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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Testing and inspection 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. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous 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.

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

C. 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, assembly, and similar operations.
   1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged. **Refer to individual specification sections for mockup requirements and to Drawings for specific (limited) mockup locations. Mockup locations not indicated on Drawings are to be reviewed with Owner and Architect prior to mockup construction. (ADDENDUM 01)**

1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or if indicated as in-place portions of permanent construction, consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.
    a. Include each system, assembly, component, and part of the exterior wall and roof to be constructed for the Project. Colors of components shall be those selected by the Architect for use in the Project.
2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."

I. 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.

J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

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

1.6 ACTION SUBMITTALS

A. Mockup Shop Drawings: For integrated mockups.
   1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
   2. Indicate manufacturer and model number of individual components.
   3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
   2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. 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.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, 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.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
   1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
   3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 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, telephone number, and email address 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 inspection.
   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 Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

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, applying, 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 is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical 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.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
   1. Provide test specimens representative of proposed products and construction.
   2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
   5. Build laboratory mockups at testing facility, using personnel, products, and methods of construction indicated for the completed Work.
   6. When testing is complete, remove test specimens and test assemblies, and mockups, and laboratory mockups; do not reuse products on Project.
   7. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups of size indicated or, if not indicated, as directed by Architect.
   2. Build mockups in location indicated or, if not indicated, as directed by Architect.

3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.
1. Coordinate construction of the mockup to allow observation of air barrier installation, flashings, air barrier integration with fenestration systems, and other portions of the building air/moisture barrier and drainage assemblies, prior to installation of veneer, cladding elements, and other components that will obscure the work.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.11 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 inspection 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. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

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

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 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 Architect.
   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 Architect's, Commissioning Authority's, Owner’s and authorities' having jurisdiction reference during normal working hours.
   1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, 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 Section 017300 "Execution."

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 015000 - TEMPORARY FACILITIES AND CONTROLS

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 requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
   1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Electric Power Service: Provide temporary electric power service and pay electric-power-service use charges for electricity used by all entities as required for construction operations. (ADDENDUM 01)

C. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use **without payment of use charges**. Provide connections and extensions of services as required for construction operations. **(ADDENDUM 01)**

~~D. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use. Provide connections and extensions of services as required for construction operations.~~ **(ADDENDUM 01)**

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Erosion and Sedimentation Control Plan: Show compliance with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
   1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
   2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
   3. Indicate methods to be used to avoid trapping water in finished work.

G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
   1. Locations of dust-control partitions at each phase of work.
   2. HVAC system isolation schematic drawing.
   3. Location of proposed air-filtration system discharge.
   4. Waste-handling procedures.
   5. Other dust-control measures.

H. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
   1. Methods used to meet the goals and requirements of the Owner.
   2. Concrete cutting method(s) to be used.
   3. Location of construction devices on the site.
   4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
   5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood Enclosure Fence: Plywood, 6 feet (1.8 m) high, framed with four 2-by-4-inch (50-by-100-mm) rails, with preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

C. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches (914 by 1524 mm).

D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices: Owner will provide conditioned interior space for field offices for duration of Project.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of [**8**] <**Insert number**> at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

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

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

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

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

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
   1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
   1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
      a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
      b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
   2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
   3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

~~G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.~~ **(ADDENDUM 01)**

H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. (ADDENDUM 01)

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.
   1. At each telephone, post a list of important telephone numbers.
      a. Police and fire departments.
      b. Ambulance service.
      c. Contractor's home office.
      d. Contractor's emergency after-hours telephone number.
      e. Architect's office.
      f. Engineers' offices.
      g. Owner's office.
      h. Principal subcontractors' field and home offices.

K. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:
   1. Utilize designated area within existing building for temporary field offices.
   2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
   1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
   1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: ~~Provide temporary offsite~~ **Use designated areas of Owner's existing** parking areas for construction personnel. **Coordinate with Owner. (ADDENDUM 01)**

F. Storage and Staging: Provide temporary offsite area for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. Project Signs: Provide Project signs as approved by Owner. Unauthorized signs are not permitted.
1. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
   a. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touch up signs, so they are legible at all times.

I. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of

correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings, requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

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

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

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

~~K. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.~~
~~1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.~~
~~2. Paint and maintain appearance of walkway for duration of the Work.~~ **(ADDENDUM 01)**

L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard, with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.

2. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Where required by Authorities Having Jurisdiction, provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
   a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
   b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
   c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

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

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Wall sheathing.
   2. Roof sheathing.
   3. Composite nail base insulated roof sheathing.
   4. Sheathing joint and penetration treatment.
   5. Vapor retarder under nail base insulated roof sheathing.

B. Related Requirements:
   1. Section 061053 – Miscellaneous Rough Carpentry for plywood backing panels.
   2. Section 072726 – Fluid-Applied Membrane Barriers for non-permeable barrier applied over wall sheathing.
   3. Section 072419 – Water Drainage Exterior Insulation and Finish System (EIFS).
   4. Section 07311 – Asphalt Shingles.
   5. Section 075423 – Thermoplastic-Polyolefin (TPO) Roofing

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
   3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Sustainable Design Submittals: (ADDENDUM 01)
1. **Chain-of-Custody Certificates: For certified wood products. Include statement of costs.**
2. **Chain-of-Custody Qualification Data: For manufacturer and vendor.**
3. **Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.**
4. **Product Data: For installation adhesives, indicating VOC content.**
5. **Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.**

C. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies. (ADDENDUM 01)
1. **Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.**
2. **Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.**
3. **Include details of interfaces with other materials that form part of air barrier.**

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:
1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

1.5 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.
1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Testing Agency Qualifications:
1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

C. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced. (ADDENDUM 01)

D. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body. (ADDENDUM 01)

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing , tie-ins to other installed air barriers, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WOOD PANEL PRODUCTS

A. Plywood: DOC PS 1.

B. Certified Wood: Certify the following wood products as "FSC Pure" or "FSC Mixed Credit" in accordance with FSC STD-01-001 and FSC STD-40-004. (ADDENDUM 01)
1. Plywood.

2. Oriented strand board.
3. Particleboard underlayment.
4. Hardboard underlayment.

C. Oriented Strand Board: DOC PS 2.

D. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

E. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground; Use Category UC3b for exterior construction not in contact with the ground; Use Category UC4a for items in contact with the ground.

B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

C. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

D. Application: Treat plywood in contact with masonry or concrete or used with roofing, flashing, vapor barrier, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Any wood sheathing or wood used shall be fire retardant treated to comply with non-combustible construction. Use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305.

C. Kiln-dry material after treatment to maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood roof sheathing and other locations where indicated on Drawings.

2.5 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corporation; GlasRoc.
   b. G-P Gypsum Corporation; Dens-Glass Gold.
   c. United States Gypsum Co.; Securock.
2. Type and Thickness: Regular, thickness as indicated on Drawings.

