed supplemental blocking, backing, and additional anchoring reinforcement with items furnished under other Sections.

3.7 INSTALLATION – GYPSUM BOARD GENERAL

- A. Install gypsum board to minimize joints. When joints are necessary, butt tapered joints together; end joints shall be avoided and kept to a minimum.
 - 1. Boards shall be brought into contact with each other but shall not be forced into place. Joints on opposite sides of a partition shall not occur on the same stud.
 - 2. Provide expansion joints as shown, as recommended per applicable references, and as directed.
- B. Where gypsum board abuts other materials, such as masonry walls, structural frame, and decking, the gypsum board shall be held back so as to form a joint, which shall be sealed with acoustical or fire rated sealant as required for the condition.
 - 1. Isolate edges of gypsum board 1/2-inch (13 mm) from abutment with structure, particularly at slabs on grade. Provide trim and caulk with sealant.
- C. Fasteners:
 - 1. Gypsum board shall be screw-fastened to framing.
 - a. Screws shall be spaced not to exceed 12-inches (305 mm) on center except at vertical butting edges of the fire-rated partitions where they shall be 8-inches (203 mm) on center.
 - b. Space fasteners in accordance with applicable reference standards and Manufacturer's recommendations, except as otherwise indicated.
- D. Single Layer Construction: Gypsum board shall be held in firm contact with framing member while fastenings are being driven. Fastening shall proceed from center portion of the gypsum board toward the edges and ends. Fasteners shall be set with heads slightly below the surface of the gypsum board in the dimple formed by the power screwdriver. Care shall be taken to avoid the breaking of the face paper of the gypsum board. Improperly driven screws shall be removed.

3.8 GYPSUM BOARD FINISHING

- A. Gypsum board shall be taped, and all screw heads, penetrations, joints, end trim, corner beads, fastener, and other depressions shall be treated with joint and finishing compounds applied per applicable references and per Manufacturer's printed recommendations for three-coat WORK.
- B. Finish gypsum WORK in accordance with ASTM C 840, to Level 4 of Gypsum Association GA-214, and the following:

1. Joint compound shall be mixed in accordance with Manufacturer's instructions. A uniform layer of compound shall be applied over the joint approximately 4-inches (102 mm) wide and filling the groove. The tape shall be centered over the joint and embedded into the compound leaving sufficient compound under tape to provide proper bond.
2. A second and third coat of joint compound or joint finishing compound shall be applied after each preceding coat has been allowed to thoroughly dry. Coats shall be spread over tape and the tapered portion of edge and feathered out at the edge.
3. All inside corners shall be coated with at least one coat of joint compound over perforated tape with the edges feathered out.
4. All screw head dimples shall receive at least three coats of compound.
5. Flanges of corner and casing beads shall be concealed by at least two coats of compound feathered out approximately 9-in (229 mm) on one or both sides of the exposed metal as applicable.
6. Allow each application of compound to joints and fastener heads to dry, then sand as required.
7. Caution shall be used to avoid roughing of the gypsum board paper. All gypsum board and treated areas shall be left smooth and ready for painting.
8. Gypsum board shall be sanded smooth, dusted, and provided with a textured orange peel finish coat.
9. Joints and penetrations in gypsum board at non-visible locations, such as within attics or in ceiling plenums shall receive joint treatment, shall be taped, and joints shall be caulked with sealant. Additional treatment to comply with the required fire ratings shall be provided.

3.9 CLEANING, FINISHING, AND PROTECTION

- A. Adhesive papers used for masking which become firmly bonded when exposed to heat and/or light shall not be used.
 1. Remove masking film and temporary labels as soon as possible after installation. Films and labels left in place after installation shall be the responsibility of the CONTRACTOR.
 2. Residue shall not be left on any surfaces.
- B. Gypsum board shall be protected from damage from subsequent construction operations.
- C. The CONTRACTOR shall make adjustments required until accepted.
- D. Damaged or defective items shall be removed and replaced at the direction of the OWNER.
- E. When gypsum board WORK is completed, remove unused materials, containers, and equipment, and clean the Site of gypsum board debris.

END OF SECTION

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SECTION 09 96 00 - PROTECTIVE COATING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.
- B. Definitions
 - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
- C. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.
- D. Where protective coatings are to be performed by a Subcontractor, the Subcontractor shall provide 5 references which show that the Subcontractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Subcontractor provided the protective coating.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Suitability: The CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.
- B. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
- C. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

- E. Colors: Colors and shades of colors of coatings shall be selected by the OWNER. Coordinate with OWNER prior to paint selection and application. Finish colors shall be custom mixed to match existing colors in residences.

- F. Substitute or "Or-Equal" Products
 - 1. To establish equality under Section 01 60 00 - Products, Materials, Equipment and Substitutions, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:
 - a. Minimum and maximum recoat times
 - b. Minimum and maximum cure time for immersion
 - c. Abrasion resistance per ASTM D4060 using CS17 Wheel
 - d. Maximum and minimum dry film thickness per coat
 - e. Compatibility with other coatings
 - f. Suitability for the intended service
 - g. Resistance to chemical attack
 - h. Temperature limitations during application and in service
 - i. Type and quality of recommended undercoats and topcoats
 - j. Ease of application
 - k. Ease of repairing damaged areas
 - l. Stability of colors
 - 2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions.
 - 3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear such costs involved as part of the WORK.

2.2 MANUFACTURERS AND PRODUCTS

- A. Products and materials shall be provided by an approved manufacturer, or equal. Approved manufacturers include:
 - 1. Sherwin-Williams
 - 2. Valspar
 - 3. Benjamin Moore
 - 4. Glidden

- B. Provide interior acrylic latex paint and primer with semi-gloss finish, two coats 2 mils DFT each.

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

- A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.

3.2 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on coating WORK.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. Damage to other surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.
- B. Coating materials shall be used within the manufacturer's recommended shelf life.
- C. **Storage and Mixing:** Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

- A. **General:** Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. **Protection of Surfaces Not to be Coated:** Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

- C. Hardware, lighting fixtures, switch plates, machined surfaces, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces.
- D. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.
- E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly coated surfaces.

3.5 ENVIRONMENTAL REQUIREMENTS

- A. No coating work shall be performed under the following conditions:
 - 1. Surface or ambient temperatures exceed the manufacturer's recommended maximum or minimum allowable.
 - 2. Dust or smoke laden atmosphere.
 - 3. Damp or humid conditions, where the relative humidity is above the manufacturer's maximum allowable.
 - 4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.
 - 5. Ambient temperature that is expected to drop below 50°F or less than 5°F above the dew point within 8 hours after application of coating.

3.6 APPLICATION OF COATINGS

- A. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The CONTRACTOR shall schedule such inspection with the OWNER in advance.
- B. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.
- C. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
- D. Coatings shall not be applied under the following conditions:
 - 1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.
 - 2. Dust or smoke laden atmosphere.
 - 3. Damp or humid weather.
 - 4. Substrate or air temperature is less than 5 degrees F above the dew point.

5. Air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.
- E. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychrometric tables.
- F. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.7 COATINGS SCHEDULE

- A. Gypsum Board and Wood Trim, indoors.
 1. Provide 2 coats, 2 mils DFT each, Acrylic Latex coating.

END OF SECTION

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SECTION 22 00 00 – PLUMBING PIPING AND SPECIALTIES

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide plumbing piping and specialties, complete and operable, as indicated here in.

1.2 WORKMANSHIP AND MATERIALS

- B. WORK shall be in strict accordance with the International Plumbing Code and codes of the State of Texas, Burnet County, and any other authorities having jurisdiction.
- C. The CONTRACTOR shall have required certifications and shall be thoroughly familiar with the local codes.
- D. The CONTRACTOR shall obtain and pay for necessary permits.
- E. Protection
- Care shall be taken at all times to protect floors, stairways, and walls during the make-up and installation of piping and equipment.
 - The CONTRACTOR shall remove stains and repair damage before final acceptance of the WORK.
- F. Identifying Marks
- If the ENGINEER finds materials that have identifying marks removed or lack such marks completely, such items will be rejected until the CONTRACTOR has furnished proof that said items conform to the Specifications.
 - Adequacy and extent of such proof will be determined by the ENGINEER.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Although design may be based on a specific manufacturer, any other equivalent manufacturer's product may be used.
- B. Plumbing piping, fixtures, specialties, and equipment shall be as recommended by the manufacturer for the intended usage.
- C. Any pipe, plumbing fitting or fixture, solder, or flux used in the installation or repair of any public water system or any plumbing in a facility providing water for human consumption, shall be "lead free" except when necessary for the repair of leaded joints of cast iron pipes.

- Lead free products shall meet or exceed the requirements of the Safe Drinking Water Act (SDWA) - USEPA.
- Lead free is defined as not more than 0.2 percent lead when used with respect to solder and flux; not more than 0.25% in the wetted surface material of pipes, pipe fittings, plumbing fittings and fixtures.

2.2 TANKLESS WATER HEATER – LIQUID PROPANE

- A. The fully modulating, on-demand, LP fired tankless water heater shall have a maximum input rating of 199,000 Btu/h and shall be available in Liquid Propane.
- B. The heater shall have ¾ in. male NPT water and LP connections. The inlet gas supply pressures shall be 4.0 in. WC (min.) up to 10.5 in. WC (max) for LP. The heater shall be supplied with a temperature remote, that can be installed up to 400 ft. from the heater using 20 gauge (minimum) control wire. The temperature remote shall provide diagnostic information, fault history, and heater set temperature.
- C. The heater shall operate using 120 V / 60 Hz power source. The indoor heater will incorporate a factory installed power cord.
- D. The heater shall be vented with 4” diameter Category III vent pipe with a length not to exceed 50 ft. (equivalent), terminating horizontally or vertically.
- E. The heater shall be direct vented with optional direct vent conversion kit, using 3” diameter intake air pipe. The intake pipe shall use material such as PVC, ABS, aluminum, or Category III pipe and cannot exceed 50 ft. (equivalent) length.
- F. The water heater shall use a commercial grade copper alloy, fin tube heat exchanger with quick release brass or bronze waterways.
- G. The heater shall be controlled by an onboard solid-state printed circuit board, and shall use the following factory installed components:
 1. Thermistors to monitor inlet and outlet water temperature; a flow sensor to measure flow rate;
 2. Flame sensor to monitor combustion;
 3. Air-Fuel Ratio Rod to measure and adjust operation in order to maintain optimal combustion efficiency.
- H. The heater shall consist of inline fusing and surge absorbers for electrical surge protection, an electronic spark igniter, aluminized stainless steel burners, a hi-limit temperature switch, modulating gas valve, an overheat cutoff fuse, ceramic heating blocks to protect the heat exchanger and water piping.
- I. The heater shall incorporate auto-fire system for additional freeze

protection.

