SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under separate contracts.
5. Access to site.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and drawing conventions.
9. Miscellaneous provisions.

B. Related Requirements:
1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Owosso Wastewater Treatment Plant Sludge Thickener Improvements, C2AE Project Number 17-0117
1. Project Location: Owosso Wastewater Treatment Plant, 1410 Chippewa Trail, Owosso, MI 48867.

B. Owner: City of Owosso, 301 West Main, Owosso MI
1. Owner's Representative: Glenn Chinavare, 989-725-0599.

C. Engineer: C2AE, 106 West Allegan Street, Suite 500, Lansing, Michigan, 48933

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
1. Demolition of existing sludge thickener mechanical equipment and drive excluding perimeter railing, weir and baffle. Supply and install new rake, scraper blade, center column, feed well, walkway bridge, drive, miscellaneous apparatus, electrical upgrades, gas & oxygen detention unit, room ventilation.
Type of Contract.
2. Project will be constructed under a single prime contract.

1.4 PHASED CONSTRUCTION

A. The Work shall be conducted in a single phase.

B. Before commencing Work, submit a schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

C. The sludge thickener is a critical portion of the wastewater treatment plant operation during significant wet weather events. The contractor shall work with the Owner Representative and Engineer to schedule work

1.5 ACCESS TO SITE

A. General: Contractor shall have use of Project site for construction operations but shall coordinate access routes and staging with plant staff.

B. Use of Site: Limit use of Project site to work in areas coordinated with plant staff. Do not disturb portions of Project site beyond areas identified for Work.
   1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
      c. Limit storage of materials to areas designated or approved in writing by the Owner.

1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
   2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.7 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Work shall be generally performed during normal business working hours of 8:00 a.m. to 5:00 p.m., Monday through Friday.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify Owner and Engineer not less than two days in advance of proposed utility interruptions.
   2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Explosion Hazard:
   1. The Contractor is informed that various processes may be classified as explosion hazards by NFPA 820.
   2. The Contractor shall use appropriate safety measures within these areas when this hazard exists.

E. Confined Spaces: The Contractor shall comply with MIOSHA Part 90 and Part 490 (325.63001) and all state and federal requirements associated with confined spaces.
   1. The Contractor shall provide one (1) copy of the confined space entry program proposed for use on this project.
   2. The confined space entry program shall conform to all applicable codes and regulations, and be acceptable to the Owner.
   3. The Contractor shall certify, in writing to the Owner, that the program will be utilized on this project.

F. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
   1. Notify Owner and Engineer not less than two days in advance of proposed disruptive operations.
   2. Obtain Owner's written permission before proceeding with disruptive operations.

G. Nonsmoking Building: Smoking is not permitted within any building or within 8 m (25 feet) of entrances, operable windows, or outdoor-air intakes.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012203 - UNIT PRICES – MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:
   1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
   2. Section 014503 "Quality Control Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent resource acceptable to Contractor.

C. Items listed herein but not listed in the Bid Form shall be considered informational only and intended for use in documenting changes to the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Division 01 – General Requirements.
   1. General Requirements, Bonds, Insurances and Mobilization (limited to maximum of 5% of total base bid)
      a. Payment: LSUM, 50% of Bid amount when Work has begun, 25% at the construction half-way point, and 25% when Work is complete and site fully restored. Total payment for this item shall be limited to **5% maximum** of the Total Base Bid. When the percentage of the original contract amount earned is less than 5% on a partial pay estimate, only the costs of specific bonding, insurances and permits will be reimbursed when a paid invoice has been received by the Engineer. The costs of these will then be subtracted from the total amount bid for mobilization.
      b. Work Required: Contractor's bonds, insurances, any required permits, any temporary facilities required but not otherwise covered in this section, mobilization of equipment and materials to the site, demobilization and removal of equipment from the site, removal of temporary facilities, and completion of all restoration work and cleanup.
   2. Electrical
      a. Payment: LSUM.
      b. Work Required: Removal of existing electrical equipment, fixtures, conduit, and hangers, Furnish, Install and connect all electrical equipment, fixtures, outside and inside as indicated on the drawings and specifications. Test all electrical equipment for proper function, replace items that are not working or not correctly installed, as indicated on the drawings and specifications, Disposal and cleanup.
   3. Demolition and Structural
      a. Payment: LSUM
      b. Work Required: Demolition of complete thickener mechanism and apparatus, bridge, cutting of concrete wall for doorway, furnish and install beam supports for doorway, beam and grating for walkway at each end of bridge, handrail modifications as indicated on the drawings and specifications, disposal and cleanup.
   4. Thickener Mechanism and Appurtenance
      a. Payment: LSUM
      b. Work Required: Furnish, install, testing of all items of the thickener drive, mechanism, and appurtenance, as indicated on the drawings and specifications
   5. Painting: Square Feet
      a. Payment: Square Feet, measured by area of new paint applied.
      b. Work Required: Clean and prepare ceiling of thickener room, furnish, install paint on ceiling of room, and new piping, if paint covers other item they are to be cleaned off or painted as indicated on the drawings and specifications, Cleanup and disposal of materials

6. Tank Coating
   a. Payment: Square Feet measuring areas where new coating is applied.
   b. Work Required: Clean entire thickener tank of all loose and spalling coating, Furnish and install new coating on areas of exposed concrete, coating shall be of same material as existing tank coating. cleanup and disposal of materials.
7. Process Piping
   a. Payment: LSUM
   b. Work Required: Removal of existing piping, patch holes in ceiling, furnish and install proposed piping, fitting, materials to connect as indicated on the drawings and specifications

END OF SECTION 012203

SECTION 013000 – ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:
   1. Preconstruction meeting.
   2. Progress meetings.
   3. Construction progress schedule.
   4. Coordination drawings.
   5. Submittals for review, information, and project closeout.
   6. Number of copies of submittals.
   7. Submittal procedures.

1.2 RELATED REQUIREMENTS

A. Document 00 7200 - General Conditions.

B. Document 00 7300 - Supplementary Conditions.

C. Section 011100 - Summary of Work.

D. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.

E. Section 017800 - Closeout Submittals: Project record documents.

1.3 PROJECT COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

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

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.

1.4 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.
   4. Attendance required:
      a. Owner
      b. Engineer
      c. Contractor
      d. Major Subcontractors
      e. Utilities
      f. Regulatory agencies
   5. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing and long-lead items.
      d. Designation of key personnel and their duties.
      e. Procedures for processing field decisions and Change Orders.
      f. Procedures for RFIs.
      g. Procedures for testing, inspecting, and reporting.
      h. Procedures for processing Applications for Payment.

i. Distribution of the Contract Documents.
j. Submittal procedures.
k. Preparation of record documents.
l. Use of the premises.
m. Work restrictions.
n. Working hours.
o. Owner's occupancy requirements.
p. Responsibility for temporary facilities and controls.
q. Procedures for disruptions and shutdowns.
r. Parking availability.
s. Office, work, and storage areas.
t. Equipment deliveries, storage, and protection.
u. Safety and first aid.
v. Security.
w. Site cleanliness.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
a. Contract Documents.
b. Related RFIs.
c. Related Change Orders.
d. Deliveries.
e. Submittals.
f. Possible conflicts.
g. Compatibility problems.
h. Time schedules.
i. Weather limitations.
j. Manufacturer's written instructions.
k. Warranty requirements.
l. Compatibility of materials.
m. Acceptability of substrates.
n. Temporary facilities and controls.
o. Space and access limitations.
p. Regulations of authorities having jurisdiction.
q. Testing and inspecting requirements.
r. Installation procedures.
s. Coordination with other work.
t. Required performance results.
u. Protection of adjacent work.
v. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MEETING

A. Engineer will schedule a meeting after Notice of Award.

B. Attendance Required:
1. Owner.
2. Engineer.
3. Contractor.
4. Major Subcontractors.
5. Utilities.
6. Regulatory agencies.