B. Cementitious Backer Units: ASTM C 1325, Type A.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Custom Building Products; Wonderboard.
   b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
   c. USG Corporation; DUROCK Cement Board.
2. Thickness: 1/2 inch, unless otherwise indicated on Drawings.

2.6 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing, thickness as indicated on Drawings.

B. Glass Mat Gypsum Cover Board: ASTM C 1177, glass-mat, water-resistant gypsum substrate, thickness as indicted on Drawings; equal to Georgia-Pacific Corporation; Dens Deck Prime.

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.7 COMPOSITE NAIL BASE INSULATED ROOF SHEATHING

A. Ventilated Nail Base Sheathing: Rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C 1289, Type II, Class 1, with oriented strand board adhered to spacers on one face.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Rmax, Inc.
   b. Hunter Panels
   c. Atlas Roofing Corp.
2. Polyisocyanurate-Foam Insulation:
   a. Thickness: As indicated on Drawings.
   b. Compressive Strength: 20 psi.
3. Oriented-Strand-Board Nominal Thickness: As indicated on Drawings.
4. Spacers: Wood furring strips or blocks not less than 3/4 inch thick and spaced not more than 12 inches o.c.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Where such sheathing is used are part of a fire-resistance rated assembly, fasteners shall comply with the tested assemblies in type, size, spacing, etc., in addition to complying with the manufacturers' installation instructions.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Plywood Sheathing to Cold-Formed Metal Framing: ASTM C 954, hot-dip zinc coating complying with ASTM A 153, with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, hot-dip zinc coating complying with ASTM A 153.
   1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
   2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

G. Screws for Fastening Ventilated Nail Base Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.9 MISCELLANEOUS MATERIALS

A. Where miscellaneous materials are used are part of a fire-resistance rated assembly, comply with the tested assemblies in type, size, spacing, etc., in addition to complying with the manufacturers' installation instructions.

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

C. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing.

D. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 and ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels. (ADDENDUM 01)

1. Verify adhesive has a VOC content of 70 g/L or less.

2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Vapor Retarder for Roofing: Basis of Design: Soprema SOPRAVAP'R Vapor Barrier.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 PLYWOOD PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:
1. Screw to cold-formed metal framing.
2. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch gap where sheathing abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FIELD QUALITY CONTROL (ADDENDUM 01)

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Air barriers will be considered defective if they do not pass tests and inspections.

C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

D. Prepare test and inspection reports.

END OF SECTION 061600

SECTION 083323 - OVERHEAD COILING DOORS

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. Service doors.
   2. Insulated service doors.
   3. Fire-rated service doors.

B. Related Requirements:
   1. Section 055000 “Metal Fabrications” for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.
   1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
   3. Include description of automatic-closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
   5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
   6. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
   1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
   1. Curtain slats.
   2. Bottom bar with sensor edge.
   3. Guides.
   4. Brackets.
   5. Hood.
   6. Locking device(s).
   7. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
   1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

B. Sound-Control Doors: Assemblies tested in a laboratory for sound-transmission-loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.

C. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction, with Authorities Having Jurisdiction, and ICC A117.1.

D. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
   1. Design Wind Load: As indicated on Drawings.
   2. Testing: According to ASTM E330/E330M.
   3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

E. Windborne-Debris Impact Resistance: Provide overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for basic protection.

2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling doors formed with curtain of interlocking metal slats. Refer to Door Schedule on Drawings for locations of each.
   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. Overhead Door Corporation.
      b. Cookson Company.
      c. Cornell.
   2. Type, Size, and Location: As indicated in Drawings and Door Schedule.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Air Infiltration: For insulated door, maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283.

D. STC Rating: Minimum 26.

E. Curtain R-Value for Insulated Door: 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W).

F. Door Curtain Material: Galvanized steel.

G. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
1. Insulated-Slat Interior Facing: Metal.
2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.

I. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

J. Hood: Match curtain material and finish.
1. Shape: As indicated on Drawings.
2. Mounting: As indicated on Drawings.

K. Locking Devices: Equip door with locking device assembly.
1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside with thumbturn.

L. Manual Door Operator: Manufacturer’s standard chain-hoist operator.

1. Provide operator with through-wall shaft operation where applicable.

M. Electric Door Operator:
1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: As indicated on Drawings.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
4. Motor Exposure: Interior ~~and Exterior~~, wet, and humid where indicated.
5. Motor Electrical Characteristics shall be as recommended by door operator. Basis of design characteristics are as follows:
   a. Horsepower: 1/2 hp.
   b. Voltage: 115-V ac, single phase, 60 Hz.
6. Emergency Manual Operation: Push-up type.
7. Obstruction-Detection Device: Manufacturer’s standard Automatic for application.

8. Control Station(s): Interior mounted unless indicated otherwise on Drawings.
9. Other Equipment: Audible and visual signals

N. Curtain Accessories: Equip door with weather seals, push/pull handles, pull-down strap and automatic-closing device.

O. Door Finish:
1. ~~Baked-Enamel or~~ Powder-Coated Finish: Color as selected by Architect from manufacturer's full range. **(ADDENDUM 01)**
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 FIRE-RATED DOOR ASSEMBLY

A. Fire-Rated Insulated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

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. Overhead Door Corporation.
b. Cookson Company.
c. Cornell.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Fire Rating: As indicated in Drawings for application.

D. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283 or DASMA 105.

E. STC Rating: 27 unless indicated otherwise.

F. Curtain R-Value: 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W).

G. Door Curtain Material: Galvanized steel.

H. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height, unless indicated otherwise.
1. Insulated-Slat Interior Facing: Metal.

I. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

J. Hood: Match curtain material and finish.
1. Shape: As indicated on Drawings.

2. Mounting: As indicated on Drawings.

K. Locking Devices: Equip door with locking device assembly.
1. Locking Device Assembly: Manufacturer’s standard for application, Cremone-type, both jamb sides locking bars, operable from inside with thumbturn.

L. Manual Door Operator: Manufacturer’s standard chain-hoist operator.

M. Electric Door Operator:
1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: As indicated on Drawings.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
4. Motor Exposure: Interior and exterior, wet, and humid where indicated.
5. Motor Electrical Characteristics:
a. Horsepower: 1/2 hp.
b. Voltage: 115-V ac, single phase, 60 Hz.
6. Emergency Manual Operation: Push-up type.
7. Obstruction-Detection Device: Manufacturer’s standard automatic for application.
a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
8. Control Station(s): Where indicated on Drawings.
9. Other Equipment: Audible and visual signals.

N. Curtain Accessories: Equip door with smoke seals, automatic-closing device, pull-down strap and automatic closing device where applicable.

O. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.
3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.5 MATERIALS, GENERAL

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.

2.6 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.7 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.
2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant. Bird netting should be incorporated for pest control of any open areas. All hardware to be stainless steel security type.