- J. The Easy-Link controls shall be built onto the onboard solid-state printed circuit board and does not require external controls. The linking control wire shall be supplied with the heater.
- K. The Easy-Link control shall modulate the system for the most efficient performance.
- L. The Easy-Link control shall rotate the priority heater every 12 hours of operation time or 100 starts for balanced duty/cycle operation.
- M. The heater shall be design certified by CSA according to ANSI Z21.10.3, approved for sale in the United States, have a minimum energy factor of 0.82, meets the energy efficiency requirements of the U. S. Department of Energy and ASHRAE 90.1, complies with Low NOx emissions of 40 ng/J or 55 ppm, and shall be certified by NSF to NSF/ANSI 5 Standard.
- N. Manufacturers, or Equal
 1. **AOSmith, Model ATI-510-P.**
 2. **State Industries Inc.**
 3. **Rudd.**

2.3 POTABLE WATER COPPER TUBING

- A. Copper tubing and fittings for potable and service water 3-inch and smaller shall be Type K copper tube with soldered fittings and shall conform to ASTM B88M ASTM B88
- B. Solder containing lead shall not be used with copper pipe.
- C. Solder Material: Solder metal shall conform to ASTM B32.
- D. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- E. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372.
- F. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.

2.4 POTABLE WATER PEX TUBING

- A. Tubing Standard: ViegaPEX High-Density Cross-linked polyethylene tubing shall be manufactured to the requirements of ASTM F876 and meet the standard grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with TR-4/03. The following three standard grade ratings are required.
- 200 degrees F at 80 psig
 - 180 degrees F at 100 psig
 - 73.4 degrees F at 160 psig
- B. Chlorine testing: According to ASTM F876 shall meet or exceed the following end use condition.
- End use conditions of: 100% @ 140°F
 - Per PEX 5006 (CL5) or NSF P171 (CLR)
- C. Tubing Standard: FostaPEX High-Density Cross-linked polyethylene tubing shall be manufactured to the requirements of ASTM F876 and meet the standard grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with TR-4/03. The following three standard grade ratings are required.
- 200 degrees F at 80 psig
 - 180 degrees F at 100 psig
 - 73.4 degrees F at 160 psig
- D. Fitting Standard: PEX Press fittings shall be manufactured from UNS C83600, C87700 or C87710 Bronze and meet the requirements of ASTM F877 tested as a system with ViegaPEX tubing. The PEX Press sleeve shall be manufactured out of a 304 grade or better stainless steel and have one to three view holes incorporated in it to ensure proper PEX tubing insertion.
- E. Fitting Standard: PEX Crimp fittings for use with copper crimp rings shall be manufactured from UNS C36000, C37700, C69300 or C87850 Brass/ Eco Brass® meeting the requirements of ASTM F1807 and or PolyAlloy™ polymer meeting the requirements of ASTM F2159. The PEX Crimp connection shall be made by use of a full circle crimp tool designed to crimp F1807 copper crimp rings.
- F. Manifolds: Acceptable manifolds shall include:
- Copper Manifolds: Shall be copper material having a male or female solder, ProPress or PEX Crimp inlets. All outlets shall be PEX
 - Press, PEX Crimp or ProPress fittings. Shall be provided by the Cross- linked Polyethylene system manufacturer.
 - Polymer Manifolds: Shall be plastic material having a male NPSM thread, PEX Press or PEX Crimp inlets. All outlets shall be PEX Press, PEX Crimp, or PEX compression connections provided by the PEX system manufacturer.
- G. Adapter Fittings: PEX adapter fittings shall conform to one of the following ASTM standards; F877, F1807, F2159, or ASME B1.20.1 and be listed to the CSA B137.5. The adapter fittings shall mate to NPT threads, copper tubing, copper fittings or ProPress fittings.

2.5 PVC PIPING AND FITTINGS FOR SANITARY DRAIN, AND VENTS

- A. PVC Schedule 40 corrosion resistant sanitary pipe, IPS sizes 1/8" through 24", shall be rated for temperatures up to and including 200 °F, and Pressure rating (120 psi to 810 psi) depending on pipe schedule, pipe size, and temperature as stated in Harvel Plastics, Inc. engineering bulletin (Product Bulletin 112/401). Pipe shall be suitable for PVC plastic drain, waste, and vent (DWV) applications. Pipe material shall be generally resistant to most acids, bases, salts, aliphatic solutions, oxidants, and halogens. Chemical resistance data is available and should be referenced for proper material selection. Pipe exhibit excellent physical properties and flammability characteristics (independently tested flame and smoke characteristics-ULC). Typical applications include: chemical processing, plating, high purity applications, potable water systems, water and wastewater treatment, drainage, irrigation, agricultural, and other applications involving corrosive fluid transfer.
- B. This specification outlines minimum manufacturing requirements for Polyvinyl Chloride (PVC) Schedule 40 iron pipe size (IPS) pressure pipe. This pipe is intended for use in applications where the fluid conveyed does not exceed 200°F. This pipe shall meet and or exceed the industry standards and requirements as set forth by the American Society for Testing and Materials (ASTM D1785 & D2665) and the National Sanitation Foundation (NSF International STD 61 & Std 14).
- C. The material used in the manufacture of the pipe shall be domestically produced rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, trade name designation H707 PVC. This compound shall be white or gray in color as specified and shall be approved by NSF International for use with potable water (NSF Std 61).
- D. All sizes of PVC Schedule 40 pipe shall be manufactured in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. PVC Sch 40 pipe sizes 1-1/2" through 24" diameters shall also meet the requirements of ASTM D2665 Standard Specification for PVC plastic drain, waste and vent (DWV) pipe and shall be dual marked as such. Each production run of pipe manufactured in compliance to the standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785 and ASTM D2665 as applicable. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672. All PVC Schedule 40 pipe must also meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid PVC pipe for pressure applications and shall bear the mark of these Listing agencies. This pipe shall have a flame spread rating of 0-25 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.
- E. Product marking shall meet the requirements of ASTM D1785 and ASTM D2665 as applicable and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM designation D1785; the ASTM designation D2665 (when dual marked); the independent laboratory's seal of approval for potable water usage; and the date and time of manufacture.
- F. All PVC Schedule 40 pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM D1785 and D2665 (where applicable), consistently meeting and/or exceeding the Quality Assurance test requirements of these standards with regard to material, workmanship, burst pressure, flattening, and extrusion

quality. The pipe shall be manufactured in the USA, using domestic materials, by an ISO 9001 certified manufacturer. Standard lengths of pipe sizes 6" and larger shall be beveled each end by the pipe manufacturer. All pipe shall be stored indoors after production at the manufacturing site until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications.

2.6 FIXTURE SCHEDULE

| Drawing Callout | Fixture Type | Description |
|-----------------|-------------------------------|--|
| LAV-1 | Lavatory faucet and drain | Faucet shall be manual with thermostatic mixing valve, and a 1-1/2-inch, chrome-plated "P" trap with chrome-plated escutcheon. Code Standards: <ul style="list-style-type: none"> • ASME A112.19.2/CSA B45.1 • ADA • ICC/ANSI A117.1 |
| SK-1 | Kitchen Sink faucet and drain | Faucet shall manual with a single control kitchen faucet, with ceramic disc cartridges and a temperature limit stop, 10" cast swing spout with 2.2 gpm aerator. P-trap shall be 1-1/2-inch polished chrome-plated |
| BT-1 | Bathtub faucet | The shower faucet shall be with a single handle 1/2-inch chrome-plated, with pressure balancing mixing valve and volume control, and shall include an adjustable brass limit stop screw, and include the showerhead and arm. |

PART 3 -- SCOPE OF WORK

- A. Retain the main potable water valve inside the exterior valve vault outside the Southwest corner of the residence and replace the supply piping from the valve to the new proposed manifold inside the house with copper. Use a dielectric fitting as appropriate at the connection to the existing pipe.
- B. Once inside the facility, raise the copper supply line to above ground level and feed to a cold-water manifold at the interior of the residence. From the new manifold distribute cold water to all the existing plumbing fixtures and to the existing on-demand hot water heater.
- C. Install a new Instantaneous Hot Water Heater.
- D. Install a hot water manifold with input from the new on-demand hot water heater and distribute hot water to all the existing plumbing fixtures.
- E. All interior lines will be PEX.
- F. Keep main vertical sanitary lines in the wall until they enter the crawl space. Inside the crawl space intercept the drain lines and replace the branch and main lines with PVC pipe. Replace the main until within one foot from the inside wall of the residence, and transition to the existing main sanitary line.

PART 4 -- EXECUTION

4.1 PREPARATION

- A. The CONTRACTOR shall coordinate the roughing-in process with provisions for wall and floor sleeves, pipe inserts, and cutting of roof and floor penetrations, such that drain lines will have the required invert elevations and slopes.

4.2 OPENINGS

A. Existing Construction

1. The CONTRACTOR shall provide openings required in existing walls, floors, and roofs for the passage of piping and plumbing equipment.
2. Openings shall be as indicated or required for passage.
3. Openings shall be cut in a neat and orderly manner, minimizing damage to existing structures.
4. Patching of openings shall match existing construction.
5. The CONTRACTOR shall be responsible for hangers and supporting members installed in existing masonry or structural steel as required for the proper completion of the WORK.

4.3 INSULATION

- A. Hot and cold water piping, valves, fittings, and exposed horizontal sanitary, storm, and vent piping shall be provided with one-inch-thick insulation.