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

D. Record minutes and distribute copies within two days after meeting to participants, with copies to Engineer, Owner, participants, and those affected by decisions made.

E. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including cell and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
   1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

3.2 PROGRESS MEETINGS

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

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
   1. Review minutes of previous meetings.

E. Review of Work progress.
   1. Field observations, problems, and decisions.

F. Identification of problems that impede, or will impede, planned progress.

G. Review of submittals schedule and status of submittals.
   1. Review of off-site fabrication and delivery schedules.
   2. Maintenance of progress schedule.
   3. Corrective measures to regain projected schedules.
   4. Planned progress during succeeding work period.
   5. Coordination of projected progress.
   6. Maintenance of quality and work standards.
   7. Effect of proposed changes on progress schedule and coordination.
   8. Other business relating to Work.

H. Record minutes and distribute copies within two days after meeting to participants, with copies to Engineer, Owner, participants, and those affected by decisions made.

3.3 PREINSTALLATION CONFERENCES

A. Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

B. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials

and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.

C. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   1. The Contract Documents.
   2. Related requests for interpretations (RFIs).
   3. Related Change Orders.
   4. Submittals.
   5. Possible conflicts.
   6. Compatibility problems.
   7. Time schedules.
   8. Weather limitations.
   9. Manufacturer's written recommendations.
   10. Warranty requirements.
   11. Compatibility of materials.
   12. Acceptability of substrates.
   13. Temporary facilities and controls.
   14. Space and access limitations.
   15. Regulations of authorities having jurisdiction.
   16. Testing and inspecting requirements.
   17. Installation procedures.
   18. Coordination with other work.
   19. Protection of adjacent work.
   20. Protection of construction and personnel.

D. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

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

F. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

3.4 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major Subcontractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.5 COORDINATION DRAWINGS

A. Review drawings prior to submission to Engineer.

3.6 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.
   5. Operation and Maintenance Manuals.

B. Submit to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.

C. Samples will be reviewed only for aesthetic, color, or finish selection.

3.7 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Engineer's knowledge as contract administrator or for Owner. No action will be taken.

3.8 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Warranties.
   3. Bonds.
   4. Other types as indicated.

B. Submit for Owner's benefit during and after project completion.

3.9 NUMBER OF COPIES OF SUBMITTALS

A. Documents for Review: Submit the number of copies which the Contractor requires, plus three copies which will be retained by the Engineer.
   1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches. Submit the number of copies which the Contractor requires, plus three copies which will be retained by the Engineer.

B. Documents for Information: Submit three copies.

C. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit three extra of submittals for information.

D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Engineer.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

END OF SECTION 013000

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall perform the Work using means, methods, and procedures to deliver a finished product that achieves the intended purpose, performs to the expected conditions, offers a serviceable installation, conforms to all applicable codes and standards, conforms with specified quality standards, and is completed with the care and skill of professionals performing similar work.

B. Section includes administrative and procedural requirements for quality assurance and quality control.

C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   2. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
   3. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

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

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

D. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

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

F. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

G. Experienced: Unless noted otherwise, when used with an entity or individual, "experienced" means having successfully completed projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 SUBMITTALS

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

B. Reports and documents as identified below.

1.4 REPORTS AND DOCUMENTS

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

B. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:
   1. Name, address, and telephone number of representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   4. Results of operational and other tests and a statement of whether observed

performance complies with requirements.

5. Other required items indicated in individual Specification Sections.

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

1.5 QUALITY ASSURANCE

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

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

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

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

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

C. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

1.7 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Engineer.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer’s reference during normal working hours.

1.8 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 1.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015213 – FIELD OFFICES AND SHEDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Temporary field offices for use of Contractor are allowed.

1.2 RELATED REQUIREMENTS

A. Section 011000 - Summary: use of premises, and responsibility for providing field offices.

B. Section 015000 - Temporary Facilities and Controls: Temporary sanitary facilities, temporary telephone service, and temporary facsimile service.

C. Section 015000 - Temporary Facilities and Controls: Parking and access to field offices.

1.3 USE OF EXISTING FACILITIES

A. Existing facilities shall not be used for field offices.

1.4 USE OF PERMANENT FACILITIES

A. Permanent facilities shall not be used for field offices.

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT, FURNISHINGS

A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.2 CONSTRUCTION

A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.

B. Lighting for Offices: 50 fc at desk top height. 2 fc exterior lighting at entrance doors.

C. Fire Extinguishers: Appropriate type fire extinguisher at each office.

2.3 ENVIRONMENTAL CONTROL

A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

2.4 CONTRACTOR OFFICE AND FACILITIES

A. Size: For Contractor's needs and to provide space for project meetings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.2 INSTALLATION

A. Coordinate location with plant operators.

3.3 MAINTENANCE AND CLEANING

A. Maintain approach walks free of mud, water, and snow.

3.4 REMOVAL

A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION 015213

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Coordination of Owner-installed products.
   6. Progress cleaning.
   7. Starting and adjusting.
   8. Protection of installed construction.
   9. Correction of the Work.

B. Related Requirements:
   1. Section 011000 "Summary" for limits on use of Project site.
   2. Section 017700 "Closeout Procedures" for submitting Project Record Documents, recording of Owner-accepted deviations from final cleaning.
   3. Section 024100 “Demolition”.

1.2 SUBMITTALS

A. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

D. Project Record Documents: Accurately record actual locations of capped and active utilities.

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

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

1.4 PROJECT CONDITIONS

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

G. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.5 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

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

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

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

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework,

investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

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

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

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

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer according to requirements of the Contract Documents.

3.3 CONSTRUCTION LAYOUT

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

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Establish limits on use of Project site.
   3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   4. Inform installers of lines and levels to which they must comply.
   5. Check the location, level and plumb, of every major element as the Work progresses.
   6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
   7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

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

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

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

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

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

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as

invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 27 deg C (80 deg F).
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

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

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

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

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

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

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements"

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.
   5. Repair of the Work.

B. Related Requirements:
   1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
   2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   3. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.2 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Complete startup and testing of systems and equipment.
   2. Perform preventive maintenance on equipment used prior to Substantial Completion.
   3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
   4. Participate with Owner in conducting inspection and walkthrough.
   5. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   6. Complete final cleaning requirements, including touchup painting.
   7. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the

Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

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

1.3 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment in accordance with the Contract Documents.
   2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

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

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Final Completion for entire Project or for a designated portion of Project:
      a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.
      e. Remove snow and ice to provide safe access to building.
      f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
      g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      h. Sweep concrete floors broom clean in unoccupied spaces.
      i. Remove labels that are not permanent.
      j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
      k. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
   1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
   2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
      a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
   3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation manuals for products and equipment.

1.2 SUBMITTALS

A. Manual Content: Submit reviewed manual content formatted and organized as required by this Section.
   1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Engineer will return one copy of draft and mark whether the general scope and content of manuals are acceptable.

C. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Engineer will return copy with comments within 15 days after final inspection.
   1. Correct or modify each manual to comply with Engineer's comments. Submit 3 final hardcopies and 2 CDs with PDF files within 15 days of receipt of Engineer's comments.

D. Format electronic files in the following format:
   1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
      a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      b. Enable inserted reviewer comments on draft submittals.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

C. Title Page: Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name and contact information for Contractor.
   6. Name and contact information for Engineer.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. Manual Contents: Organize into sets of manageable size. Arrange content alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
   2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.

9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.3 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

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

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

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

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of operation and maintenance manuals.

F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Requirements:
   1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set(s) of marked-up record prints.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Record data as soon as possible after obtaining it.
      c. Record and check the markup before enclosing concealed installations.
   2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

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

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

B. Format: Submit record Product Data as annotated PDF electronic file.

2.4 MISCELLANEOUS RECORD SUBMITTALS

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

B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from

deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION 017839

SECTION 260000 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Drawings and specifications.
2. Scope of work.
3. Codes, permits and inspections.
4. Interferences.
5. Materials and workmanship.
6. Acceptance.