2.8 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
1. Lock Cylinders: As standard with manufacturer and keyed to building keying system.
2. Keys: As specified by owner for each cylinder.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.9 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant and pest-controlled installation unless otherwise indicated.
   1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
   2. At door jambs, use Manufacturer's standard replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene nylon brushes.

C. Astragal for Interior Doors: Where indicated, equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

D. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

E. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches (2130 mm) high.

F. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Automatic-closing device shall be designed for activation by the following: **(ADDENDUM 01)**

   1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.
   ~~2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.~~
   ~~3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.~~
   ~~4. Building fire-detection, smoke-detection, and -alarm systems.~~

2.10 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic-closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.11 MANUAL DOOR OPERATORS

A. General: Where applicable, equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf (111 N).

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.12 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location as indicated for each door.
1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
5. Through-Wall Mounted: Operator is mounted on other side of wall from coil side of door.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. **(ADDENDUM 01)**
~~1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.~~
~~a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.~~
2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
~~3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.~~

G. Control Station: ~~Key switch~~ **Push button** control station in fixed location with momentary-contact **push-button** controls labeled "Open" and "Stop" and sustained- or constant-pressure

push-button control labeled "Close." ~~Key station to use replaceable cylinder that matches the existing standard cylinder system.~~

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. ~~Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.~~ **(ADDENDUM 01)**

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

2.13 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.14 STEEL AND GALVANIZED-STEEL FINISHES

A. ~~Baked Enamel or~~ Powder-Coat Finish: Manufacturer's standard ~~baked on~~ **powder-coat** finish ~~consisting of prime coat and thermosetting topcoat~~. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum ~~dry film~~ thickness. **(ADDENDUM 01)**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

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

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Power-Operated Doors: Install according to UL 325.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
   2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, section 5.2.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
   3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
   1. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by skilled employees of coiling-door Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Perform maintenance, including emergency callback service, during normal working hours.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084126 - ALL-GLASS ENTRANCES AND PARTITIONS

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. Interior swinging all-glass entrance doors and framing, including hardware.
   2. All-glass sidelights and transoms.
   3. Interior all-glass partitions.
   4. Metal trim and accessories in conjunction with all-glass entrances and partitions.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each component of all-glass system.

B. Sustainable Design Submittals:
   1. Product Data: For sealants, indicating VOC content.
   2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For all-glass entrances and partitions.
   1. Include plans, elevations, and sections.
   2. Include details of fittings and glazing, including isometric drawings of patch fittings and rail fittings, including showing type and thickness of glazing system, anchoring, and joining to adjacent construction.
   3. Door hardware locations, mounting heights, and installation requirements.
   4. No work shall be fabricated until shop drawings for that work have been approved by Architect for fabrication.

D. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below.
   1. Metal Finishes: 6-inch- long sections of patch fittings and rail fittings, accessory fittings, and other items in specified alloy, temper, finish and thickness required for completed Work.
   2. Glass: 6 inches square, showing exposed-edge finish, in thickness indicated in Documents.
   3. Door Hardware: For exposed door hardware of each type, in specified finish, full size.

E. Fabrication Sample: Continuous rail fitting at bottom, made from 12-inch lengths of full-size components and showing details of the following:
   1. Joinery.
   2. Anchorage.
   3. Glazing with butt glazing.

F. Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors sidelights, transoms, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Test Reports: For all-glass systems, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project, minimum two years documented experience.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

C. Source Limitations: Obtain all-glass entrance door and partition system and components from a single firm specializing in fabrication of all-glass entrance and partition systems, with not less than 3 projects of similar scope within the past 5 years.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Packaging of components shall be so selected to protect the components from damage during shipping and handling.

B. Storage on Site: Store all-glass entrance and partition components in a location and in a manner to avoid damage to the components. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of metals and glass edges.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so that the all-glass entrance and partition work will be accurately designed, fabricated and fitted to the structure. Indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Sequencing and Scheduling: Coordinate all-glass entrance and partition Work with contiguous Work and provide components at proper time and sequence to avoid delays in overall Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Provide tempered or laminated safety glass for locations subject to human impact as required by the governing codes, rules, and regulations of the authority having jurisdiction.

C. Structural Loads:
1. Structural Live Loads: Glass door and partition system to be designed to withstand live loads in accordance with governing local, state, and federal codes, rules, and regulations of the authority having jurisdiction.
2. Deflection Limits: Deflection normal to glazing plane is limited to 1/175 of clear span or 3/4 inch, whichever is smaller, except limit deflection of glass to 1/2 inch.

D. Seismic Performance: All-glass entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

F. Building Frame Movement: Design, fabricate, and install all-glass entrances and storefronts to withstand building movements including loading deflections, shrinkage, creep, and similar movements.

2.2 METAL COMPONENTS

A. Fitting Configuration:
1. Manual-Swinging, All-Glass Entrance Doors Sidelights and Transoms: Patch fitting at top and continuous rail fitting at bottom as indicated on Drawings.
2. All-Glass Partitions: Recessed glazing channel at top and continuous rail fitting at bottom as indicated on Drawings.

B. Patch Fittings: Bronze-clad aluminum.

C. Rail Fittings:
1. Material: Match patch-fitting metal and finish,] Bronze-clad aluminum.
2. Height:
a. Top Patch as indicated.
b. Bottom Rail: 10 inches as indicated.
3. Profile: Square, unless indicated otherwise.
4. End Caps: Manufacturer's standard precision-fit end caps for rail fittings with matching finish.

D. Accessory Fittings: Match patch- and rail-fitting metal and finish.

E. Anchors and Fastenings: Concealed.

F. Materials:
1. Aluminum: ASTM B 221, with strength and durability characteristics of not less than Alloy 6063-T5.
a. Color: As selected by Architect from full range of industry colors and color densities.

2. Bronze Cladding: ASTM B 36/B 36M, alloy as standard with manufacturer.
3. Finish: As selected by Architect from full range of industry finishes.

2.3 **LAMINATED** GLASS **(ADDENDUM 01)**

~~A. Glass: Class 1 (clear), ASTM C 1048, Kind FT (fully tempered), Low-Iron, Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.~~

A. Laminated Glass: Glass Type (7): Clear laminated low-iron glass, 1/2–inch thickness. ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer, ionomeric polymer interlayer, or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

3. Interlayer Color: Clear unless otherwise indicated.

4. Glass type **(7) in** locations as indicated in Drawings.
5. Glass thickness as recommended by GANA, for doors and partitions in heights indicated in Drawings.
6. ~~Temper glass using horizontal roller process.~~
7. Exposed Edges: Machine ground and flat polished.
8. Butt Edges: Flat ground.
9. Corner Edges: Lap-joint corners with exposed edges polished.

2.4 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch fittings and rail fittings. If finishes are not specified,

B. Opening-Force Requirements:
   a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion.
   b. Accessible Interior Swinging Doors: Not more than 5 lbf to fully open door.