Pipe insulation shall have an average density of 4 pounds per cubic foot or greater, and its conductivity (k) shall not exceed 0.23 BTU-inch per (hour) (square foot) (degree F) at a mean temperature of 75 degrees F.

4.4 INSTALLATION AND APPLICATION

- A. The CONTRACTOR shall provide plumbing specialties in accordance with manufacturer's printed instructions.
- B. Pipe shall be arranged in a neat and orderly manner to occupy the minimum amount of space and so that the pipe will not obstruct passageways and movement of building occupants or interfere with normal operation and maintenance of any equipment.
- C. Pipe shall be carefully placed and properly sloped and shall be neatly and firmly supported by hangers or supports.
- D. Piping in buildings shall be as close to the ceilings or walls as possible unless indicated otherwise.
- E. Joints
 1. Screwed joints shall be made with joint compound and be tight and leak-proof.

2. A sufficient number of brass-to-ferrous metal seat unions shall be placed in lines such that any pipe, valve, or piece of equipment may be easily disconnected.

F. Drainage and Sanitary Lines

1. Drainage and sanitary lines shall be properly run, trapped, and vented in order to conform to Code requirements.
2. Changes in direction shall be made with "Y" branch fittings and shall be of the same size as the pipe.
3. Changes in pipe size shall be made with reducing fittings.
4. The minimum depth of cover shall be 3 feet.

- G. Horizontal soil, drain, and waste pipes shall be provided with a slope of at least 1/4 inch per foot, unless indicated otherwise.

4.5 TESTING

- A. The CONTRACTOR shall demonstrate to an Owner witness that the piping passes the following pressure tests before it is insulated or covered by walls or ceilings. Test piping after all fittings and valves for that portion of the piping have been installed.

- B. All pressure testing shall be witnessed and documented with results approved and signed off by an Owner representative.

- C. Repair leaks discovered during pressure testing. Retest failed sections of piping to demonstrate satisfactory results.

D. Potable Water Testing:

1. Upon completion of a section or of the entire hot and cold water supply system, it shall be tested and proved tight under a water pressure not less than one and half time of the working pressure under which it is to be used, but not less than 125 psi.
2. The water used for tests shall be obtained from a potable source of supply.
3. The piping shall withstand the test without leaking for a period of not less than 15 minutes.

E. Drainage Water Testing:

1. The drainage, and venting systems shall be tested with water.
2. The water test shall be applied to the drainage and vent systems either in its entirety or in sections.
3. Where the test is applied to the entire system, openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to point of overflow.
4. Where the system is tested in sections, each opening shall be tightly plugged, except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10 foot head of water.

5. In testing successive sections, not less than the upper 10 feet of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 feet of the system) shall have been submitted to a test of less than a 10 foot head of water.
6. The water shall be kept in the system, or in the portion under test, for not less than 15 minutes before inspection starts.
7. The system shall then be tight at all points.

F. Gas Piping Testing and Purging

1. Before the gas piping system is accepted, a test for tightness shall be performed and witnessed by the ENGINEER.
2. The system shall be subjected to a test pressure of at least 1.5 times the maximum operating pressure, but never less than 3 psig.
3. Air or an inert gas such as carbon dioxide, or nitrogen, shall be used as the pressurizing medium.
4. Under no circumstances shall oxygen or natural gas be used to test for tightness or to locate leaks.
5. The system shall hold pressure after disconnecting the pressure source for a period of at least 30 minutes without showing any drop in pressure after the test gas in the pipe has been given time to come to equilibrium at the ambient temperature.
6. Leaks shall be located by approved leak detectors, or by a soap and water solution, while the system is under pressure.
7. Purging
 - a. After pressure testing, piping shall be fully purged with an inert gas inserted from the location most distant from the point of entry of the natural gas.
 - b. Each major branch line shall be similarly purged from its far end.
 - c. Purging shall be performed only by personnel experienced in this particular operation.
8. Repair or replace defective piping, and retest.

4.6 DISINFECTION

- A. The line shall then be filled with water and maintained under not less than 10 psig pressure, for not less than 48 hours, during which period each valve on the line shall be opened and closed several times, after which it shall be flushed clean and then tested by the OWNER.
- B. After potable water supply lines are successfully pressure tested, they shall be disinfected by introducing an HTH solution, liquid chlorine, or chlorine solution of sufficient strength.

- C. Potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority or water purveyor having jurisdiction or, in the absence of a prescribed method, the procedure described in either AWWA C651 or AWWA C652, or as described in this section.
1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
 2. The system or part thereof shall be filled with a water/chlorine solution containing not less than 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing not less than 200 parts per million (200 mg/L) of chlorine and allowed to stand for 3 hours.
 3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
 4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.
- D. This procedure shall be repeated as often as necessary until the line is pronounced safe for use by the OWNER.
- E. No cross-connection between the water main and any pipe not yet disinfected will be permitted.

END OF SECTION

SECTION 26 00 00 – ELECTRICAL WORK, GENERAL

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Provide the electrical WORK, complete and operable, as indicated in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all Sections in Division 26, except as otherwise indicated.
- C. The WORK of this Section is required for operation of electrically driven equipment provided under Specifications in other Divisions.
- D. The CONTRACTOR'S attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment Specifications.

1.2 REFERENCE STANDARDS

| | |
|---------------|---|
| NEC (NFPA 70) | National Electrical Code: 2017 Edition |
| NETA | International Electrical Testing Association |
| NEMA 250 | Enclosure for Electrical Equipment (1000 Volts Maximum) |

- A. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.
- B. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes and regulations.
- C. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE AND MARKINGS

- A. Identification
 - 1. Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal, state, OSHA, and NEC requirements.
- B. Local Disconnect Switches
 - 1. Legibly mark each local disconnect switch for motors and equipment in order to indicate its purpose unless the purpose is indicated by the location and arrangement.

1.4 PUBLIC UTILITIES REQUIREMENTS

- A. Contact the serving utility and verify compliance with requirements before construction.
- B. Coordinate schedules and payments for WORK by utilities.

- C. Where conduits and conductors in the WORK are indicated to be larger, heavier schedule, or have greater protective coating than utility requirements, provide the larger size, heavier schedule, or greater protection.
- D. Provide electrical service as indicated and as required by the serving utility.
- E. Verify and provide service conduits, fittings, transformer pad, grounding devices, and service wires not provided by the serving utility.
- F. Verify with the utility the exact location of each service point and type of service, and pay charges levied by the serving utilities as part of the WORK.

1.5 PERMITS AND INSPECTION

- A. Obtain permits and pay inspection fees according to the General Conditions.

1.6 CONTRACTOR SUBMITTALS

A. General

1. Custom-prepare Shop Drawings.
2. Drawings or data indicating "optional" or "as required" equipment will not be accepted.
3. Cross out options not proposed or delete from the Shop Drawings.

B. Shop Drawings: Include the following:

1. complete material lists stating manufacturer and brand name of each item or class of material.
2. Shop Drawings for grounding WORK not specifically indicated
3. component data
4. types of materials and finish
5. temperature limitations, as applicable
6. voltage requirement, phase, and current, as applicable
7. grounding requirements

C. Catalog Cuts

1. Submit catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material.
2. Stamp the catalog data sheets in order to indicate the Project name, applicable Specifications Section and Paragraph, model number, and options.

D. Materials and Equipment Schedules

1. Within 30 Days of the commencement date in the Notice to Proceed, deliver to the OWNER a complete list of materials, equipment, apparatus, and fixtures that are proposed for use.
2. Include in the list the type, size, name of manufacturers, catalog number, and such other information as required to identify the item.

E. Technical Manuals

1. As-Built Drawings

- a. Prepare as-built drawings, showing invert and top elevations and routing of duct banks and concealed below-grade electrical installations.

1.7 AREA DESIGNATIONS

A. General

1. Designations for raceway system enclosures shall comply with the requirements of Section 26 05 33 – Electrical Raceway Systems.
2. Designations for electrical WORK specifically indicated in other Sections shall comply with the requirements of those Sections unless indicated otherwise.

B. Material Requirements

1. Construct NEMA 1, 3R, and 12 enclosures of steel, and prime and coat with ANSI 61 light grey paint.

1.8 TESTS

- A. The CONTRACTOR shall be responsible for factory and field tests indicated in Division 26, as required by the OWNER, and as required by other authorities having jurisdiction.
- B. Furnish necessary testing equipment.
- C. Pay the costs of the tests, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of a faulty installation.
- D. Reporting
 1. Where test reporting is indicated, submit proof-of-design test reports for mass-produced equipment with the Shop Drawings.
 2. Submit factory performance test reports for custom-manufactured equipment for approval prior to shipment.
 3. Submit field test reports for review prior to Substantial Completion.
- E. Remove and replace equipment or material that fails a test, or, if the OWNER approves, repair and retested for compliance.
- F. Corrections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be performed in a manner that does not void the warranty.

1.9 DEMOLITION AND RELATED WORK

A. General

1. Perform electrical demolition WORK as indicated.
2. The CONTRACTOR is cautioned that demolition WORK may also be indicated on non-electrical Drawings.
3. Coordinate with all trades regarding electrical de-energization, disconnection, and removal, and the overall sequence of construction.

B. Electrical Requirements for Removed Equipment

1. Remove dedicated wiring and exposed conduits back to the source.
2. Remove power wiring from the power source to the point of utilization.
3. Encased Conduits
 - a. Abandon in place wiring routed through encased conduits.
 - b. Cut encased conduits flush to the floor and grout flush with the floor.

C. Where new lighting and receptacles are installed, remove old lighting, receptacles, switches, wiring, and conduits.

D. Junction Boxes

1. Provide a junction box with a NEMA rating in accordance with the area in which it is located and sized as required.
2. Properly identify wires and terminals before disconnection.

E. Removed materials and equipment not indicated to be returned to the OWNER shall, upon removal, become the CONTRACTOR'S property and shall be disposed of off- Site.

F. Remove and relocate material and equipment indicated to be relocated or reused and reinstall with care in order to prevent damage.

G. Place materials indicated to be returned to the OWNER in boxes, with the contents clearly marked, and store at a location determined by the OWNER.