1.2 DRAWINGS AND SPECIFICATIONS

A. The Architectural, Structural, Mechanical, Electrical, and equipment drawings and specifications are hereby incorporated into and become a part of this Division. Contractor shall examine all such drawings and specifications and become thoroughly familiar with provisions contained herein and the submission of his bid shall be construed as indicating such knowledge

B. Electrical drawings are in part diagrammatic, intending to convey scope of work, indicating general arrangement of panelboards, switches, equipment, conduit, outlets, and other devices. Due to the diagrammatic nature of the drawings, many of the necessary individual component parts are not indicated but shall be included by the Contractor for a complete and operable electrical system. Follow drawings in laying out work, and verify places for installation of materials and equipment. Whenever a question exists as to exact intended location of outlets or equipment, obtain instructions from the Engineer before proceeding with work. Information presented on these drawings is as accurate as preliminary surveys and planning can determine, but complete accuracy is not guaranteed, and Contractor field verification of all dimensions and conditions is required.

C. All changes from these drawings necessary to make the work conform to the building as constructed and to fit the work of other trades or to conform to the rules and regulations of the State, City, or Municipal bodies having jurisdiction, are to be made by electrical contractor, at his own expense.

D. The exact locations of apparatuses, fixtures, equipment and conduits shall be ascertained from the Owner or his representative in the field, and the work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the work shall be changed at his own expense when so ordered by the Owner. The Owner reserves the right to make minor changes in the location of conduit and equipment up to the time of installation, without additional cost.

E. The electrical drawings and specifications are intended to supplement each other and any material or labor called for in one shall be supplied even though not specifically mentioned in both. Labor and/or materials neither shown nor specified, but necessary for the completion and proper functioning of the system, shall be provided by Contractor.

F. Should conflicting information exist in the drawings and/or specifications, the better quality or greater quantity shall be provided when a clarification cannot be obtained.

1.3 SCOPE OF WORK

A. Supply all labor and material to complete all electrical work shown on the drawings, specified herein or required to complete the construction of the building as shown.

B. The listing of article or material, operation or method, requires that the Contractor shall provide and install, unless noted to be supplied by others, each item listed of quality or subject to qualification noted. Each operation shall be performed according to standard practice, manufacturer's instructions and conditions stated, providing all necessary labor, equipment and incidentals.

C. Responsibility: the electrical contractor shall be responsible for the work of all his sub-contractors and the materials of all his suppliers. Include all materials, labor, and equipment required for a complete and working installation. Do not supply materials that will not work in the particular situation of this project.

1.4 CODES, PERMITS AND INSPECTIONS

A. Install all work in full accord with codes, rules and regulations of Municipal, City, County, State and Public Utilities and all other authorities having jurisdiction over the premises. This shall include all requirements of the City Building Code, regulations of the State Department of Industrial Relations, MIOSHA and the requirements of the National Electrical Code, as interpreted by the Local Inspection Division. All these codes, rules, and regulations are hereby incorporated into this specification.

B. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the above standards.

C. Wiring methods used shall be suitable for the installation and use in conformity with the provisions of the National Electric Code. Listed or labeled equipment shall be used or installed in accordance with any instructions included in the listing or labeling.

D. Comply with specification requirements which are in excess of code requirements and not in conflict with same.

E. The Contractor shall secure all permits and certificates of inspection incidental to his work, required by the foregoing authorities. All such certificates shall be delivered to the Owner in duplicate, before final payment on contract will be allowed. The Contractor shall pay all fees, charges and other expenses in connection therewith.

1.5 INTERFERENCES

A. Before installing any of this work, the Contractor shall see that it does not interfere with clearances for the erection of finish beams, columns, pilasters, walls, ducts, and other structural, mechanical, or architectural members as shown on the drawings. If any work is so installed and later the architectural design cannot be followed, electrical contractor shall, at his own expense, make such changes in his work as the Architect or Engineer may direct to permit the completion of the other work in accordance with the drawings and specifications.

B. It shall be the duty of the Contractor to report any interferences between his work and that of any other Contractor to the Engineer as soon as they are discovered. The Engineer will determine which equipment shall be relocated regardless of which was first installed.

1.6 MATERIALS AND WORKMANSHIP

A. All work shall be installed in a practical and workmanlike manner by competent workers, skilled in their branch of the trade.

B. Unless expressly specified or indicated on the drawings to the contrary, all materials shall be new and free from defects and shall be the best of their several kinds.

C. During installation and construction, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing and operating and repainting if required.

D. During the construction operation and at its completion, the Contractor shall remove all debris and excess materials caused by his work and he shall leave the area of the operation broom clean.

1.7 SUBSTITUTIONS

A. Refer to Section 012500 – Substitution Procedures.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 260000

SECTION 260501 - MINOR ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Architect/Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service for temporary power. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Coordinate outages with the Owner and all other trades.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, all existing electrical installations, except where shown to be reused. Coordinate to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors that remain, and patch surfaces.

D. Disconnect all existing outlets and remove devices, unless noted otherwise. Remove abandoned outlets if conduit servicing them is abandoned and removed.

E. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

H. Extend existing installations using materials and methods as specified.

END OF SECTION 260501

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Connectors, splices, and terminations rated 600 V and less.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:
   1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders and Branch Circuits: Copper; stranded or solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

A. Feeders and Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

C. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

D. Conduit Hubs: Mechanical type, terminal with threaded hub.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel slotted support systems.
   2. Conduit support devices.
   3. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
   1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   2. Material for Channel, Fittings, and Accessories: Galvanized steel.
   3. Channel Width: 1-5/8 inches (41.25 mm).
   4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   2. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   3. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M,Grade A325 (Grade A325M).
   4. Toggle Bolts: Stainless-steel springhead type.
   5. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA 1.
   2. NECA 101

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps or single-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
   6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal conduits and fittings.
   2. Boxes, enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:
   1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. GRC: Comply with ANSI C80.1 and UL 6.
   3. PVC-Coated Rigid Steel Conduit: Comply with NEMA RN 1 for 0.040 inch minimum coating.
   4. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.
   1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Fittings, General: Listed and labeled for type of conduit, location, and use.
   3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
   4. Coating for Fittings For PVC-Coated Conduit: Minimum thickness of 0.404 inch with overlapping sleeves protecting threaded joints.

C. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

C. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 4X or Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel or stainless steel.
2. Nonmetallic Enclosures: Not Allowed.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC unless otherwise indicated on the Drawings as PVC-coated rigid steel.
   2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   3. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.
   1. Exposed Conduit: GRC unless otherwise indicated on the Drawings as PVC coated rigid steel.
   2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC; listed flexible conduit in NEMA 7 classified spaces.
   3. Boxes and Enclosures: NEMA 250, Type 12, except use NEMA 250, Type 7 in classified spaces.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
   2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.

C. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

D. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

E. Support conduit within 12 inches (300 mm) of enclosures to which attached.

F. Threaded Conduit Joints, Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

G. Coat field-cut threads on PVC-coated raceway with a corrosion preventing conductive compound prior to assembly.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

J. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

K. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches (915 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in non-hazardous locations. Use listed flexible conduit in hazardous locations.

L. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by the manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Electrical identifications requirements.
   2. Nameplates and labels.
   3. Wire and cable markers.
   4. Identification schedule.
   5. Fasteners for labels and signs.

1.3 COORDINATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Apply identification devices to surfaces that require finish after completing finish work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Materials:

a. Laminated acrylic or melamine plastic, two or three layer, electrically nonconductive with beveled edges; minimum thickness of 1/16-inch for nameplates having any dimension less than four inches; 1/8-inch for larger nameplates.

2. Mounting holes for mechanical fasteners: Two centered on the sides for sizes up to 1-inch high nameplates; four at corners for larger sizes.