C. Hardware Set 1: Floating Header: At door as indicated on Drawings.
   1. Floating Header: At transom above door as indicated on Drawings.
      a. Basis of Design manufactured by CRL, model no. NFH4BSS.
      b. Finish: As selected by Architect.
   2. Top Patches: Basis of Design manufactured by CASMA, model no. 42410.
      a. Finish: As selected by Architect.
   3. Bottom Rail: As indicated on Drawings.
      a. Square, Basis of Design manufactured by Doralco.

b. Finish: As selected by Architect.

4. Hinges/Pivot: Size and configuration as indicated and as recommended by manufacturer for proper performance, operation and application.
   a. Walking Beam Pivot, Basis of Design manufactured by Dorma, model 8062.
5. Closer and Pulls: As recommended by manufacturer for size of door and application in consideration of details indicated. Provide manufacturer's accessory components as required for a complete installation.
   a. Floor Closer, Basis of Design manufactured by Dorma, model no. BTS80.
   b. Swing: Single acting.
   c. Pull Hardware: Back to Back Pulls, Basis of Design manufactured by Rockwood, model no. RM3301 at 96 inches with mid post.
      i. Finish: As selected by Architect.
6. Stops:
   a. Door Header Stop: Basis of Design, manufactured by Dorma, manufacturer's standard 3 inch.
      i. Finish: As selected by Architect.
   b. Wall Stop: Basis of Design manufactured by Rockwood, model no. 403.
      i. Finish: As selected by Architect.
7. Single-Door Lockset:
   a. Rail Lock Set: Basis of Design manufactured by Ryadon, model no. LL01
      i. Finish: As selected by Architect.
8. Cylinders: Confirm requirements with Owner.

2.5 GLAZING ACCESSORIES

A. Glazing Accessories: Manufacturer's standard setting blocks, spacers, glazing adhesives and sealants suitable for glazing glass in fittings and for application indicated.

B. Fasteners:
   1. Unless indicated otherwise, provide manufacturer's standard anchors and fasteners for attachment of components to structural supports and for connecting components, as recommended by manufacturer for application.
   2. Provide concealed fasteners, except where indicated or where shown and accepted on final Shop Drawings.

2.6 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.
   1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work: Repair or replace non-conforming work.
   1. Remove and replace glass that is broken, chipped, cracked, abraded, or otherwise damaged, including natural causes, accidents, and vandalism, during construction period.

3.4 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.
   1. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a three-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 084126

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 01 Section “Cash Allowances”.
2. Division 08 Section “Hollow Metal Doors and Frames”.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
5. Division 28 Section “Access Control”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.
    c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Automatic Operator Supplier Qualifications: Power operator products and accessories are required to be supplied and installed through current members of the manufacturer's "Power Operator Preferred Installer" program. Suppliers are to be factory trained, certified, and a direct purchaser of the specified power operators and be responsible for the installation and maintenance of the units and accessories indicated for the Project.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closer bodies.
4. Ten years for heavy duty floor closers.
5. Five years for motorized electric latch retraction exit devices.
6. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

    a. Two Hinges: For doors with heights up to 60 inches.
    b. Three Hinges: For doors with heights 61 to 90 inches.
    c. Four Hinges: For doors with heights 91 to 120 inches.
    d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

    a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
    b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

    a. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

    a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

    a. Bommer Industries (BO).
    b. Lawrence Brothers (LA).
    c. McKinney Products (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

    a. Bommer Industries (BO).
    b. Pemko Products (PE).
    c. Select Products (SE).

C. Floor Closers: ANSI/BHMA A156.4 certified floor closers. Provide independent and adjustable valves for closing speed, latch speed, and backcheck with built-in dead stop and hold open features as specified. Provide finished cover plates or thresholds as indicated in door Hardware Sets.

1. Manufacturers:

    a. C.R. Lawrence (LW).
    b. Jackson Corporation (JA).
    c. Rixson Door Controls (RF).

D. Pivots: ANSI/BHMA A156.4, Grade 1, certified. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

1. Manufacturers:

    a. Accurate Lock and Hardware (AC).
    b. Architectural Builders Hardware (AH).
    c. Rixson Door Controls (RF).

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Architectural Builders Hardware (AH) - PT1000-EZ Series.
    b. Pemko Products (PE) - EL-CEPT Series.
    c. Securitron (SU) - EL-CEPT Series.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. McKinney Products (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

    a. Door Controls International (DC).
    b. Rockwood Products (RO).
    c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
3. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

4. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood Products (RO).
    c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of temporary keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

1. Manufacturers:

    a. Corbin Russwin Hardware (RU).
    b. Sargent Manufacturing (SA).
    c. Yale Locks and Hardware (YA).

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Match Facility Standard.

D. Permanent Cores: Match standard. Reference Division 01 "Cash Allowances" for material required under project. Installation to be included under Division 08 "Door Hardware" base bid package.

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3) each.
2. Master Keys (per Master Key Level/Group): Five (5) each.
3. Construction Keys: Ten (10) each.
4. Construction Control Keys: Two (2) each.
5. Permanent Control Keys: Two (2) each.

G. Construction Keying: Provide temporary keyed brass construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

I. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

J. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge. Provide factory key system formatted for importing into “Key Wizard” software.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Yale Locks and Hardware (YA) - 8800FL Series.

2.7 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): Subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.
2. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ML20900 Series.
    b. Sargent Manufacturing (SA) - 8200 Series.
    c. Yale Locks and Hardware (YA) - 8800FL Series.

2.8 AUXILIARY LOCKS

A. Cylindrical Deadlocks: ANSI/BHMA A156.36, Grade 1, cylindrical type deadlocks to fit standard ANSI 161 preparation and 1 3/8" to 1 3/4" thickness doors. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

    a. Corbin Russwin Hardware (RU) - DL3200 Series.
    b. Sargent Manufacturing (SA) - 480 Series.
    c. Yale Locks and Hardware (YA) - D100 Series.

2.9 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Auxiliary Deadlocks: BHMA A156.36.
3. Dustproof Strikes: BHMA A156.16.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

6. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

7. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.

8. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

9. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

10. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

11. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

12. Extended cycle test: Devices to have been cycle tested in ordinance with ANSI/BHMA 156.3 requirements to 9 million cycles.

13. Rail Sizing: Provide exit device rails factory sized for proper door width application.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000/ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Yale Locks and Hardware (YA) - 7000 Series.

2.11 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC8000 Series.
b. Norton Door Controls (NO) – 9500 Series.
c. Sargent Manufacturing (SA) - 281 Series.

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 certified surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

1. Manufacturers:

a. Corbin Russwin (RU) - DC5000 Series.
b. Norton Door Controls (NO) - 2800ST Series.
c. Sargent Manufacturing (SA) - 422 Series.

D. Door Closers, Overhead Concealed (Narrow Profile): ANSI/BHMA 156.4 certified Grade 1 door closers designed for narrow profile frames and doors. Closers to have fully concealed body in the frame head for offset hung applications, with separate and independent valves for closing speed and backcheck adjustments.