1.10 CONSTRUCTION SEQUENCING

A. General

1. Because the existence of asbestos in the sheetrock to be removed, all sheetrock must be removed in areas of electrical demolition and new construction prior to electrical work beginning. It is critical that the CONTRACTOR carefully examine the WORK to be provided completed and coordinate any modifications to the plans with the asbestos remediation team prior to demolition.
2. Schedule the WORK, subject to OWNER's approval, to minimize required shutdown time.

3. Submit a written sequencing request, including the sequence and duration of activities to be performed.

B. Modifications

1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.
2. Perform modifications to existing equipment, panels, and cabinets in a professional manner.
3. Repair coatings to match existing.
4. The costs for modifications to existing electrical facilities that are required for a complete and operating system shall be included as part of the WORK.

C. Existing Utilities

1. Exercise extreme caution when digging trenches to not damage existing underground utilities.
2. The cost of repairs of damages caused during construction shall be included as a part of the WORK.

D. Field Verifications

1. Visit the Site before submitting a Bid to become better acquainted with the WORK of this Contract.
2. The lack of knowledge will not be accepted as justification for extra compensation to perform the WORK.
3. The CONTRACTOR shall be responsible for identifying available existing circuit breakers in lighting panels for the intended use as required.
4. The CONTRACTOR shall be responsible for field verifying the available space in substation switchboards to integrate new power circuit breakers.
5. The cost for the above verifications shall be included as part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Provide equipment and materials that are new and are the products of experienced and reputable manufacturers in the industry.
- B. Provide equipment and materials listed by UL and bearing the UL label, where UL requirements apply.
- C. Provide similar items in the WORK as products of the same manufacturer.
- D. Provide equipment and materials of industrial grade standard of construction.

- E. Where a NEMA enclosure type is indicated in a non-hazardous location, use that type of enclosure despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.
- F. On devices indicated to display dates, display the year as 4 digits.
- G. Temperature Ratings of Equipment Terminations
 - 1. Provide terminations and lugs rated for use with 75-degree C conductors.
 - 2. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75-degree C ratings.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

- 1. Provide nuts, bolts, and washers constructed of stainless steel.
- 2. Provide threaded rods for trapeze supports constructed from continuous threaded galvanized steel, 3/8-inch diameter minimum.
- 3. Struts
 - a. Construct struts for mounting of conduits and equipment of galvanized steel.
 - b. Where contact with concrete or dissimilar metals may cause galvanic corrosion, use suitable non-metallic insulators in order to prevent such corrosion.
 - c. Do not use aluminum strut for free-standing support frames.
 - d. Strut Manufacturer, or Equal: **Unistrut; B-Line**
- 4. End Caps
 - a. Provide plastic protective end caps for all exposed strut ends.
 - b. End Caps Manufacturer, or Equal: **Unistrut, Model P2860**
- 5. Anchors
 - a. Provide stainless steel expansion anchors for attaching equipment to concrete walls, floors, and ceilings.
 - b. Wood plugs will not be accepted.
 - c. Anchor Manufacturer, or Equal: **"Power-Bolt"** or **"Power-Stud"** as manufactured by **Power Fasteners, Inc.**; similar by **Star**.

2.3 ELECTRICAL IDENTIFICATION

A. Conductor and Equipment Identification

- 1. Provide imprinted plastic-coated cloth marking devices, such as manufactured by Brady, Thomas & Betts, or equal.

2. Alternatively, provide heat-shrunk plastic tubing, imprinted split-sleeve markers cemented in place.

PART 3 -- EXECUTION

3.1 GENERAL

A. Incidentals

1. Provide materials and incidentals required for a complete and operable system, even if not required explicitly by the Contract Documents.
2. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

B. Field Control of Location and Arrangement

1. The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items.
2. Exact locations shall be determined by the CONTRACTOR in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions.

3. Follow the locations on the Drawings, however, as closely as possible.

4. Conduits

- a. Where conduit development drawings or "home runs" are indicated, route the conduits in accordance with those requirements.
- b. Provide exposed or encased routings as indicated, except conceal conduit in finished areas unless indicated otherwise.
- c. Size conduits encased in a slab for conduit OD not to exceed 1/3 of the slab thickness and lay out and space as to not impede concrete flow.

5. Placement

- a. Install conduit and equipment in such a manner as to avoid obstructions, to preserve headroom, and to keep openings and passageways clear.
- b. Locate luminaires, switches, convenience outlets, and similar items within finished rooms as indicated.
- c. Where exact locations are not indicated, such locations will be determined by the ENGINEER.
- d. If equipment is installed without instruction and must be moved, the cost of moving shall be included as part of the WORK.
- e. Slightly adjust luminaire locations in order to avoid obstructions and to minimize shadows.

6. Circuits

- a. Wherever conduits and wiring for lighting and receptacles are not indicated, it shall be the CONTRACTOR'S responsibility to provide lighting and receptacle-related conduits and wiring as required, based on the actual installed fixture layout and the circuit designations as indicated.
- b. Provide No. 12 AWG minimum wiring, and 3/4-inch minimum conduits (exposed) and one-inch minimum conduits (encased).
- c. Where circuits are combined in the same raceway, derate conductor ampacities in accordance with NEC requirements.

7. Workmanship

- a. Install materials and equipment in strict accordance with the printed recommendations of the manufacturer and using workers skilled in the WORK.
- b. Coordinate installation in the field with other trades in order to avoid interferences.

8. Protection of Equipment and Materials

- a. Fully protect materials and equipment against damage from any cause.
- b. Cover materials and equipment, both in storage and during construction, in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint.
- c. Keep moving parts clean and dry.
- d. Replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

3.2 CLEANING

- A. Before final acceptance, thoroughly clean the electrical WORK of cement, plaster, and other materials.
- B. Remove temporary tags, markings, stickers, and the like.
- C. Remove oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.
- D. Apply touch-up paint to scratches on panels and cabinets.
- E. Vacuum clean electrical cabinets and enclosures. Do not use compressed air to clean cabinets.
- F. Clean luminaires inside and out. Replace failed lamps.
- G. Properly dispose cleaning debris and refuse off-site.

END OF SECTION

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SECTION 26 01 26 – ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. This Section specifies the WORK necessary to test, commission, and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.
- B. The WORK of this Section includes furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.
- C. The requirements of Section 26 00 00 - Electrical Work, General, apply to the WORK of this Section.
- D. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.

1.2 REFERENCES

A. General

- 1. The publications listed below form a part of this specification to the extent referenced.
- 2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American National Standards Institute (ANSI)

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

D. IEEE 400-2001, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

E. IEEE 576-2000, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications

F. InterNational Electrical Testing Association (NETA)

G. NFPA 70, National Electrical Code (NEC)

1.3 SUBMITTALS

- A. Submit complete system test procedures for review. Test procedures shall include but not be limited to:
 - 1. Detailed procedures in sufficient detail to verify conformance with these Specifications.

2. Incorporation of the Test Record Sheets included at the end of this Section.
3. Detailed comprehensive testing schedule including:
 - a. Each major piece of electrical distribution equipment.
 - b. Each major electrical subsystem.
 - c. Duration of each test.
 - d. Milestone test completion date.
 - e. Ambient Conditions at time of test
 - f. Date of test results submittals following completion of the tests.
 - g. Names and qualifications of the individual(s) responsible for performing the testing.
- B. Following completion of the test submit the completed test results to the Owner for review. The results shall include a dedicated section with the “as-left” settings of all devices, relays, circuit breakers, etc.
- C. Test result shall be submitted in one submittal
- D. Test reports shall be based on NETA’s latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA’s Acceptance Testing Specifications latest edition.

PART 2 -- TESTING & REPORTS

2.1 PRE-ENERGIZATION AND OPERATING TESTS

- A. The complete electrical system shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the recommendations of the protective device study and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the authority having jurisdiction.
 1. Switching Circuits. Each switching circuit shall be observed to operate the associated equipment being switched.
 2. Acceptance Tests. Complete acceptance tests shall be performed, after the station installation is completed, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.
- B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be delivered to the authority having jurisdiction prior to energization. Acceptance Testing shall be in accordance with NETA ATS-2017, *For Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing Association.

2.2 TEST REQUIREMENTS

- A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Lighting: Switching, include remote control, if present in system. Circuitry is in accordance with panel schedules. All interior and exterior lighting shall be checked for proper operation.
2. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.
3. Low Voltage Cables-600 volts Maximum
 - a. Visual and Mechanical Inspection
 - 1) Compare cable data with drawings and specifications.
 - 2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.
 - 3) Inspect bolted electrical connections for high resistance using one of the following methods:
 - a) Use of low-resistance ohmmeter
 - 4) Inspect compression-applied connectors for correct cable match and indentation.
 - 5) Inspect for correct identification and arrangements.
 - 6) Inspect cable jacket insulation and condition.
 - b. Electrical Tests
 - 1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.
 - a) Panelboard feeders tested with feeder breaker open and panelboard connected. If a lighting transformer is associated with the panelboard, it shall be connected, and the test made for both primary and secondary sides.
 - b) Prior to performing insulation resistance tests on cables, verify that they are not connected to a solid-state device.
 - c) Equipment which may be damaged during this test shall be disconnected.
 - d) The Owner shall be consulted if minimum insulation values cannot be obtained.
 - 2) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

- 3) Perform continuity test to insure correct cable connection.
- c. Test Values – Visual and Mechanical
 - 1) Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- d. Test Values – Electrical
 - 1) Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS-2017 Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.
 - 3) Cable shall exhibit continuity.
4. Test ground interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle manufacturer.
5. A functional test and check of electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
 - a. Visual and physical check of cables, circuit breakers, transformers, and connections associated with each item of new and modified equipment.
6. Complete ground testing of grounding electrodes per requirements below prior to operating the equipment.
- B. Provide ground resistance tests on the main grounding electrode or system in the presence of the OWNER and submit results
 1. Visual and Mechanical Inspection
 - a. Verify ground system is in compliance with drawings and specifications.
 2. Electrical Tests
 - a. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81 on the main grounding electrode or system.
 - b. The earth resistance of each ground electrode shall be measured and recorded before electrodes are connected to the grounding loop.
 - c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
 3. Test Values

- a. The resistance between the main grounding electrode and ground shall be no greater than five ohms for commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner.
 - b. Investigate point-to-point resistance values which exceed 0.5 ohm.
- C. Subsystems shall be defined as individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.