B. Identification Labels:
1. Polyester or vinyl, self-adhesive, weather, chemical and UV-resistant for indoor use only.
2. Text: Machine printed.

C. Equipment Identification Format:
1. Minimize size: 1 inch by 2.5 inches.
2. Legend: Equipment designation or other approved description.
3. Text: All capitals, 1/2 inch minimum text height unless otherwise indicated.
4. Color:
a. Normal power system: White text on black background.
b. Emergency power system: White text on red background.
c. Fire alarm system: White text on red background.

D. Control Device Identification Format:
1. Minimize size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitals, 3/16 inch minimum text height unless otherwise indicated.
4. Color: Black text on clear background.

2.3 WIRE AND CABLE MARKERS

A. Vinyl Wraparound Labels: Polyester or vinyl, self-adhesive, self-laminating markers, heat shrink sleeves, or split plastic sleeves suitable for the conductor or cable to which applied.

B. Legend: Power source and circuit number for power conductors and cables or other designation as appropriate for the system identified.

C. Text: Machine printed, all capitals, 1/8 inch height.

D. Color: Black text on white background unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 IDENTIFICATION SCHEDULE

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification of Equipment:
   1. Use engraved identification nameplate to identify each piece of electrical distribution equipment and control equipment and associated sections, compartments and components.
      a. Enclosed switches, circuit breakers and motor controllers; include the following:
         1) Voltage and phase.
         2) Power source and circuit number. Include location when not within sight of equipment.
         3) Identify loads served; include location when not within sight of equipment.
   2. Provide self-adhesive identification label or engraved nameplate inside door of each fusible switch to identify required NEMA fuse class and Ampere rating.

C. Identification of Conductors and Cables.
   1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
      a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
      b. Colors for 208/120-V Circuits:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
      c. Colors for 240-V Circuits:
         1) Phase A: Black.
         2) Phase B: Red.
      d. Colors for 480/277-V Circuits:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
      e. Color for Neutral: White or gray.
      f. Color for Equipment Grounds: Green.
      g. Colors for Isolated Grounds: Green with white stripe.
   2. Provide wrap-around cable markers to identify circuit number or other designation indicated for power, control and instrumentation conductors and cables at the following locations:
      a. At each source and load location.
      b. Within equipment enclosures when conductors or cables enter or leave the enclosure.

END OF SECTION 260553

SECTION 262717 - EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.

1.3 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.4 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections or by the Owner.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

E. Provide power to all electrically operated equipment whether or not circuit numbers are shown. Review entire set of documents for equipment to be provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Conform to NEMA WD 1.

2. Cord Construction: NFPA 70, Type SJO, multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 262816 and in individual equipment sections.

C. Motor Starters and Combination Starter/Disconnects: As specified in Section 262913 unless specified in mechanical equipment sections as provided and installed with equipment.

D. Wire and Cable: As specified in Section 260519.

E. Flexible Conduit: As specified in Section 260533.

F. Boxes: As specified in Section 260533.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energizing.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors or listed flexible conduit in hazardous locations.

C. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

D. Install terminal block jumpers to complete equipment wiring requirements.

E. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 262717

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Standard-grade receptacles, 125 V, 20 A.
   2. GFCI receptacles, 125 V, 20 A.
   3. Toggle switches, 120/277 V, 20 A.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. Comply with NEMA WD 1.

D. Device Color:
   1. Wiring Devices Connected to Normal Power System: Black unless otherwise indicated or required by NFPA 70 or device listing.

E. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Eaton (Arrow Hart).
   2. Hubbell Incorporated; Wiring Device-Kellems.
   3. Leviton Manufacturing Co., Inc.
   4. Pass & Seymour/Legrand (Pass & Seymour).

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A <**Insert drawing designation**>:
   1. Description: Two pole, three wire, and self-grounding.
   2. Configuration: NEMA WD 6, Configuration 5-20R.
   3. Standards: Comply with UL 498 and FS W-C-596.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:
   1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.4 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole, Two-Pole, Three-Way and Four-Way Switches, 120/277 V, 20 A:
   1. Standards: Comply with UL 20 and FS W-S-896.

2.5 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
   1. Material for Unfinished Spaces: Galvanized steel or listed cast-metal box and cover for hazardous spaces.

B. Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
   1. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   2. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   3. Install wiring devices after all wall preparation, including painting, is complete.

C. Device Installation:
   1. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
   2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Receptacle switches.
   4. Molded-case circuit breakers (MCCBs).
   5. Enclosures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. Comply with NFPA 70.

C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Appleton Electric.
   2. Crouse-Hinds.
   3. Eaton.
   4. Square D; by Schneider Electric.

2.2 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2.3 RECEPTACLE SWITCHES

A. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 600-V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

B. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

C. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Eaton.
   2. General Electric Company.
   3. Siemens Industry, Inc., Energy Management Division.
   4. Square D; by Schneider Electric.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings.

D. MCCBs shall be equipped with a device for locking in the isolated position.

E. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.

F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

G. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12); a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel); copper-free cast aluminum alloy (NEMA 250 Types 7, 9).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Type 7 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

E. NEMA 250 Type 7 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
   1. Indoor locations: NEMA 250, Type 12.
   2. Outdoor Locations: NEMA 250, Type 4X stainless steel.
   3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 with cover attached by Type 316 stainless steel bolts.

3.2 INSTALLATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

B. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Install fuses in fusible devices.

F. Comply with NFPA 70 and NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION 262816

SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manual motor controllers.
   2. Enclosed full-voltage magnetic motor controllers.
   3. Enclosures.
   4. Accessories.
   5. Identification.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.

C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

2.2 MANUAL MOTOR CONTROLLERS

A. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
   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. Appleton Electric.
      b. Crouse-Hinds.
      c. Eaton.
      d. Square D; by Schneider Electric.
   2. Configuration: Two speed.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type or melting alloy type.

2.3 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Appleton Electric.
   2. Crouse-Hinds.
   3. Eaton.
   4. Square D; by Schneider Electric.

C. Standard: Comply with NEMA ICS 2, general purpose, Class A.

D. Configuration: Nonreversing.

E. Contactor Coils: Pressure-encapsulated type.
   1. Operating Voltage: 120V

F. Control Power:
   1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.

G. Overload Relays:
   1. Thermal Overload Relays:
      a. Inverse-time-current characteristic.
      b. Class 10 tripping characteristic.
      c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
      d. Ambient compensated.
      e. Automatic resetting.

2.4 ENCLOSURES

A. Comply with NEMA 250, type designations as indicated on Drawings as NEMA 4X stainless steel, NEMA 12 or NEMA 7, complying with environmental conditions at installed location.

B. The construction of the enclosures shall comply with NEMA ICS 6.

2.5 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
   1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.
      a. Push Buttons: As indicated in the controller schedule.
      b. Pilot Lights: As indicated in the controller schedule.

2.6 IDENTIFICATION

A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.

C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 SYSTEM FUNCTION TESTS

A. Test system functions to prove the correct interaction of sensing, processing, and action devices.

1. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
2. Demonstrate proper operation to the Owner.

END OF SECTION 262913.03

SECTION 40 9010 - BASIC INSTRUMENTATION AND CONTROL SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the basic requirements for the process control and instrumentation system applicable to Division 40 9XXX Sections.

B. Related Requirements:
   1. Section 26 0000 “General Electrical Requirements” for electrical and instrumentation specification and drawing requirements applicable to the process control and instrumentation system.

1.2 SYSTEM DESCRIPTION

A. This specification defines the minimum requirements for performance, fabrication, integration, testing and startup of the process control and instrumentation system required for this project.

B. The Contractor shall provide a complete process control and instrumentation system that functions in accordance with and fulfills all of the requirements set forth in this Specification or indicated on the Drawings. Any omission of details from this Specification or from the Drawings shall not relieve the Contractor from furnishing a complete, operating system. In the event of a discrepancy between the Drawings and the Specifications, the more stringent requirements shall apply.