1. Manufacturers:

a. Jackson Corporation (JA) - Series.
b. LCN Closers (LC) - 2030 Series.
c. Rixson Door Controls (RF) - 91 Series.

2.12 AUTOMATIC DOOR OPENERS

A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Certified ANSI/BHMA A156.19.

C. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Norton Door Controls (NO) – 6000-LS Series.

2.13 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood Products (RO).
    c. Trimco (TC).

2.14 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood Products (RO).
    c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. Rixson Door Controls (RF).
    b. Rockwood Products (RO).
    c. Sargent Manufacturing (SA).

2.15 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko Products (PE).
3. Reese Enterprises, Inc. (RE).

2.16 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 3280 Series.
b. Security Door Controls (SD) - DPS Series.
c. Securitron (SU) - DPS Series.

B. Switching Power Supplies: Provide switching power supplies that are dual voltage, UL listed, supervised units. Units shall be field selectable with a dedicated battery charging circuit that provide 4 Amp at 12VDC or 24VDC continuous, with up to 16 independently controlled power limited outputs. Units shall tolerate brownout or overvoltage input ± 15% of nominal voltage and have thermal shutdown protection with auto restart. Circuit breaker shall protect against overcurrent and reverse battery faults and units shall be available with a single relay fire trigger or individually triggered relayed outputs. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Manufacturers:

a. Securitron (SU) - AQ Series.

2.17 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.19 EXISTING HARDWARE

A. All hardware for doors listed as existing to remain in the door schedule or in the hardware sets will remain. The general contractor shall clean and adjust these items for proper alignment and operation.

2.20 EXISTING HARDWARE PREPS

A. The general contractor shall verify that all new hardware specified for existing doors and frames will be compatible with the existing hardware preparations. Lack of verification prior to bid, that requires additional work to the existing doors and frames or additional material, will be the responsibility of the general contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Power Operator products and accessories are required to be installed through current members of the manufacturer's "Power Operator Preferred Installer" program.

D. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

Set: 1 – Entry Vestibule

Doors: 800

2	Floor Closer	28NHO x 90 deg x less floor plate	613E	RF
2	Angle Stop	60131	613E	RF
2	Push/Pull	(2) RM2300 x 96" x MP x Type 13HD mounting	US10BE	RO
1	Automatic Door Opener	6061-LS x 120VAC	690	NO
1	Bollard Post & Switch	500 x 125VAC	689	NO
1	Door Position Switch	505 x 125VAC		NO
1	Threshold	Type 1 x 700 x DOW x 1/4-20 ms & la	BZ	RF
2	Door Bottom Seal	321 DN x DOW		PE

Gasketing and astragal furnished by frame manufacturer

Set: 1.1 – Entry Vestibule

Doors: 801.2

1	Floor Closer	28NHO x 90 deg x less floor plate	613E	RF
1	Angle Stop	60131	613E	RF
1	Push/Pull	(2) RM2300 x 96" x MP x Type 13HD mounting	US10BE	RO
1	Threshold	Type 1 x 700 x DOW x 1/4-20 ms & la	BZ	RF
1	Door Bottom Seal	321 DN x DOW		PE

Gasketing furnished by frame manufacturer

Set: 1.2 – Exterior Entry

Doors: 801 **(ADDENDUM 01)**

2	Floor Closer	27NHO x 90 deg x SC x less floor plate	613E	RF
3	Intermediate Pivot	M19	613E	RF
1	**Electric Intermediate Pivot**	**E-M19 x QC-12**	**613E**	**RF**
	(Install at second from bottom pivot-active leaf only)			
1	**ElectroLynx Harness**	**QC-C1500P**		**MK**
	(Install between electric intermediate pivot and junction box)			
1	**Electric Latch Retraction Exit Device (Fail Secure)**	**8622-SE-36"-MEC x 2-1/4" thick door x 24VDC**		**AD**
1	**ElectroLynx Harness**	**QC-CXXX x required length**		**MK**
	(Install between electric intermediate pivot and electric latch retraction exit device)			
1	**Mortise Cylinder**	**CR1040 x temporary core x CMK**	**613E**	**RU**
1	Permanent Core	To match facility standard x MK	606	OT
1	**Exit Device**	**8622-36"-MEC x 2-1/4" thick door**		**AD**
2	Pull	RM2300 x 96" x MP x Type 12HD mounting x **2-1/4"** thick door	US10BE	RO
2	Overhead Stop	1-X36 x 90 deg	613E	RF
1	Threshold	Type 5 x 400 x DOW x 1/4-20 ms & la	BZ	RF
2	Door Bottom Seal	345 DV x DOW		PE
1	Astragal (Set)	(2) 297 DS x DOH		PE
1	Drip Strip	346 D x DOW + 4"		PE
1	**Card Reader**	**Furnished and installed by security contractor**		**OT**
2	Door Position Switch	DPS-M-BK		SU
1	**Power Supply**	**Refer to Hardware Set 1.3**		**SU**
1	**Wiring Diagram**	**WD-SYSPK**		**RU**

Gasketing furnished by frame manufacturer
Card reader to be used by authorized persons to gain entry from the exterior side of the opening
Card reader to be used to retract the latch of the electric latch retraction exit device
Push bar of exit devices always free for immediate egress

Set: 1.3 – Exterior Entry

Doors: 801.1 **(ADDENDUM 01)**

1	Floor Closer	27NHO x 90 deg x SC x less floor plate	613E	RF
1	Intermediate Pivot	M19	613E	RF
1	**Electric Intermediate Pivot**	**E-M19 x QC-12**	**613E**	**RF**
	(Install at second from bottom pivot)			
1	ElectroLynx Harness	QC-C1500P		MK
	*(Install between electric **intermediate pivot** and junction box)*			
1	**Electric Latch Retraction Exit Device (Fail Secure)**	**8602-SE-36"-MEC x 2-1/4" thick door x 24VDC**		**AD**
1	**ElectroLynx Harness**	**QC-CXXX x required length**		**MK**
	(Install between electric intermediate pivot and electric latch retraction exit device)			

1	Rim Cylinder	CR3040 x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Pull	RM2300 x 96" x MP x Type 12HD mounting x **2-1/4"** thick door	US10BE	RO
1	Automatic Door Opener	6061-LS x 120VAC	690	NO
2	Bollard Post & Switch	500 x 125VAC	689	NO
1	Overhead Stop	1-X36 x 90 deg	613E	RF
1	Threshold	Type 5 x 400 x DOW x 1/4-20 ms & la	BZ	RF
1	Door Bottom Seal	345 DV x DOW		PE
1	Drip Strip	346 D x DOW + 4"		PE
1	Card Reader	Furnished and installed by security contractor		OT
1	Door Position Switch	DPS-M-BK		SU
1	Power Supply	AQD4		SU
1	Wiring Diagram	WD-SYSPK		RU