2.3 TEST REPORTS

- A. The test report shall include the following:
- 1. Summary of project.
 - 2. Description of equipment tested.
 - 3. Description of test.
 - 4. Test data.
 - 5. Analysis and recommendations.
- B. Test data records shall include the following minimum requirements:
- 1. Identification of the testing organization.
 - 2. Equipment identification.
 - 3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.
 - 4. Date of inspections, tests, maintenance, and/or calibrations.
 - 5. Identification of the testing technician.
 - 6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
 - 7. Indication of expected results when calibrations are to be performed.
 - 8. Indication of "as-found" and "as-left" results.
 - 9. Sufficient spaces to allow all results and comments to be indicated.
- C. The testing firm shall furnish a copy or copies of the complete report to the owner as required in the acceptance contract.

PART 3 -- TEST RECORD SHEETS

The test record sheets listed below shall be used to record testing of electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

| Sheet No. | Title |
|-----------|--|
| 1 | Insulation Resistance (Power, Control Wire, and Cable) Test Record |
| 4 | Ground Electrode Testing Test Record |
| 5 | Neutral Grounding Resistor Test Record |
| 6 | Bonding Resistance Readings (Nonelectrical Equipment/Structures) Test Record |
| 7 | Bonding Resistance Readings (Electrical Equipment) Test Record |

**INSULATION RESISTANCE
(POWER, CONTROL WIRE, AND CABLE)
TEST RECORD**

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
TEST EQUIPMENT: _____ TEST VOLTAGE: _____
AMBIENT TEMPERATURE: ___ °C ___ °F DATE: _____

- NOTES: 1. Perform Insulation Resistance Test (megger) between each conductor and all other conductors and metallic sheath for cables with nonshielded conductors. Test between each conductor and shield for multiconductor cables with shielded conductors. Record lowest reading for each cable.
2. Use 1,000-V test set for cable rated 600 volts and 2,500-V test set for cable rated over 600 volts.
3. Readings will vary inversely with temperature and cable length. When the use of temperature correction factors is specified, attach a second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

| Panel No. | | Cable | Wire or Cable | Insulation | | | | |
|---------------------------|-----------------|------------------|---------------|------------|------|----|--------------------------|----------|
| Circuit No. Feeder No. | Wire Tagging | Rated Voltage | Quantity | Size | From | To | Resistance (megohms)* | Initials |
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*Minimum acceptable values:

| | | | | |
|----------------------------|----------------------|----------------------------------|--|--|
| <u>Cable Rated Voltage</u> | <u>Test Duration</u> | <u>Resistance for Cable Only</u> | <u>Cable/Wire Size or Amperage (megohms)</u> | <u>Resistance When Cable Connected to Equipment (ohms)</u> |
|----------------------------|----------------------|----------------------------------|--|--|

DISTRIBUTION: _____ CONTRACTOR/Date _____

GROUND ELECTRODE TESTING TEST RECORD

TEST EQUIPMENT: _____ (Note 1) _____ (Note 2)

REFERENCE DRAWING: _____

- NOTES:
1. Record resistance-to-earth for each electrode with all other conductors disconnected. Resistance not to exceed 25 ohms for any single anode.
 2. Check continuity from each electrode to any test bar or other electrode such that the complete ground loop is tested.

| Rod Number | Resistance to Earth (ohms) | Ambient Temperature (°C/°F) | Weather | Taps (□) | Initials/Date |
|------------|----------------------------|-----------------------------|---------|----------|---------------|
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DISTRIBUTION: _____

CONTRACTOR/Date _____

NEUTRAL GROUNDING RESISTOR TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
 TEST EQUIPMENT: _____ TEST VOLTAGE: _____

- NOTES: 1. Use 1,000-volt test set for 600-volt equipment and below, 2,500-volt test set for equipment rated over 600 volts.
2. Resistor must be disconnected from ground and neutral during Insulation Resistance (megger) and DC Overpotential Tests.
3. Resistor must be disconnected from neutral during Cold Resistance Test.
4. Apply DC Overpotential Test between terminals and ground for the complete device. (The voltage applied between the terminals of each assembly and its grounded enclosure shall be twice the rated AC voltage plus 1000 V when rated 600 V or less, or 2.25 times the rated AC voltage plus 2000 V when rated over 600 V for 1 minute. This test is a Pass/Fail test based purely on withstand alone.
5. Inspect assembly for damage and missing parts.
6. Check to assure that the center tap ratio is correct when CT is supplied with resistor.
7. Verify resistor reterminated.

| Tag No. | Cold Res. (ohms) | Insul. Res. (megohms)* | Overpot. (□) | CT Ratio Pri-Sec | Reterm (□) | Initials/Date |
|---------|------------------|------------------------|--------------|------------------|------------|---------------|
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*Minimum acceptable values:

VOLTAGE CLASS
(megohms)

INSULATION RESISTANCE

DISTRIBUTION:

CONTRACTOR/Date _____

**BONDING RESISTANCE READINGS
(NONELECTRICAL EQUIPMENT/STRUCTURES)
TEST RECORD**

TEST EQUIPMENT USED: _____ WEATHER: _____

- NOTES: 1. Vessels, tanks, and structural steel bonded to the main grounding system, dedicated ground rod or foundation, as indicated on drawings listed below.
2. Measure resistance from ground wiretap (or anchor bolt) to tagged equipment frame or structural steel.

| EQUIPMENT TAG NO. OR STRUCTURE | DRAWING | MEASURED RESISTANCE (ohms) | INITIALS/DATE |
|--------------------------------------|---------|----------------------------------|---------------|
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DISTRIBUTION:

CONTRACTOR/Date _____

SECTION 26 05 19 - WIRE AND CABLING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide wire and cable, complete and operable, in accordance with the Contract Documents.

1.2 DELIVERY, STORAGE AND HANDLING

- A. The CONTRACTOR shall protect all cables from damage at all times.
- B. Cable ends shall be protected from water entry in accordance with the manufacturer's recommended procedures. Cable ends shall not be left open in manholes or other locations subject to submergence. If the cable ends become submerged prior to splicing or termination, the cables shall be replaced in their entirety.
- C. Cables shall be pulled into raceways in accordance with the manufacturer's requirements. Under no circumstances shall cable pulling tensions exceed the manufacturer's written instructions.
- D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

- A. Although design may be based on a specific manufacturer, any other equivalent manufacturer's product may be used.
- B. Conductors include grounding conductors 10AWG and smaller shall be SOLID copper. Conductors include grounding conductors 8AWG and larger shall be STRANDED copper. Aluminum conductor will not be permitted. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.
- C. Low Voltage Power and Lighting Wire
 - 1. Wire rated for 600 volts in duct or conduit, walls, attic or crawl space for power and lighting circuits shall be Type NM, Class B Type XHHW or XHHW-2 cross-linked polyethylene conforming to UL-44 - UL Standard for Thermoset-Insulated Wires and Cables.
 - 2. Wiring for 600-volt class power and lighting shall be as manufactured by **Romex** or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The CONTRACTOR shall provide, terminate and test all power, control, and instrumentation conductors.
- B. Conductors shall not be pulled into any raceway until raceway has been cleared of moisture and debris.
- C. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps and shall be neatly fanned out to terminals.
- D. Single conductor cable in cable trays shall be No. 1/0 or larger and shall be of a type listed and marked for use in cable trays. Tray cable smaller than 1/0 shall be multi-conductor, with outer jacket.

3.2 FIELD ASSEMBLY

A. General

- 1. Wire taps and splices shall be properly taped and insulated according to their respective classes.
- 2. In general, there shall be no cable splices in underground manholes or pull boxes. If splices are necessary, the cables shall be spliced using submersible cable splices, suitable for continuous submergence. Splices in underground manholes and pull boxes may be made only with the approval of the OWNER.
- 3. Stranded conductors shall be terminated directly on equipment box lugs making sure that conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
- 4. Excess control and instrumentation wires shall be long enough to terminate at any terminal block in the enclosure, be properly taped, be identified with origin, and be neatly coiled.

B. Power Wire and Cable

- 1. 120/240-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR.

3.3 FIELD QUALITY CONTROL

- A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-95-658/NEMA WC70 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. The following field tests (in addition to the tests specified in Section 26 01 26 – Electrical Tests) shall be the minimum requirements:
 - 1. Insulation resistance testing, using a DC megohmmeter, shall be performed on cables operating at more than 2,000 volts to ground. Time-resistance readings shall be taken and recorded at intervals of 30 seconds and one minute. Time-resistance voltage levels shall be per the cable manufacturer's recommendations.

2. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmmeter.
3. Field testing shall be done after cable is installed in the raceways.
4. Field megger testing may be performed by the CONTRACTOR or a NETA-certified test organization. When tested by the CONTRACTOR, submit test equipment calibration sheets prior to performing any field testing. Test results shall be submitted to the OWNER for review and acceptance.
5. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

END OF SECTION

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SECTION 26 05 26 – GROUNDING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Provide the electrical grounding system, complete and operable, as indicated in accordance with the Contract Documents.
- B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.
- C. Single Manufacturer
 - 1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

- A. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
- B. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.
- C. Grounding System
 - 1. Ground Rods
 - a. Unless indicated otherwise, provide ground rods minimum of 3/4 inch in diameter, 10 feet long, and with a uniform covering of electrolytic copper metallurgically bonded to a rigid steel core.
 - b. Provide corrosion-resistant copper-to-steel bond.
 - c. The rods shall conform to UL 467.
 - d. The rods shall be of the sectional type, joined by threaded copper alloy couplings.
 - 2. Make buried, concrete-encased, or otherwise inaccessible cable-to-cable and cable-to-ground rod connections using exothermic welds by **Cadweld, Thermoweld**, or equal.
 - 3. Exposed Connectors
 - a. Exposed grounding connectors shall be exothermic welds by **Cadweld, Thermoweld**, or equal.
 - 4. Use grounding clamps to bond each separately derived system to the grounding electrode conductors.
 - 5. Equipment Grounding Circuit Conductors

- a. The conductors shall be the same type and insulation as the load circuit conductors.
 - b. The minimum size shall be as indicated. Where not indicated, sizes shall conform to Table 250.122 of the National Electrical Code.
 - c. Metallic conduit systems shall have an equipment grounding wires as well as being equipment grounding conductors themselves.
6. Grounding Materials Manufacturer, or Equal
- a. **Copperweld**
 - b. **Thermoweld**
 - c. **Burndy**
 - d. **Thomas and Betts**
 - e. **OZ Gedney**

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.
- B. Route the conductors inside the raceway.
- C. Provide a grounding-type bushing for secondary feeder conduits that originate from the secondary section of each MCC section, switchboard, or panelboard.
- D. Individually bond the raceway to the ground bus in the secondary section.
- E. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw, and, for grounding type devices, to the equipment grounding conductor.
- F. Measure ground impedance in accordance with IEEE STD 81 after installation but before connecting the electrode to the remaining grounding system. Provide additional grounding system testing in accordance with Section 26 01 26 – Electrical Tests.
- G. Embedded Ground Connections
 1. Underground and grounding connections embedded in concrete shall be UL-listed ground grid connectors.
 2. The connection shall be made in accordance with the manufacturer's instructions.
 3. Do not conceal or cover ground connections until the OWNER or an authorized representative has established that every grounding connection conforms to the requirements of the Contract Documents and has given the CONTRACTOR written confirmation.
- H. Ground Rods

1. Provide ground rods at the indicated locations.
2. A single electrode that does not have resistance-to-ground of 5 ohms or less shall be augmented by additional electrodes to obtain this value.
3. Take the resistance-to-ground measurement during dry weather, a minimum of 48 hours after a rainfall.
4. Rods forming an individual ground array shall be equal in length.

END OF SECTION

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SECTION 26 05 33 - ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Provide electrical raceway systems, complete and in place, as indicated in accordance with the Contract Documents.
- B. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the WORK.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
- B. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.

2.2 CONDUIT

A. PVC Rigid Non-Metallic Conduit

1. Provide rigid non-metallic conduit manufactured from Schedule 40 PVC, as indicated, and sunlight resistant.
2. Provide rigid non-metallic conduit manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit.
3. Manufacturer, or Equal
 - a. **Carlton**
 - b. **Cantex**

B. Liquid-Tight Flexible Conduit

1. Provide liquid-tight flexible conduit constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.
2. Provide liquid-tight flexible conduit manufactured in accordance with the requirements of UL-360 - Steel Conduits, Liquid-Tight Flexible.
3. Manufacturer, or Equal
 - a. **Anaconda, Sealtite**
 - b. **Electriflex, Liquatite**

C. Electrical Metallic Tubing (EMT).

1. Provide EMT in accordance with UL Standard 797 Electrical Metal Tubing - Steel and manufactured in accordance with ANSI C80.3.
2. Manufacturer, or Equal
 - a. **Calbrite**
 - b. **Allied**

2.3 FITTINGS AND BOXES

A. General

1. For use with metallic conduit, provide cast and malleable iron fittings of the threaded type with 5 full threads.
2. Fittings and Boxes
 - a. Provide fittings and boxes with neoprene gaskets and non-magnetic stainless-steel screws.
 - b. Attach covers by means of holes tapped into the body of the fitting.
 - c. Covers for fittings attached by means of clips or clamps will not be accepted.
 - d. Provide surface-mounted switches and receptacles shall be housed in FS or FD-type weatherproof conduit fittings. Bell type are not permitted.
3. Provide boxes larger than standard cast or malleable types manufactured of Type 304 or Type 316 stainless steel, NEMA 4X.
4. Terminations
 - a. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, Appleton, or equal.
 - b. In other than outdoor areas, provide sealed locknuts and bushings.

B. Cast Aluminum Fittings and Boxes

1. Provide cast aluminum boxes and fittings with less than 0.40 percent copper content and use with aluminum conduit.
2. Manufacturer, or Equal
 - a. **Crouse-Hinds Mark 9**
 - b. Equivalent by **O.Z. Gedney**
 - c. Equivalent by **Appleton**

C. PVC Fittings and Boxes

1. For use with rigid non-metallic conduit, provide fittings manufactured of solvent-welded PVC.
2. Provide boxes manufactured of PVC or fiberglass reinforced polyester (FRP).
3. Manufacturer, or Equal
 - a. **Carlton**
 - b. **Crouse-Hinds**
 - c. **Hoffman**
4. Provide welding solvent as required for the installation of non-metallic conduit and fittings.

2.4 WIREWAY

A. General

1. Provide wireway of the lay-in type and NEMA-rated for the area in which it is to be installed in accordance with the requirements of Section 26 00 00 – Electrical Work, General.

B. Fittings and Covers

1. Provide fittings and sections with non-magnetic stainless-steel screws.
2. Attach covers by hinges and clamps to the bodies.
3. Covers attached by means of clips or screws will not be accepted.
4. Provide covers and bodies constructed of aluminum or minimum 14-gauge steel.

C. Grounding

1. Ground the steel and aluminum wireway bodies.
2. Provide steel dividers with steel wireways or aluminum dividers with aluminum wireways, and ground by means of an individual grounding conductor.
3. Non-metallic dividers will not be accepted.

D. Terminations

1. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, or equal.

EXECUTION

2.5 GENERAL

- A. Run wiring in raceway unless indicated otherwise.
- B. Install raceways between equipment as indicated.

- C. Provide raceway systems that are electrically and mechanically complete before conductors are installed.
- D. Bends and Offsets
 - 1. Provide bends and offsets that are smooth and symmetrical, and accomplished with tools designed for this purpose.
 - 2. Provide factory elbows wherever possible.
- E. Routing
 - 1. Where raceway routings are indicated, follow those routings to the extent possible.
 - 2. Where raceways are indicated but routing is not indicated, such as home runs or on conduit developments and schedules, raceway routing shall be the CONTRACTOR's choice and provided in strict accordance with the NEC as well as customary installation practice.
 - 3. Provide the raceway encased, exposed, concealed, or under-floor as indicated, except conceal conduit in finished areas unless specifically indicated otherwise.
 - 4. Adjust routings in order to avoid obstructions.
- F. Coordination
 - 1. Coordinate between trades prior to installing the raceways.
 - 2. The lack of such coordination shall not be justification for extra compensation, and any costs for removal and re-installation to resolve conflicts shall be part of the Contract Price
- G. Install exposed raceways parallel or perpendicular to structural beams.
- H. Expansion Fittings
 - 1. Install expansion fittings with external bonding jumpers wherever exposed raceways cross building expansion joints.
 - 2. Install expansion/deflection fittings where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur.
 - 3. Encased Expansion Fittings
 - a. Install encased expansion fittings wherever encased conduits cross building expansion joints.
 - b. Deflection type fittings shall not be required for encased conduits crossing an expansion joint within a single structure.
 - 4. Provide expansion and expansion/deflection fittings constructed of the same material as the raceway to which they are installed.

- I. Install expansion fittings with bonding jumpers wherever raceways cross building expansion joints.
- J. Install exposed raceways at least 1/2 inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, install exposed raceways at least 1/4 inch from the face of walls or ceilings by the use of clamp backs or struts.
- K. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, provide a means of suitable insulation in order to prevent such corrosion.

2.6 CONDUIT

- A. Provide exposed conduit manufactured of EMT, except as follows and unless indicated otherwise:
 - 1. For conduit containing only grounding system bonding conductors, provide Schedule 80 PVC conduit.
- B. Power conduit encased in concrete shall be constructed of Schedule 40 PVC.
- C. Concrete Encasement
 - 1. Where PVC or RGS conduit is stubbed up from a concrete encasement, provide a PVC-coated RGS elbow.
 - 2. The conduit shall emerge from the concrete in a direction perpendicular to the surface whenever possible.
 - 3. Do not encase conduit in the bottom floor slab below grade.
- D. Size
 - 1. Provide exposed conduit of 3/4-inch minimum trade size.
 - 2. Provide encased conduit of one-inch minimum trade size.
- E. Install supports at distances required by the NEC.
- F. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4 inch for concrete not exposed to weather or in contact with the ground.
- G. Place the conduit such that cutting, bending, or displacing reinforcement from its proper location will not be required.
- H. Joints
 - 1. Provide joints that are tight, thoroughly grounded, secure, and free of obstructions in the pipe.
 - 2. Adequately ream the conduit in order to prevent damage to the wires and cables inside.
 - 3. Use strap-wrenches and vises to install the conduit, in order to prevent wrench marks on the conduit.

4. Replace conduit with wrench marks.
- I. Slope
 1. Wherever possible, slope the conduit runs to drain at one or both ends of the run.
 2. Wherever conduit enters a substructure below grade, slope the conduit in order to drain water away from the structure.
 3. Take extreme care in order to avoid pockets or depressions in the conduit.
 - J. Connections
 1. Make connections to lay-in-type grid lighting fixtures by using flexible metal conduit not exceeding 4 feet in length.
 2. Make connections to motors and other equipment subject to vibration by using liquid-tight flexible conduit not exceeding 3 feet in length.
 3. Provide equipment subject to vibration that is normally provided with wiring leads with a cast junction box for the make-up of connections.
 - K. Provide conduit for data cables in accordance with the equipment manufacturer's recommendations, especially regarding separation from low- and medium-voltage power raceways.

END OF SECTION

SECTION 26 05 36 - WIRING DEVICES

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide wiring devices, complete and operable, as indicated in accordance with the Contract Documents.
- B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.
- C. Single Manufacturer
 - 1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
- B. Devices shall carry the U.L. label and shall be designed for use with stranded copper conductors.
- C. Color
 - 1. General purpose duplex receptacles and toggle switch handles shall be matched to existing everywhere except unless otherwise indicated.
- D. Receptacles and switches shall be of specification grade and shall conform to NEMA WD-1, Federal Specifications W-C-596E and W-S-896E, respectively.