C. The Contractor shall perform the work and provide the equipment as described in the Division 40 Specification Sections or indicated on the Drawings including the supply of all required hardware, interconnecting cabling, software, and engineering or support services.

1.3 SUBMITTALS

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

B. Wiring Diagrams: Both elementary and schematic; differentiate between manufacturer installed and field installed wiring.

C. Operation and Maintenance Data: For instrumentation equipment, to include in operation and maintenance manuals.

D. Other Submittals: Refer to other instrumentation and control system equipment sections.

E. Closeout Submittals:
   1. Operation and Maintenance Data for all instrumentation equipment and as described in Sections 40 9XXX.
   2. Complete control panel drawings which include all modifications necessary to reflect installed condition as required in Section 40 9443

1.4 QUALITY ASSURANCE

A. System Integrator Qualifications: Company specializing in supplying process control and instrumentation systems of the type specified and indicated on the drawings with a minimum of five years of documented experience.

B. Electrical Components, Devices, and Accessories: Where applicable, listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate delivery, installation and start-up of Process Control and Instrumentation System components with process equipment installation and facility construction provided by others. Due to the nature of this project, only portions of the Process Control and Instrumentation System may be delivered, installed and placed in service at any time. Coordinate equipment delivery and field activities with the Contractor and conform to the Contractor's overall project construction sequence and schedule.

1.6 WARRANTY

A. Warranty Provide the Owner with a written one-year warranty that all equipment, components, materials and/or workmanship shall be free from defects for a period of one year following startup, testing and acceptance of the installed system. The System Integrator shall, upon notice, without undue delay, and without expense to the Owner, make good or repair the whole or any part of the work which shall, within the one year after date of acceptance of the completed work, fail or develop unfitness for the purposes for which is it intended as a result of any defect in design, material or workmanship. The warranty period begins on the date the equipment and system is accepted by the Owner and a Certificate of Substantial Completion is executed by the Owner and the Contractor.

1.7 EXTRA MATERIALS

A. Furnish extra materials as described in Division 40 specification sections.

PART 2 - PRODUCTS

2.1 PROCESS CONTROL AND INSTRUMENTATION SYSTEM INTEGRATORS

A. All equipment specified in Division 40 shall be designed as a system, fabricated or purchased, shipped to the project site, and started up by one of System Integrators listed below:
   1. Commerce Controls Co., Novi, MI (Phone: 248.476.1442).
   2. Feyen Zylstra System Engineering, Grand Rapids, MI. (Phone: 616.224.7707).
   3. IDC Corporation, Dimondale, MI (Phone: 517.646.0358).
   4. Perceptive Controls, Inc., Plainwell, MI (Phone 269.685.3040).
   5. RS Technical Services, Inc., Lowell, MI (Phone: 616.897.7041).
   6. UIS Corporation, Dexter, MI (Phone: 800.277.5740).
   7. West Michigan Instrumentation Systems, Inc., Nunica, MI (Phone: 616.837.6148).
   8. Windemuller Automation, Wayland, MI (Phone: 616.877.8770).

2.2 MANUFACTURERS

A. In Part 2 of the Division 40 equipment specification sections, where manufacturers are listed, the products are subject to the requirements of the specification section and the application indicated for the product. Because product models and performance may change with time, listing of any particular manufacturer does not guarantee that the manufacturer produces a product that is acceptable for incorporation into this particular project.

PART 3 - EXECUTION

3.1 GENERAL PROCESS CONTROL AND INSTRUMENTATION SYSTEM REQUIREMENTS

A. Installation and Startup: The System Integrator shall provide an experienced, factory trained, competent and authorized service representative to ensure that the equipment and system furnished is installed, connected and placed in operation correctly.

B. Test Equipment: The System Integrator shall have available he test and calibration equipment recommended by the equipment manufacturers or required to demonstrate satisfactory equipment or system operation to the Engineer.

C. Signal Standards:
   1. Electronic: Unless otherwise indicated, electronic analog signals transmitted between control panels or from control panels to equipment furnished by other vendors shall be individual isolated and floating outputs conforming to ISA

Standard 50.1. Field instruments shall have 4-20mAdc outputs unless otherwise indicated.

2. Pneumatic: All pneumatic instruments shall have a 3-15 psig input or output range unless otherwise indicated or required by the specific application.
3. Within Control Panels: Electronic analog signals may be either 4-20mAdc or 1-5Vdc.

D. Equipment Identification: Provide nameplates or tags for all process control and instrumentation items. Nameplates and tags shall be three-layer laminated plastic; white letters on a black background; punched or drilled for screw mounting. Letter size shall be 1/8-inch for individual equipment items and ¼-inch for identifying grouped equipment. Fasteners for nameplates shall be self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

3.2 INSTALLATION

A. Install equipment as indicated, in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that products and equipment fulfill requirements.

B. Provide equipment identification nameplates as specified herein. Nameplates shall contain the Engineer's item designation and, for indicators and transmitters, the design measurement range and units of the device.

C. The Contract Drawings are not intended to show every detail of construction or location of equipment. Where proper operation or construction makes it necessary or advisable the change location of piping, instrumentation or control equipment, or other equipment, the Contractor shall so inform the Engineer for his approval.

D. The Contractor shall furnish a complete and fully operable process control and instrumentation system. The Contract Drawings and Specifications are not intended to include all details of a complete system installation for the purposes specified. The Contractor shall be responsible for all details that may be necessary to properly install, adjust and place the process control and instrumentation system in operation. Any error in the Contract Drawings or Specifications which prevents proper operation of the supplied system shall be shown correct at the time of shop drawing submittal or brought to the attention of the Engineer with, or prior to, the submittal.

1. The Contractor shall be responsible for all costs incurred to correct any of the aforementioned errors brought to the Engineer's attention after the first submittal date for the equipment or system involved. The Contractor shall assume full responsibility for additional costs that may result from unauthorized deviations from the Specifications.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 0526 – Grounding and Bonding for Electrical Systems.

B. Connect wiring according to Section 26 0519 – Low Voltage Electrical Power Conductors and Cables.

3.4 FIELD QUALITY CONTROL

A. Check circuitry for electrical continuity and short circuits prior to energization.

B. Calibrate equipment in accordance with the manufacturer's instructions to the ranges or setpoints indicated on the Drawings.

3.5 STARTUP SERVICE

A. Provide a service representative at the project site to perform startup service of the installed systems and equipment.
   1. Notify the Engineer not less than 48 hours prior to beginning startup service.
   2. Complete installation and startup checks according to manufacturer's written instructions.
   3. Due to the nature of this project, only portions of the process control and instrumentation system may receive startup service at any time. Coordinate startup activities with the Contractor and conform to the Contractor's overall project construction schedule.
   4. Proper operation of the installed hardware and software shall be demonstrated to the Engineer. This includes all normal operating functions, alternate operating functions and emergency operating functions.

3.6 CLEANING

A. After completing installation of exposed, factory-finished items, inspect exposed finishes and repair damaged finishes.

3.7 DEMONSTRATION AND TRAINING

A. Provide a service representative at the project site to train Owner's personnel to adjust, operate, and maintain the installed process control and instrumentation system and equipment. This training shall have a duration of two eight-hour days.

END OF SECTION 40 9010

SECTION 409123.63 - GAS DETECTION INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Combustible gas detectors.
   2. Oxygen deficiency detectors.

B. Related Requirements:
   1. Section 409010 “Basic Instrumentation and Control System Requirements” for general requirements applicable to all 409XXX specification sections.

1.2 SUBMITTALS

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

B. Operation and Maintenance Data: For all products to include in operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in the Section with a minimum of three years of experience.

B. Source Limitations: Obtain each type of produce through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Where applicable, listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 COMBUSTIBLE GAS DETECTORS

A. Manufacturers: Subject to compliance with requirements, provide Sierra Monitor Corp., Sentry Series products to match existing equipment installed at the facility.