Gasketing furnished by frame manufacturer
Card reader to be used by authorized persons to gain entry from the exterior side of the opening
Card reader to be used to **retract the latch of the electric latch retraction exit device** and allow for use of the exterior press wall switch
Push side press wall switch to **retract the latch of the electric latch retraction exit device** and then activate the automatic door operator at all times
Push bar of **electric latch retraction** exit device always free for immediate egress

Set: 2 – Meeting

Doors: 802, 803, 803.1, 804, 804.1

4	Concealed Hinge	MK100	Black	MK
1	Exit Device	EX89-R-3080-3-MB x less cylinder	313	AD
1	Mortise Cylinder	CR1040 x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Mounting Bracket	BKT075SP		PE
1	Overhead Concealed Closer	91H x 90 deg	613E	RF
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	7770 D x DOW x DOH		ZE
1	Automatic Door Bottom	434 APKL x DOW		PE

Set: 3 – Folding Partition/Overhead Roll-up/Sliding Door

Doors: 802.1, 803.2, 809, 820, 842.2, 842.4, 853.1, 854.2

All hardware furnished by door manufacturer

Set: 4 – Storage

Doors: 802A, 802B, 803A, 803B

2	Pivot (Set)	147	613E	RF
4	Intermediate Pivot	M19	613E	RF
2	Angle Stop	60131	613E	RF
1	Deadlock	DL3013 x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
2	Flush Pull	94C	US10BE	RO
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
2	Armor Plate	K1050 16" x 1" LDW 4BE CSK	US10BE	RO
2	Overhead Stop	1-X36 x 90 deg	613E	RF

Wood astragal furnished by door manufacturer

Set: 5 – Meeting

Doors: 805.1

8	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Exit Device	ED5470 x 106955ET x temporary core x M52 x M55 x M110 x CMK	613E	RU
1	Exit Device	ED5470 x 106950ET x temporary core x M52 x M55 x M110 x CMK	613E	RU
2	Mounting Bracket	BKT075SP		PE
3	Permanent Core	To match facility standard x MK	606	OT
2	Closer/Holder	DC8210 A12	690	RU
2	Mounting Bracket	BKT075SP		PE
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO

STC rated assembly-threshold, sound seal, automatic door bottoms and astragal furnished by door manufacturer

Set: 6 – Exterior Corridor

Doors: 806.1

1	Pivot (Set)	147	613E	RF
2	Intermediate Pivot	M19	613E	RF
1	Exit Device	EX89-M x less cylinder	313	AD
1	Rim Cylinder	CR3040 x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Pull	RM2300 x 96" x MP x Type 12HD mounting x 2" thick door	US10BE	RO
1	Closer	DC8210 A3 x M77	690	RU

1	Mounting Plate	754F25	690	RU
1	Overhead Stop	1-X36 x 90 deg	613E	RF
1	Threshold	170 B x DOW x MS & ES25		PE
1	Door Bottom Seal	345 DV x DOW		PE
1	Drip Strip	346 D x DOW + 4"		PE
1	Door Position Switch	DPS-M-BK		SU

Gasketing furnished by frame manufacturer

Set: 7 – Exterior Corridor

Doors: 806.2

2	Continuous Hinge	DFM95HD1		PE
1	Power Transfer	EL-CEPT	US10B	SU
	(For active leaf of pair only)			
1	ElectroLynx Harness	QC-C1500P		MK
	(Install between power transfer and junction box)			
1	Electric Latch Retraction Exit Device (Fail Secure)	ED5200A x 106957ET x temporary core x M52 x MELR x M110 x CMK x 24VDC	613E	RU
1	ElectroLynx Harness	QC-CXXX x required length		MK
	(Install between power transfer and electric latch retraction exit device)			
1	Exit Device	ED5200A x temporary core x M52 x M110	630	RU
1	Removable Mullion	CR908BKM x 96" x temporary core x		RU
	(Removable mullion to be cut to size in the field)			
2	Permanent Core	To match facility standard x MK	606	OT
1	Automatic Door Operator	6061 x 120VAC	690	NO
	(For active leaf of pair only)			
2	Press Wall Switch	505 x 125VAC		NO
1	Closer	DC6210 A13	690	RU
2	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
2	Overhead Stop	9-X36 x 90 deg	613E	RF
1	Threshold	171 B x DOW x MS & ES25		PE
	(Threshold to be notched for removable mullion in the field)			
1	Gasketing (Set)	316 DS x DOW x DOH		PE
1	Mullion Door Seal	5110 BL x DOH		PE
2	Door Bottom Seal	345 DV x DOW		PE
1	Drip Strip	346 D x DOW + 4"		PE
1	Card Reader	Furnished and installed by security contractor		OT
2	Door Position Switch	DPS-M-BK		SU
1	Power Supply	ADQ4		SU
1	Wiring Diagram	WD-SYSPK		RU

Card reader to be used by authorized persons to gain entry from the exterior side of the opening
Card reader to be used to retract the latch of the electric latch retraction exit device and allow for use of the exterior press wall switch
Push side press wall switch to retract the latch of the electric latch retraction exit device and then

activate the automatic door operator at all times

Push bar of exit devices always free for immediate egress

Set: 8 – Box Office/Coats/Concessions

Doors: 806A, 810, 811

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Overhead Concealed Closer	91N x 90 deg	613E	RF
1	Mop Plate *(For door 806A only)*	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	Door Stop *(For door 810 only)*	481	US10BE	RO
3	Silencer *(Furnish at wood frame only)*	609		RO

Set: 9 – Box Office/Closet

Doors: 806B, 811.1

4	Hinge	TA2714 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Mop Plate *(For door 806B only)*	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	Overhead Stop *(For door 806B only)*	9-X36 x 90 deg	613E	RF
3	Silencer *(Furnish at hollow metal frame only)*	608-RKW		RO

Set: 10 – Catering

Doors: 807

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Office Lockset	ML2051 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer/Holder	DC8200 A1	690	RU
1	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
3	Silencer	608-RKW		RO

Set: 11 – Catering

Doors: 807.1 **(ADDENDUM 01)**

8	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Office Lockset	ML2051 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
1	Closer	DC8200	690	RU
	(For active leaf of pair only)			
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
2	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	Overhead Stop	1-X36 x 90 deg	613E	RF
	*(For **inactive** leaf of pair only)*			
2	Silencer	608-RKW		RO
1	Astragal	355 DS x DOH		PE

Set: 12 – Green Room

Doors: 808, 808.1 **(ADDENDUM 01)**

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Classroom Lockset	ML2055 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	**Threshold**	**151 B x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 DSN x DOW x DOH**		**PE**
1	**Door Bottom Seal**	**234 AV x DOW**		**PE**

Set: 12.1 – Green Room (ADDENDUM 01)