2.2 LIGHTING SWITCHES

- A. Toggle switches shall be AC only, ROCKER type switch.
 - 1. 20A, 120/277V, Single, Double, 3-Way and 4-Way, Respectively
 - a. **Leviton:** 5621-2, 5623-2
 - b. **Hubbell:** HBL1221, HBL1222, HBL1223, HBL1224
 - c. **Pass and Seymour:** PS20AC1, PS20AC2, PS20AC3, PS20AC4
 - d. **Or Equal**

2.3 OCCUPANCY SENSORS

- A. Wall Switch Sensor Light Switch, Dual Technology:
 - 1. 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:

- a. **Eaton (Wiring Devices - Arrow Hart).**
 - b. **Leviton Manufacturing Co., Inc.**
 - c. **Pass & Seymour; Legrand North America, LLC.**
 - d. **Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.**
 - e. **Or Equal**
2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
 3. Standards: Comply with UL 20.
 4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 5. Adjustable time delay of five minutes.
 6. Able to be locked to Manual-On mode.

2.4 GENERAL PURPOSE RECEPTACLES

- A. Duplex receptacles shall be of the polarized 3-wire type for use with a 3-wire cord with grounded lead, and one designated stud shall be permanently grounded to the conduit system in accordance with NEC article 406.4.
- B. Dry Areas
 1. NEMA Configuration #5-20R: duplex receptacle rated 125V, 20A
 - a. **Leviton: #5362**
 - b. **Hubbell: #HBL5362**
 - c. **Pass and Seymour: #5362A**
 - d. **Or Equal**
- C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
 1. 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:
 - a. **Eaton (Wiring Devices - Arrow Hart).**
 - b. **Leviton Manufacturing Co., Inc.**
 - c. **Pass & Seymour; Legrand North America, LLC.**
 - d. **Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.**
 - e. **Or Equal**
 2. Description: Two-pole, three-wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Standards: Comply with UL 498 and FS W-C-596.
 5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.5 USB RECEPTACLES

A. USB Charging Receptacles:

1. 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:
 - a. **Eaton (Wiring Devices - Arrow Hart).**
 - b. **Leviton Manufacturing Co., Inc.**
 - c. **Pass & Seymour; Legrand North America, LLC.**
 - d. **Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.**
 - e. **Or Equal**
2. Description: Single piece, rivet less, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. **Eaton (Wiring Devices - Arrow Hart).**
 - b. **Leviton Manufacturing Co., Inc.**
 - c. **Pass & Seymour; Legrand North America, LLC.**
 - d. **Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.**
 - e. **Or Equal**
2. Description: Single piece, rivet less, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
3. Line Voltage Receptacles: Two-pole, three-wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.

2.6 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. 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:
 - a. **Pass & Seymour; Legrand North America, LLC.**
 - b. **Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.**
 - c. **Or Equal**

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two-pole, three-wire, and self-grounding.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Type: Feed through.
 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
- B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:
1. 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:
 - a. **Pass & Seymour; Legrand North America, LLC.**
 - b. **Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.**
 - c. **Or Equal**
 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two-pole, three-wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Type: Feed through.
 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
1. 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:
 - a. **Eaton (Wiring Devices - Arrow Hart).**
 - b. **Leviton Manufacturing Co., Inc.**
 - c. **Pass & Seymour; Legrand North America, LLC.**
 - d. **Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.**
 - e. **Or Equal**
 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two-pole, three-wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 3. Configuration: NEMA WD 6, Configuration 5-15R.
 4. Type: Feed through.
 5. Standards: Comply with UL 498 and UL 943 Class A.

6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.
7. Feed-through-type GFCIs serving standard receptacles will not be permitted.

2.7 ENCLOSURES AND COVERS

- A. In finished areas, switch and receptacle covers shall match the color of existing covers.
Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Wet Locations
 1. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum, "While In-Use" with lockable cover.
 2. Provide a gasket between the enclosure and the mounting surface, and between the hinged cover and mounting plate/base.
 - a. **Appleton:** WCIU
 - b. **Crouse-Hinds:** TP74
 - c. **Hubbell TayMac:** Extra Duty
 - d. **Or Equal**

2.8 RECEPTACLE – SPECIAL PURPOSE

- A. Special purpose receptacles shall be provided with the ratings and number of poles as indicated or required for the proposed purpose.
- B. Provide a matching plug with cord-grip features with each special purpose receptacle.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Perform WORK in accordance with the requirements of the NEC.

3.2 CONNECTION

- A. Rigidly attach wiring devices in accordance with the NEC and as indicated, avoiding interference with other equipment.
- B. Securely fasten nameplates using screws, bolts, or rivets centered under or on the device, unless otherwise indicated.

3.3 GROUNDING

- A. Devices, including switches and receptacles, shall be grounded in accordance with NEC, Article 250, and Section 26 05 26 – Grounding.
- B. Switches and associated metal plates shall be grounded through the switch mounting yoke, outlet box, and raceway system.
- C. Flush Receptacles

1. Flush receptacles and their metal plates shall be grounded through positive ground connections to the outlet box and grounding system.
2. Maintain the ground to each receptacle by a spring-loaded grounding contact to the mounting screw, or by a grounding jumper, each making a positive connection to the outlet box and grounding system at all times.

3.4 FIELD TESTING

- A. Provide checkout, field, and functional testing of wiring devices in accordance with Section 26 00 00 – Electrical Work, General.
- B. Test each receptacle for polarity and ground integrity, using a standard receptacle tester.

END OF SECTION

SECTION 26 12 16 – PANELBOARDS

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide panelboards, complete and operable, in accordance with the Contract Documents.
- B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
- B. Panelboards
 - 1. Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1-Panelboards, as well as the provisions of UL 50 - Safety Enclosures for Electrical Equipment and UL 67 - Safety Panelboards. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/240 volt for single phase operation as indicated.
 - 2. The manufacturer of the panelboard shall be the manufacturer of the major components within the assembly, including circuit breakers.

2.2 PANELBOARDS

A. Ratings

- 1. Panelboards rated 240 VAC or less shall have short circuit ratings not less than 10,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.
- 2. Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.

B. Construction

- 1. Lighting and power distribution panels shall have tin-plated copper bus bars.
- 2. Breakers shall be one or 2 pole as indicated, with ampere trip ratings as required by the equipment. Breakers shall be quick-make and quick-break, inverse time trip characteristics, to trip free on overload or short circuit, and to indicate trip condition by the handle position.
- 3. The panels shall have hinged doors with combination catch and latch. The front panels shall be so arranged that when the plates are removed, the gutters, terminals

and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.

4. Panelboards shall be rated for the intended voltage.
 5. Circuit breakers shall be interchangeable and capable of being operated in any position as well as being removable from the front of the panelboard without disturbing adjacent units. No plug-in circuit breakers will be acceptable.
 6. Panelboards shall be UL listed except for special enclosures which are not available with UL listing.
 7. Panelboards shall be suitable for use as service entrance where indicated.
- C. Manufacturers: **General Electric, Eaton, Schneider Electric/Square D Company, or equal**
- D. Surge Protection Devices (SPD)
1. Provide integral SPDs. SPDs shall conform to Section 26 43 00 – Surge Protection Devices.
 2. SPD units shall be rated for the voltage and phase service of the panel at 120 kA per phase.

PART 3 -- EXECUTION

3.1 GENERAL

- A. WORK of this Section shall be installed as indicated in Section 26 00 00 – Electrical Work, General.

END OF SECTION

SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPD)

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install surge protective devices (SPD).
- B. SPDs furnished under this Section shall be ANSI/UL 1449 Type 2 integrating both surge suppression and high-frequency noise filtering suitable for use on low-voltage distribution systems.
- C. The requirements of Section 26 00 00 – Electrical Work, General, apply to the WORK of this Section.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Reference Standards:

- 1. ANSI/UL 1449, Fourth Edition, Safety Surge Protective Devices
- 2. IEEE C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits
- 3. IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connect to Low-Voltage (1000V and Less) AC Power Circuits
- 4. UL 1283, Safety Electromagnetic Interference Filters
- 5. NFPA 70, National Electric Code

1.3 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer: Shall have at least five (5) years' experience manufacturing and servicing products substantially similar to those required and shall be able to submit documentation of at least 5 installations in satisfactory operation for at least five (5) years each.

B. Component Supply and Compatibility:

- 1. Obtain all products included in this Section regardless of component manufacturer from a single SPD manufacturer.
- 2. SPD manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
- 3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by SPD manufacturer.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
- B. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
- C. SPD shall be suitable for operation under the following environmental conditions:
 - 1. Relative Humidity: Zero to 95%, non-condensing
 - 2. Frequency: 47 to 63 Hz
 - 3. Temperature: Zero to 149°F
 - 4. SPD operating voltage shall be suitable for the associated SPD location(s).
 - 5. SPD shall be suitable for internal and external mounting. SPD shall be factory-mounted and integrated into distribution equipment specified under the following Sections:
 - a. Section 26 00 00 – Electrical Work, General
 - b. Section 26 12 16 – Panelboards
- D. SPD shall include a surge suppression path for each mode as required for the system configuration. Each mode shall be individually fused and equipped with thermal cutouts. SPD short-circuit current rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:
 - 1. Line-to-line
 - 2. Line-to-neutral
 - 3. Line-to-ground
 - 4. Neutral-to-ground
- E. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.
- F. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115% of nominal system operating voltage.
- G. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

| Modes | 240/120 |
|---------------|----------------|
| L-N, L-G, N-G | 800 |
| L-L | 1200 |

- H. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

| Category | Application | Per Phase | Per Mode |
|----------|---|-----------|----------|
| C | Service entrance | 240 kA | 120 kA |
| B | High exposure locations (distribution equipment) | 160 kA | 80 kA |
| A | Branch locations | 120 kA | 60 kA |

- I. Provide SPD equipped with the following accessories:
1. Surge counter with display for indicating the number of surges detected.
 2. LED indicators for monitoring device status.
- J. Source Quality Control: Perform manufacturer's standard factory tests on equipment. Tests shall be in accordance with ANSI/UL 1449.
- K. Manufacturers: **General Electric, Eaton, Schneider Electric/Square D Company, or equal.**

PART 3 -- EXECUTION

3.1 GENERAL

- A. Install SPD in accordance with equipment manufacturer's written recommendations and instructions and the Contract Documents.
- B. Where an SPD cannot be installed integral with the equipment to which it is connected, conductor length between suppressor and connection point shall be as short and as straight as possible.