B. Type: Two or three-wire sensor/transmitter assembly providing a 4-20 mAdc output linearly proportional to a 0 to 100% LEL methane input range. Provide with one alarm contact field adjustable for high combustible gas alarm.

C. Operating conditions.
   1. Temperature: -40 degrees C to 80 degrees C.

2. Humidity: 0 to 99% relative humidity, non-condensing.
3. Power input: 10 to 29 VDC.

D. Sensor
1. Type: Infrared or catalytic bead; poison resistant.
2. Life Expectancy: One year, minimum with intermittent exposure to combustible gas/air mixtures.
3. Zero Drift: Not greater than +/- 2.0 % of full scale per month.
4. Repeatability: Not greater than +/- 3 % of full scale.
5. Response Time: For any step input, less than 60 seconds to reach 90% of final reading.

E. Transmitter Enclosure: NEMA 7, explosion proof, suitable for use in a Class 1, Division 1, Group D environment.

F. Adjustments:
1. Zero.
2. Span.
3. Provide a calibration switch to disconnect the signal line during calibration.

G. Local Indicator: Digital two-wire type displaying 0-100% LEL either integral to the unit or housed in a separate enclosure mounted adjacent to the unit.

H. Calibration Kit: Provide a calibration kit containing a span gas cylinder, calibration cup, dispensing valve/regulator assembly housed within a carrying case.

2.2 OXYGEN DEFICIENCY DETECTORS

A. Manufacturers: Subject to compliance with requirements, provide Sierra Monitor Corp., Sentry Series products to match existing equipment installed at the facility.

B. Type: Two or three-wire sensor/transmitter assembly providing a 4-20 mAdc output linearly proportional to a 0 to 25% input range. Provide with one alarm contact field adjustable for low oxygen gas alarm.

C. Operating conditions.
1. Temperature: -40 degrees C to 85 degrees C.
2. Humidity: 0 to 99% relative humidity, non-condensing.
3. Power input: 10 to 29 Vdc.

D. Sensor
1. Type: Electrochemical cell.
2. Life Expectancy: One year, minimum.
3. Accuracy: Not greater than +/-1.0 % of full scale.
4. Repeatability: Not greater than +/- 1 % of full scale.
5. Response Time: For any step input, less than 30 seconds to reach 90% of final reading.

E. Transmitter Enclosure: NEMA 7, suitable for use in a Class 1, Division 1, Group D environment.

F. Adjustments:
   1. Zero.
   2. Span.
   3. Provide a calibration switch to disconnect the signal line during calibration.

G. Local Indicator: Digital two-wire type displaying 0-25% Oxygen concentration either integral to the unit or housed in a separate enclosure mounted adjacent to the unit.

H. Calibration Kit: Provide a calibration kit containing a span gas cylinder, calibration cup, dispensing valve/regulator assembly housed within a carrying case.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment installation areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install equipment as indicated, in accordance with the manufacturer's instructions and in compliance with recognized industry practices to ensure products fulfill requirements.

B. Provide equipment identification nameplates complying with Section 409010. Nameplates shall contain Engineer's item designation and, for indicators and transmitters, the design measurement range and units.

3.3 FIELD QUALITY CONTROL

A. Check circuitry for electrical continuity and short circuits prior to placing equipment in service.

3.4 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions.

B. Calibrate equipment in accordance with the manufacturer's instructions to the ranges or setpoints indicated.

3.5 DEMONSTRATION AND TRAINING

A. After completion of installation and startup service, demonstrate functioning of products in accordance with the requirements to the Owner. Train Owner's maintenance personnel to adjust, operate, and maintain products. Refer to Section 017900 – Demonstration and Training.

END OF SECTION 409123.63

SECTION 409513 - PROCESS CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Control Panel Enclosures.
   2. Switches, Pushbuttons, Lights.
   3. Relays.
   4. Intrinsically Safe Relays.
   5. Digital Indicators.
   6. Terminal Blocks.

B. Related Requirements:
   1. Section 409010 “Basic Instrumentation and Control System Requirements” for general requirements applicable to all 409XXX specification sections.

1.2 SUBMITTALS

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

B. Control Panel Outline Drawings: To scale showing the front of panel with all components, tags, nameplates, etc. Nomenclature for nameplates, tags and annunciator windows shall be included with exact lettering style shown for each.

C. Panel Subplate Layout Drawings: To scale showing the location of all subplate mounted components.

D. Wiring Diagrams: Both elementary and schematic, differentiating between manufacturer installed and field installed wiring. Control logic schematics shall be in ladder diagram format, shall comply with the latest NFPA 79 and IEEE 315 standards, and shall be complete with line numbers, wire numbers and terminal numbers.

E. Operation and Maintenance Data: For all products to include in operation, and maintenance manuals.

F. Project Record Documents: Include complete control panel drawings and wiring diagrams of installed equipment conforming to installed conditions.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in the Section with a minimum of three years of experience.

B. Electrical Components, Devices, and Accessories: Where applicable, listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with the requirements of NFPA 79.

D. Comply with the applicable requirements of UL913.

E. Fabricate control panels not containing intrinsically safe relays or barriers in accordance with UL508A and provide each control panel with a serialized UL508 label. Fabricate control panels containing intrinsically safe barriers or relays in accordance with UL698A and provide each control panel with a serialized UL698A label

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Provide three of each size and type installed.
   2. Relays and Timers: Provide two of each type and timing range installed.
   3. Lamps: Provide 12 of each incandescent type; 2 of each LED type.
   4. Other Materials: As indicated elsewhere in these specifications.

PART 2 - PRODUCTS

2.1 CONTROL PANEL ENCLOSURES

A. Enclosure Size: Size enclosures as required for equipment installed.

B. Material: Fabricate panel bodies from sheet steel as follows:
   1. 14 gauge minimum steel.
   2. Subplate: Same gauge as the enclosure.
   3. Provide stiffening members as required for panel strength and stiffness.

C. Panel Access:
   1. Provide continuous hinged doors which, when open, expose a minimum of 80% of panel interior.
   2. Provide gasketing on all door openings.
   3. Provide print pockets on each door.
   4. Provide two point latching mechanism on panel doors 40 inches high or less. Provide three point latching mechanism on panel doors exceeding 40 inches high.

D. Finish:
   1. Use phosphatizing treatment on all panel interior and exterior surfaces after fabrication.
   2. Finish with two coats of enamel.
      a. Interior Color: White, ANSI 51.

b. Exterior Color: Gray, ANSI 61.

E. Panel Subplate Layout:
1. Mount panel subplates on collar studs for easy removal.
2. Provide a 3 inch minimum space between subplates and panel exterior walls for entering field wiring.
3. Provide 1.5 inch minimum space between top of subplate mounted components and wire ducts.
4. Provide 1.0 inch minimum space between bottom of subplate mounted components and wire ducts.
5. Mount terminal blocks on vertical edges of subplate. Provide 20% spare terminal blocks.
6. Provide 2.0 inch minimum space between terminal blocks and wire ducts and between adjacent columns of terminal blocks.
7. Provide a minimum of 15% unused subplate space.

F. Panel Wiring:
1. Use 16 AWG minimum, Class C stranded copper, 90 degree C MTW or THHN for internal panel control wiring.
2. Use two conductor, 18 AWG, shielded cable for all instrument signal and telephone circuit wiring.
3. Bundle and tie all panel wiring not routed in wire ducts.
4. Identify each wire with the same exclusive number at each terminal.
5. Color code control wiring as follows:
a. Red: All a.c. control circuits de-energized when the panel is de-energized.
b. Yellow: All interlock a.c. control circuits wired from an external power source.
c. Blue: All d.c. control circuits.
d. Black: All a.c. power distribution circuits within panel.
e. White: Grounded power circuit conductor.
f. Green: (with or without yellow stripe) Equipment grounding conductors.