Doors: 808.1

4	**Hinge**	**T4A3786 4-1/2" x 4-1/2"**	**US10BE**	**MK**
1	**Classroom Lockset**	**ML2055 106X x temporary core x CMK**	**613E**	**RU**
1	**Permanent Core**	**To match facility standard x MK**	**606**	**OT**
1	**Closer**	**DC8200**	**690**	**RU**
1	**Kickplate**	**K1050 10" x 2" LDW 4BE CSK**	**US10BE**	**RO**
1	**Wall Stop**	**406**	**US10BE**	**RO**
1	**Threshold**	**151 B x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 DSN x DOW x DOH**		**PE**
1	**Automatic Door Bottom**	**420 APKL x DOW**		**PE**

Set: 13 – SLL

Doors: 809.1 **(ADDENDUM 01)**

8	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
2	Push/Pull	(2) RM2300 x 84" x MP x Type 5HD mounting	US10BE	RO
2	Overhead Concealed Closer	91N x 90 deg	613E	RF
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
2	Door Stop & Holder *(Install at top of door-both leaves)*	494R	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
2	Automatic Door Bottom	434 APKL x DOW		PE
1	Astragal (Set)	(2) 354 DPK x DOH		PE

Sound seal furnished by frame manufacturer

Set: 13 – Audience Chamber

Doors: 840 (ADDENDUM 01)

8	**Hinge**	**T4A3786 4-1/2" x 4-1/2" NRP**	**US10BE**	**MK**
2	**Push/Pull**	**(2) RM2300 x 84" x MP x Type 5HD mounting**	**US10BE**	**RO**
2	**Overhead Concealed Closer**	**91N x 90 deg**	**613E**	**RF**
2	**Kickplate**	**K1050 10" x 1" LDW 4BE CSK**	**US10BE**	**RO**
2	**Door Stop & Holder** ***(Install at top of door-both leaves)***	**494R**	**US10BE**	**RO**
1	**Threshold**	**151 B x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 DSN x DOW x DOH**		**PE**
2	**Automatic Door Bottom**	**434 APKL x DOW**		**PE**
1	**Astragal (Set)**	**(2) 354 DPK x DOH**		**PE**

Set: 14 – Group Toilet

Doors: 812, 814

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Push Plate	70C 4 x 16	US10BE	RO
1	Pull	RM720 x 12" x Type 8 mounting	US10BE	RO
1	Closer	DC5230	690	RU
1	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO

Set: 15 – Corridor Toilet

Doors: 813, 855

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Privacy Set & Indicator	ML2060 106X x M19V	613E	RU
1	Closer	DC5230	690	RU
1	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	Door Stop *(For door 813 only)*	481	US10BE	RO
3	Silencer *(Furnish at hollow metal frame only)*	608-RKW		RO

Set: 15.1 – Corridor Toilet

Doors: 856.1

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Privacy Set & Indicator	ML2060 106X x M19V	613E	RU
1	Closer/Stop	DC8210 A11	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
3	Silencer	608-RKW		RO

Set: 16 – Copy

Doors: 821

4	Hinge	TA2714 4-1/2" x 4-1/2"	US10BE	MK
1	Office Lockset	ML2051 106X x temporary core x CMK	613E	RU
1	Wall Stop	406	US10BE	RO
3	Silencer	608-RKW		RO

Set: 17 – Office

Doors: 822

8	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Office Lockset	ML2051 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
2	Wall Stop	406	US10BE	RO

STC rated assembly-threshold, sound seal, automatic door bottoms and astragal furnished by door manufacturer

Set: 18 – Office **(ADDENDUM 01)**

Doors: 823, 824, 825

4	Hinge	TA2714 4-1/2" x 4-1/2"	US10BE	MK
1	Office Lockset	ML2051 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Wall Stop	406	US10BE	RO
1	Door Stop	481	US10BE	RO
	(For door 823 only)			
1	**Threshold**	**151 B x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 DSN x DOW x DOH**		**PE**
1	**Automatic Door Bottom**	**434 APKL x DOW**		**PE**

Set: 19 – Piano Lab

Doors: 830

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Security Classroom Lockset	ML2052 106X x temporary core x CMK	613E	RU
2	Permanent Core	To match facility standard x MK	606	OT
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Automatic Door Bottom	434 APKL x DOW		PE

Sound seal furnished by frame manufacturer

Set: 20 – Exterior Corridor

Doors: 831

1	Continuous Hinge	DFM97HD1		PE
1	Exit Device	ED5200 x 106957ET x temporary core x M52 x W048 x M110 x CMK	613E	RU
2	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8210 A13	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Overhead Stop	9-X36 x 90 deg	613E	RF
1	Threshold	1715 D x DOW x MS & ES25		PE
1	Gasketing (Set)	316 DS x DOW x DOH		PE
1	Door Bottom Seal	345 DV x DOW		PE
1	Drip Strip	346 D x DOW + 4"		PE
1	Door Position Switch	DPS-M-BK		SU

Set: 21 – Utility

Doors: 831A

8	Hinge	TA2714 4-1/2" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
1	Closer/Stop *(For active leaf of pair only)*	DC8210 A11	690	RU
1	Overhead Stop *(For inactive leaf of pair only)*	9-X36 x 90 deg	613E	RF
2	Silencer	608-RKW		RO

Flat metal astragal furnished by door manufacturer

Set: 22 – Orchestra Pit Access

Doors: **841A.1 (ADDENDUM 01)**

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Classroom Lockset	ML2055 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8210 A3	690	RU
1	**Mounting Bracket**	**BKT075SP**		**PE**
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	**Threshold**	**151 B x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 DSN x DOW x DOH**		**PE**
1	**Automatic Door Bottom**	**420 APKL x DOW**		**PE**

Set: 22.1 – Corridor

Doors: 850A (ADDENDUM 01)

4	**Hinge**	**T4A3786 4-1/2" x 4-1/2"**	**US10BE**	**MK**
1	**Classroom Lockset**	**ML2055 106X x temporary core x CMK**	**613E**	**RU**
1	**Permanent Core**	**To match facility standard x MK**	**606**	**OT**
1	**Closer**	**DC8200**	**690**	**RU**
1	**Kickplate**	**K1050 10" x 2" LDW 4BE CSK**	**US10BE**	**RO**
1	**Wall Stop**	**406**	**US10BE**	**RO**
1	**Threshold**	**151 B x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 DSN x DOW x DOH**		**PE**
1	**Automatic Door Bottom**	**434 APKL x DOW**		**PE**

Set: 23 – Mechanical Room

Doors: 837

4	Hinge	T4A3786 5" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO

STC rated assembly-threshold, sound seal and automatic door bottom furnished by door manufacturer

Set: 24 – Audience Chamber

Doors: 840.1, 843.1 **(ADDENDUM 01)**

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Exit Device	ED5200 x 106910ET x temporary core x M52 x M110 x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Overhead Concealed Closer	91N x 90 deg	613E	RF
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	**Door Stop**	**481**	**US10BE**	**RO**
	(For door 840.1 only)			
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Automatic Door Bottom	434 APKL x DOW		PE

Set: 25 – Stage

Doors: 842

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Classroom Lockset	ML2055 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8210 A3	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
3	Silencer	609		RO