END OF SECTION

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SECTION 26 50 00 – LIGHTING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Provide luminaires and accessories, complete and operable, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes

| | |
|-----------------------------------|--|
| NFPA 70 | National Electric Code |
| NEMA 250 | Enclosures for Electrical Equipment (1,000 Volts Maximum) |
| International Building Code (IBC) | Earthquake Requirements |
| UL-595 | Standard for Safety Marine-Type Electric Lighting Fixtures |
| UL-844 | Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified Locations) |
| UL-924 | Standard for Safety Emergency Lighting and Power Equipment |
| ANSI C82.1 | Specifications for Fluorescent Lamp Ballasts |
| ANSI C84.4 | Specifications for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type) |

Standards of the Certified Ballast Manufacturer's Association

PART 2 -- PRODUCTS

2.1 LUMINAIRES

- A. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
- B. General
 - 1. Additional WORK requirements are indicated in the Luminaire Schedule on the Drawings.
 - 2. All luminaires shall be LED type.
- C. Provide a feed-through type or separate junction box.
- D. Provide minimum 12 AWG wire leads.

- E. Provide components that are accessible and replaceable without removing the luminaire from the ceiling.
- F. Soffit Installations
 - 1. Installations shall be UL-labeled as "Suitable for Damp Locations."
 - 2. Provide removable and prewired ballasts.
- G. Exterior Installations
 - 1. Installations shall be UL-labeled as "Suitable for Wet Locations."
 - 2. Provide removable and prewired ballasts.
 - 3. When factory-installed photocells are provided, the entire assembly shall be UL-labeled.

2.2 LAMPS

- A. LED
 - 1. Color: 2700K – 5000K
 - 2. Rated Burning Life: 20,000 hours
- B. Manufacturer, or Equal
 - 1. **General Electric**
 - 2. **Sylvania**
 - 3. **North American Philips**
 - 4. **Or Equal**

2.3 LIGHTING CONTROL

- A. Photocell
 - 1. Photo Control: automatic ON-OFF switch
 - 2. Housing: self-contained; die-cast aluminum; unaffected by moisture, vibration, or temperature changes
 - 3. Settings: ON at dusk; OFF at dawn
 - 4. Provide a time delay feature in order to prevent false switching.
 - 5. field-adjustable to control operating levels
 - 6. Manufacturer, or Equal
 - a. **Tork**

b. Paragon

PART 3 -- EXECUTION

3.1 LUMINAIRES

A. General

1. Install in accordance with the manufacturer's recommendations.
2. Provide necessary hangers, pendants, canopies, and other accessories.
3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to the building as required to safely mount the luminaire.
4. Install the luminaire plumb and level.
5. The mounting heights indicated for wall-mounted or pendant-mounted luminaires are from the bottom of the luminaire to finished floor or finished grade, whichever is applicable.
6. Install each luminaire outlet box with a galvanized stud.

B. Pendant Mounting

1. Provide swivel-type hangers and canopies to match the luminaires, unless otherwise indicated.
2. Space single-stem hangers on continuous-row fluorescent luminaires 48 inches apart.
3. Provide twin-stem hangers on single luminaires.

C. Finished Areas

1. Install recessed luminaires tight to the finished surface such that no spill light will show between the ceilings and the sealing rings.
2. Junction Boxes.
 - a. In concealed locations, install junction boxes to be accessible by the removal of the luminaire.
3. Wiring and Conduit
 - a. Provide wiring of a suitable temperature rating as required by the luminaire.
4. Provide plaster frames when required by ceiling construction.
5. Independent Supports
 - a. Provide each recessed fluorescent luminaire with 2 safety chains or 2 No. 12 soft-annealed galvanized steel wires of length needed to secure the luminaire to the building structure, independent of the ceiling structure.

- b. Ensure that the tensile strength of chain or wire, and the method of fastening to the structure, is adequate to support the weight of the luminaire.
 - c. Fasten the chain or wire to each end of the luminaire.
 - D. Unfinished Areas
 - 1. Locate the luminaires to avoid conflicts with other building systems and blockage of the luminaire light output.
- 3.2 LAMPS
 - A. Within each luminaire, provide the number and type for which the luminaire is designed, unless otherwise indicated.
- 3.3 LIGHTING CONTROL
 - A. Outdoor Luminaires
 - 1. The photocells shall switch lights ON at dusk and OFF at dawn.
 - B. Dimming Systems
 - 1. Install in accordance with the manufacturer's recommendations.
 - 2. Do not connect ballasts or equipment to the dimming system unless such connections are acceptable to the dimming system manufacturer.
- 3.4 CLEAN-UP
 - A. Remove labels and other markings, except the UL listing mark.
 - B. Wipe the luminaires inside and out in order to remove construction dust.
 - C. Clean the luminaire plastic lenses with an antistatic cleaner only.
 - D. Touch up painted surfaces of the luminaires and the poles with matching paint provided by the manufacturer.
 - E. Replace defective lamps at the Date of Substantial Completion.

END OF SECTION

SECTION 27 13 01 - COMMUNICATION CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Telephone Cables.
- B. Video Coaxial Cables.

1.2 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 26 05 26 Grounding.

1.3 REFERENCES

A. American National Standards Institute (ANSI):

- 1. ANSI J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications, 2002.

B. ASTM International (ASTM):

- 1. ASTM E662 Test Method for Specific Optical Density of Smoke Generated by Solid Materials

C. Insulated Cable Engineers Association, Inc. (ICEA):

- 1. ICEA S-84-608 Telecommunications Cable Filled, Polyolefin Insulated, Copper Conductor Technical Requirements.

D. Institute of Electrical and Electronics Engineers (IEEE):

- 1. IEEE 383 Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

E. National Electrical Manufacturers Association (NEMA):

- 1. NEMA WC7 Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

F. National Fire Protection Association (NFPA):

- 1. NFPA 258 Standard Research Test Method for Determining Smoke Generation of Solid Materials

G. Rural Electrification Administration (REA):

- 1. REA PE-39 Filled Telephone Cables

H. Underwriters Laboratories Inc. (UL):

1. UL 1581 Electrical Wires, Cables, and Flexible Cords
2. UL 1666 Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

1.4 ABBREVIATIONS

| | |
|------|-----------------------------------|
| AWG | American Wire Gauge |
| DC | Direct Current |
| DS | Digital Signal |
| ETS | Emergency Trip System |
| FRPE | Flame-retardant |
| | Polyethylene GRP Glass Reinforced |
| IP | Internet Protocol |
| IPP | IP Precedence |
| LSZH | Low Smoke, Zero Halogen |

1.5 SUBMITTALS

- A. General: Refer to Contract Specifications Section 01 33 00 - Submittal Procedures for submittal requirements and procedures.
- B. Submittal Requirements: Before installation of wires and cables, submit complete product data sheets for each type and size of wire and cable required for the project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ship each unit securely wrapped, packaged, and labeled for safe handling in shipment and to avoid damage.
- B. Store wire and cable in a secure and dry storage facility.

PART 2 – PRODUCTS

1.1 TELEPHONE CABLES

A. Manufacturer, or Equal:

1. Subject to the requirements indicated. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.

- a. **Commercial Electric.**
 - b. **Zenith.**
 - c. **GE.**
- B. Provide outdoor rated, 2-pair, solid plain copper conductor with solid PVC insulation and overall PVC sheath. Conductors shall be twisted together in pairs. Maximum conductor resistance: 97.8 ohms/km @ 20 deg C. Maximum unbalanced capacitance: 500pF/500m. Minimum insulation resistance: 50Mohms/km @ 20 deg C.
- C. Telephone cables shall be certified by the manufacturer to have a minimum life of 40 years.
- D. Telephone cable shall be manufactured in accordance with CW1308.

1.2 RG6 COAXIAL CABLE

- A. Manufacturer, or Equal:
- 1. Subject to the requirements indicated. Although design is based on a manufacturer listed below, any other equivalent manufacturer's product may be used.
 - a. **Southwire.**
 - b. **Commercial Electric.**
 - c. **Zenith.**
- B. Provide solid copper, 3GHz, 75Ohm Coaxial Cable. Cable construction shall be 18AWG pure copper, UV resistant PVC jacket.
- C. Connectors shall be O-ring weather sealed, constructed with all brass compression connectors.

PART 3 - EXECUTION

1.3 INSTALLATION

- A. Provide wiring complete as indicated. Provide ample slack for field terminated wires and preformed cables with connections, including service connections, and extensions. In outlet or junction boxes provided for installation of equipment by others, tape ends of wires and install blank covers.
- B. Do not bend cables during installation, either permanently or temporarily, to radii less than 12 times the outer diameters, except where conditions make the specified radius impractical and shorter radii are permitted by NEMA WC70, Appendix N.
- C. Bundle cable and conductors neatly and securely with nylon straps located in branch circuit panel boards, equipment cabinets and control panels. Use nylon bundling straps, bundle power cables separately from control cables.

- D. For wire pulling, comply with the following requirements:
1. Do not pull wires into conduit until conduits and outlets have been thoroughly cleaned and swabbed. Do not use a block and tackle or other mechanical means for pulling conductors smaller than 2 AWG in raceways.
 2. Use lubricant and installation procedure as recommended by the cable manufacturer.
 3. Pulling tension shall not exceed manufacturer's recommendations.
 4. Provide masking or other means to prevent obliteration of cable identifications when solid color coating or colored tracers are used.
 5. Multiple cables to be installed in a single conduit shall be pulled together.
- E. Power and Control Cable Installation in Manholes and Pull boxes: Route cables along the manhole or handhole walls providing the longest possible slack. Form cables closely parallel to the walls so that they do not interfere with duct entrances, supported on brackets and cable insulators spaced at a maximum of four feet. In existing manholes and handholes where new ducts are to be terminated or where new cables are to be installed, modify the existing locations of cables, cable supports, and grounding as required providing a properly arranged and supported installation.

END OF SECTION