G. Identification:
1. Provide all front of panel mounted components with an engraved laminated black plastic identification nameplate indicating the function of the component.
2. Provide all components within the panel with an engraved laminated black plastic identification nameplate indicating the tag name and/or function of the component.
3. All nameplate wording shall be subject to approval by the Engineer.
4. Provide all wiring within the panel with adhesive type identification tags at each termination. Tag markings shall correspond to the panel wiring and piping diagrams.

2.2 SWITCHES, PUSHBUTTONS AND LIGHTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allen Bradley.

2. Cutler Hammer, Inc.
3. General Electric Company.
4. Square D Company.

B. General: Provide UL listed, NEMA 13 rated, 22.5mm or 30mm round devices unless otherwise indicated.

C. Selector Switches: Standard, non-illuminated, keyless operator.

D. Pushbuttons: Full guard, non-illuminated operator. Provide red operator for stop pushbuttons and black operator for all other pushbuttons unless otherwise indicated on the Drawings.

E. Pilot Lights: Push to test, LED type, lens color as indicated on the Drawings.

F. Contacts: NEMA 600 a.c.; NEMA Q300 d.c.

G. Legend Plate: Manufacturer's standard compatible with unit.

2.3 RELAYS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allen Bradley.
2. Cutler Hammer, Inc.
3. General Electric Company.
4. Square D Company.

B. Type: Plug-in with manual operator, indicating light and transparent cover.

C. Coil: 120Vac or 24Vdc.

D. Contacts: Rated 3A at 120Vac.

2.4 INTRINSICALLY SAFE RELAYS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. B/W Controls.
2. Delavel-Gems Sensor Division.
3. Fluid Products Co., Inc.
4. Warrick Controls

B. Voltage: 120Vac +/- 10%.

C. Output: NO or NC as required.

D. Wiring: Wire intrinsically safe circuits in accordance with NFPA 70.

2.5 ELECTRONIC TIMERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ATC.
   2. Eagle Signal.

B. Type: Plug-in; on delay, off delay or repeat cycle is indicated on the Drawings or required. Timing interval as indicated on the Drawings or required.

C. Voltage: 120Vac +/- 10%, 60Hz.

2.6 DIGITAL INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Digilin.
   2. Dynalco.
   3. Newport.
   4. Red Lion.

B. Type: Panel mounted, digital process meter, scaled in engineering units. Provide with high and low level alarm relays having field adjustable trip and reset points.

C. Input: 4–20 mAdc or 1–5 Vdc process signals.

D. Display: 3 1/2 active digits with jumper selectable dummy right hand zero; adjustable decimal point.

E. Accuracy: +/- 0.5% of span; +/- 1 count.

2.7 TERMINAL BLOCKS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Allen Bradley.
   2. Square D Company.

B. Type: Fusible or non-fusible as required. Channel mounted, box lug with pressure plate type or binding head screw type with pressure plate; with white marking strip.

C. Voltage: 300Vac or 600Vac rated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as indicated, in accordance with the manufacturer's instructions and in compliance with recognized industry practices to ensure products fulfill requirements.

B. Provide equipment identification nameplates complying with Section 409010. Nameplates shall contain Engineer's item designation and, for indicators and transmitters, the design measurement range and units.

3.2 FIELD QUALITY CONTROL

A. Check circuitry for electrical continuity and short circuits prior to placing equipment in service.

3.3 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions.

B. Calibrate equipment in accordance with the manufacturer's instructions to the ranges or setpoints indicated.

3.4 DEMONSTRATION AND TRAINING

A. After completion of installation and startup service, demonstrate functioning of products in accordance with the requirements to the Owner. Train Owner's maintenance personnel to adjust, operate, and maintain products. Refer to Section 017900 – Demonstration and Training.

END OF SECTION 409513

SECTION 464321 - CIRCULAR THICKENER MECHANISM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pier supported, circular collector(s) with center drive assembly, overload alarm, access bridge/walkway, support column, drive cage, sludge collector arms, installation in existing circular concrete tank complete with all accessories and appurtenances required for the proper performance of the work. Launder trough and supports to remain.

B. Modifications

1.2 RELATED SECTIONS

A. Section 01 7900 - Demonstration and Training.

C. Section 05 1200 - Structural Steel Framing.

E. Division 26 - Electrical.

1.3 DESIGN REQUIREMENTS

A. General

1. The thickener mechanism shall be of the center drive type, supported on a stationary influent column, with the flow entering at the bottom of the influent column and flowing upward into a feedwell through openings near the water level. The clarifier shall be designed to remove settled sludge from the bottom of the tank
2. The central mechanism shall support and rotate a drive cage supporting the truss supported sludge rakes.
3. The sludge collection mechanism shall be designed to remove sludge uniformly from the bottom of the tank.
4. The assembly shall be designed to withstand twice the rated torque of the turntable without over-stressing the members.
5. Components of the sludge collectors shall be factory assembled prior to shipment to the extent possible so that a minimum of field erection will be required.

B. Steel members in contact with liquid either continuously or intermittently shall have a minimum thickness of 1/4". Structural steel shall conform to ASTM A 36. Cast iron shall conform to ASTM A 48, Class 30 minimum.

C. Submerged trusses shall be designed for twice the continuous torque of the drive.

1.4 REFERENCES

A. ASTM A 36 - Structural Steel

B. ASTM A 325 - Fasteners

C. ASTM A 304 - Bolts

D. ASTM A 316 - Bolts

E. ASTM A 48 - Cast Iron

F. ASTM A 536 - Cast Iron

G. ANSI 4142 - Heat Treated Steel

H. AGMA 6034-B92 - Practice for Enclosed Worm Gear Speed Reducers and Gear Motors.

I. AGMA 2001-B88 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.

J. AWS - American Welding Society Current Standards.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 3000 - Administrative Requirements, and the General Conditions.

B. Operation and Maintenance Manuals.

C. Shop and Placement Drawings. The equipment manufacturer shall submit calculations to Engineer for approval substantiating the continuous output torque rating. Calculations shall include worm gear set and bearings used in the gear reduction unit.

D. Manufacturer's Field Reports: Certify that installed Products meet or exceed specified requirements.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum fifteen (15) years documented experience in designing circular clarifier mechanisms.

B. Fabricator: Company specializing in fabricating the work of this section with minimum fifteen (15) years documented experience in fabricating circular clarifier mechanisms.

1.7 PRECONSTRUCTION CONFERENCE

A. Convene one week prior to commencing work of this section with Contractor, Installer and Owner's representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products as required by the manufacturer.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.10 WARRANTY

A. The circular sludge mechanisms shall be guaranteed for a period of one year from the date of substantial completion.

1.11 SPARE PARTS

A. Provide the following spare parts, protected for storage in the manufacturer's original undamaged container. Deliver to Owner's storage.
   1. One (1) set of seals for the center drive assembly.
   2. Two (2) oil sight glass. (Upper and lower housing)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All circular mechanisms furnished shall be the product of a single manufacturer.
   1. Westech
   2. Evoqua
   3. Or approved equal.

2.2 DRIVE UNIT

A. The center drive mechanism shall consist of a motor driven primary gear reduction unit, steel chain roller drive, shear pin coupling, enclosed worm gear reduction unit, and an overload system. Worm gear assembly driven by a minimum 1HP totally enclosed gear motor with 1.25 safety factor conforming to NEMA specifications for AC motors in continuous humid outdoor conditions.

B. The drive unit shall be capable of producing and withstanding the listed momentary peak torque while starting.

C. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours.

D. The continuous output torque rating and the allowable stress values used in the design of a worm gear reduction unit shall be in strict conformance with the latest revision of the following standard: Worm & Worm Gearing: ANSI/AGMA 6034-B92.

E. The drive shall be designed to allow removal and replacement of internal gear, balls and strip liners without raising the walkway.

F. The main gear to pinion gear mesh shall be grease lubricated. Lubrication fittings shall be readily accessible above grating, next to motor.

G. All bearings shall have a minimum L10 life of 20 years, based on combined thrust and radial loads. Plain and sleeve type bearings are not acceptable..

	Percent Solids	Torque (ft.-lbs.)
Design running:	4-6	30,375
Momentary peak:	10	60,750

2.3 OVERLOAD PROTECTION

A. Provide torque monitor with visual indicator. The device shall be readable from the access walkway mounted in a weatherproof NEMA 4X housing with the torque and alarm switches.

B. Alarm at 100% of continuous torque value.

D. Motor cut-out at 125% of continuous torque value.

E. Momentary peak at 200% of continuous torque value with shear pin approximately 80% of momentary peak.

2.4 DISTRIBUTION WELL

A. Provide center feed influent distribution well.
1. Well shall be fabricated from 3/16" steel plate.
2. A feedwell shall be supported outside of the center cage to diffuse the liquid into the tank without disturbance or formation of density currents.
3. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
4. Well diameter shall maintain a velocity less than 5 ft/min. at maximum flow. The well diameter shall not be less than 20 percent of the tank diameter.
5. Well depth shall be no less than 60 percent of the tank depth.

2.5 DRIVE CAGE

A. A steel drive cage designed to support and rotate the sludge collector arms. Connection to the worm gear shall be adjustable for proper alignment and allowance for structural tolerances.

2.6 SLUDGE COLLECTOR

A. The sludge collector arms shall be of steel truss construction with segmented steel scraper blades and adjustable stainless steel squeegees. Squeegees shall be fastened to the rake blade with 304 stainless steel fasteners. Blades shall properly convey settled sludge to the sludge pit. Arms shall be adjustable to assure an even grout thickness over the bottom.

2.7 INFLUENT CHANNEL

A. Stationary Influent Well - Influent well shall accommodate the new influent channel and be designed to dissipate the influent velocity head and equalize the flow to periphery of the influent well.

2.8 ANCHORS

A. Provide type 304 stainless steel anchor bolts.

B. Provide setting templates for anchors.

2.9 SUPPORT BRIDGE/ WALKWAY

A. Provide three feet wide galvanized steel beam bridge/walkway with galvanized steel grating from outside tank wall to support drive mechanism and provide access to center drive platform. According to contract plans

B. Design to support dead load plus live load of 150 lb/lineal ft, with deflection of less than 1/360 of span.

C. Provide center platform with minimum 11 feet x 11 feet centered on drive unit.

D. Provide 1-1/2” diameter aluminum handrails and 4 inch toe-plates along both sides for bridge and center platform in accordance with OSHA standards.

2.10 COATING

A. Manufacturer shall provide all components with hot dipped galvanized coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, foundations, and conditions with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the circular clarifier mechanisms. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Prepare a written report, endorsed by the Installer, listing dimensional discrepancies

and conditions detrimental to the performance of the circular clarifier mechanisms and the date of correction.

3.2 INSTALLATION

A. Install as required by the manufacturer and in accordance with the contract documents.

3.3 FIELD QUALITY CONTROL

A. Provide a factory trained technical representative to inspect the equipment installation, supervise mechanical adjustments, conduct start-up, supervise torque testing, and instruct the Owner, or his representative, in the operation and maintenance of the equipment.

B. Torque Tests
   1. The entire sludge collector mechanism shall be statically load tested by loading the rake arm with 150 percent of the specified design running torque. The test shall verify the torque overload control device settings for alarm and motor cutout. One truss arm shall be anchored and the load measured to demonstrate the rake arms', cage's, and drive unit's ability to withstand the specified torque. Sketches and calculations shall be submitted illustrating how the torque will be applied prior to the test taking place.

C. Operation Tests
   1. The contractor shall operate the mechanism in a dry tank for a minimum of 4 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky, or unusual motion exhibited during this run in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 4 hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be repaired or replaced and the test re-run.

D. The contractor shall provide all necessary lubrication of all equipment prior to placing the equipment in operation.

E. Engage a factory-authorized service representative, for a minimum of one (1) day to train Owner's maintenance personnel to adjust, operate, and maintain units as specified:
   1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
   2. Review data in maintenance manuals.
   3. Schedule training with Owner with at least seven days' advance notice.

F. Provide written certification that the equipment is properly installed and operating.

3.4 PROTECTION OF FINISHED WORK

A. Provide protective coverings, barriers, devices, signs, or such other methods or procedures to protect the work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

END OF SECTION 464321

SECTION 999000 – SPECIAL PAINTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Consists of furnishing all labor, equipment, and materials in connection with prepare surface to be painted. Painting ceiling and piping of thickener room.

1.3 DESIGN REQUIREMENTS

A. Requirements:
   1. Color code all piping that is not buried in accordance with Section 54.4 of "Recommended Standards for Wastewater Facilities" 2014 Edition and Owner's existing color code system unless otherwise indicated. Final color selection by Owner.
   2. Submittals: Submit the following Contractor Drawings
   3. Product data including manufacturer's installation instructions and procedures.
   4. Materials Safety Data Sheet(s)
   5. Color selection charts

1.5 SUBMITTALS

A. Submit in accordance with Section 01 3000 - Administrative Requirements, and the General Conditions.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Provide the following coating systems for substrates indicated.
   1. Submerged or Intermittently Submerged Concrete
      a. Two-Component, Polyamide-Epoxy Coating & Modified Polyamine Epoxy Coating.
      b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP5
      c. Primer: Patching and filling voids and bug holes; Tnemec: Series 218
      d. MortarClad, min. DFT 1/32" to 1/4".
      e. First Coat: Tnemec: Series N69 Hi-Build Epoxoline, DFT 4.0 to 6.0 mils.
      f. Finish Coat: Tnemec: Series 436 Perma-Shield FR, DFT 50.0 to 125.0 mils.
      g. Total DFT: 54.0 to 131.0 mils plus primer.

B. Exterior Ferrous MetaL
   1. Epoxy/Epoxy/Polyurethane Coating:
      a. Surface Preparation: In accordance with manufacturer's instructions
      b. Primer: Tnemec: Series N69 Hi-Build Epoxoline, DFT of 3.0 – 5.0 mils.

c. Intermediate Coat: Tnemec: Series N69 Hi-Build Expoxoline, DFT 4.0 – 6.0 mils.
d. Finish Coat: Tnemec: Series 1075 Endura-Shield, DFT 2.0 to 3.0 mils.
e. Total DFT: 9.0 to 14.0 mils

C. Submerged or Intermittently Submerged Ferrous Metal
1. Modified Polyamine Epoxy Coating:
a. Surface Preparation: SSPC-SP5/NACE 1
b. Primer – Tnemec: Series 435 Perma-Glaze, DFT 15.0 to 20.0 mils.
c. Finish Coat – Tnemec: Series 435 Perma-Glaze, DFT 15.0 to 20.0 mils.
d. Total DFT: 30.0 to 40.0 mils.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide the following coating systems for substrates indicated.
1. Surface Preparation: Clean and prepare surfaces to be coated according to the manufacturer's instructions for each particular substrate condition and as specified.
2. Material Preparation: Carefully mix and prepare materials according to the coating manufacturer's directions.
3. Coating Application Schedule:
a. Submerged or Intermittently Submerged Concrete: All interior surfaces of the Lift Station Wet Well and Dry Well. Refer to the Special Provision for Alternates and the contract plans.
b. Interior Ferrous Metal: Piping, fittings, valves, and supports, within the Dry Well.
c. Exterior Ferrous Metal: Piping and fittings located above grade.
d. Submerged or Intermittently Submerged Ferrous Metal: Piping, fittings, and supports within the Lift Station Wet Well.

3.4 PROTECTION OF FINISHED WORK

A. Provide protective coverings, barriers, devices, signs, or such other methods or procedures to protect the work from damage or deterioration

END OF SECTION 999000