Set: 26 – Stage

Doors: 842.1

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Exit Device	ED5200A x 106955ET x temporary core x M110 x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Mounting Bracket	BKT075SP		PE
1	Closer/Stop	DC8210 A11	690	RU
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO

STC rated assembly-threshold, sound seal and automatic door bottom furnished by door manufacturer

Set: 27 – **Stage**

Doors: 842.3 **(ADDENDUM 01)**

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	**Closer**	**DC8200**	**690**	**RU**
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	**Overhead Stop**	**1-X36 x 90 deg**	**613E**	**RF**
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 27.1 – Storage

Doors: 892 **(ADDENDUM 01)**

3	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Wall Stop	406	BSP	RO
1	**Gasketing (Set)**	**S88 BL x DOW x DOH**		**PE**

Set: 28 – Stair

Doors: 842.5

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Exit Device	ED5200A x 106955ET x temporary core x M110 x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Mounting Bracket	BKT075SP		PE
1	Closer/Stop	DC8210 A11	690	RU
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 29 – SLL

Doors: 843

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Exit Device	ED5200 x 106910ET x temporary core x M52 x M110 x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Mounting Bracket	BKT075SP		PE
1	Closer	DC8210 A3	690	RU
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 30 – Stair

Doors: 844 **(ADDENDUM 01)**

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer/Stop	DC8210 A11	690	RU
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	**Door Bottom Seal**	**234 AV x DOW**		**PE**

Set: 31 – SLL

Doors: 845

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Push/Pull	(2) RM2300 x 84" x MP x Type 5HD mounting	US10BE	RO
1	Overhead Concealed Closer	91N x 90 deg	613E	RF
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Automatic Door Bottom	434 APKL x DOW		PE

Set: 32 – Lift Vestibule

Doors: 845.1

4	Concealed Hinge	MK100	Black	MK
1	Push/Pull	(2) RM2300 x 84" x MP x Type 5HD mounting	US10BE	RO
1	Overhead Concealed Closer	91N x 90 deg	613E	RF
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	7770 D x DOW x DOH		ZE
1	Automatic Door Bottom	434 APKL x DOW		PE

Set: 33 – Crossover

Doors: 846 **(ADDENDUM 01)**

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	**Closer/Stop**	**DC8210 A11**	**690**	**RU**
1	**Mounting Bracket**	**BKT075SP**		**PE**
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	**Threshold**	**151 B x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**7770 D x DOW x DOH**		**ZE**
1	**Automatic Door Bottom**	**420 APKL x DOW**		**PE**

Set: 33.1 – Corridor Storage

Doors: 859, 886

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT

1	Closer	DC8200	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
1	Gasketing (Set)	S88 BL x DOW x DOH		PE

Set: 34 – Exterior Stair

Doors: 846.1 **(ADDENDUM 01)**

1	Continuous Hinge	**DFM83HD1**		PE
1	Power Transfer	EL-CEPT	US10B	SU
1	ElectroLynx Harness	QC-C1500P		MK
	(Install between power transfer and junction box)			
1	Electric Latch Retraction Exit Device (Fail Secure)	ED5200A x 106957ET x temporary core x MELR x W048 x M110 x CMK x 24VDC	613E	RU
1	ElectroLynx Harness	QC-CXXX x required length		MK
	(Install between power transfer and electric latch retraction exit device)			
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8210 A13	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Overhead Stop	9-X36 x 90 deg	613E	RF
1	Threshold	1715 D x DOW x MS & ES25		PE
1	Gasketing (Set)	316 DS x DOW x DOH		PE
1	Door Bottom Seal	345 DV x DOW		PE
1	Drip Strip	346 D x DOW + 4"		PE
1	Card Reader	Furnished and installed by security contractor		OT
1	Door Position Switch	DPS-M-BK		SU
1	Power Supply	AQD4		SU
1	Wiring Diagram	WD-SYSPK		RU

Card reader to be used by authorized persons to gain entry from the exterior side of the opening
Card reader to be used to retract the latch of the electric latch retraction exit device
Push bar of electric latch retraction exit device always free for immediate egress

Set: 35 – Corridor

Doors: 850

8	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Exit Device	ED5470 x 106955ET x temporary core x M52 x M55 x M110 x CMK	613E	RU
1	Exit Device	ED5470 x 106950ET x temporary core x M52 x M55 x M110 x CMK	613E	RU
3	Permanent Core	To match facility standard x MK	606	OT
2	Overhead Concealed Closer	91N x 90 deg	613E	RU
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO

2	Door Stop	481	US10BE	RO

Set: 36 – Corridor

Doors: 850.1

8	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	Exit Device	ED5470 x 106955ET x temporary core x M52 x M55 x M110 x CMK	613E	RU
1	Exit Device	ED5470 x 106950ET x temporary core x M52 x M55 x M110 x CMK	613E	RU
3	Permanent Core	To match facility standard x MK	606	OT
2	Mounting Bracket	BKT075SP		PE
2	Closer/Stop	DC8210 A11	690	RU
2	Mounting Bracket	BKT075SP		PE
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
2	Automatic Door Bottom	434 APKL x DOW		PE
1	Astragal (Set)	(2) 354 DPK x DOH		PE

Sound seal furnished by frame manufacturer

Set: 37 – Loading

Doors: 854

2	Continuous Hinge	DFM95HD1		PE
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
1	Closer	DC8200	690	RU
	(For active leaf of pair only)			
2	Armor Plate	K1050 16" x 1" LDW 4BE CSK	US10BE	RO
2	Door Stop	481	US10BE	RO
2	Silencer	608-RKW		RO

Metal astragal furnished by door manufacturer

Set: 38 – **Corridor** Storage **(ADDENDUM 01)**

Doors: 851

8	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO

1	Closer	DC8200	690	RU
	(For active leaf of pair only)			
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
2	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
	(For door 854C only)			
2	Door Stop	481	US10BE	RO
1	Gasketing (Set)	S88 BL x DOW x DOH		PE

Metal astragal furnished by door manufacturer

Set: 38.1 – Corridor Storage

Doors: 854D

8	Hinge	T4A3786 5" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
1	Closer/Stop	DC8210 A11	690	RU
	(For active leaf of pair only)			
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
1	Overhead Stop	9-X36 x 90 deg	613E	RF
	(For inactive leaf of pair only)			
1	Gasketing (Set)	S88 BL x DOW x DOH		PE

Flat metal astragal furnished by door manufacturer

Set: 39 – Dressing

Doors: 852, 853

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Classroom Lockset	ML2055 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC5230	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Door Stop	481	US10BE	RO
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 40 – Exterior Loading

Doors: 854.1

1	Continuous Hinge	DFM95HD1		PE
1	Power Transfer	EL-CEPT	US10B	SU

1	ElectroLynx Harness *(Install between power transfer and junction box)*	QC-C1500P		MK
1	Electrified Lockset (Fail Secure)	ML20906-SEC x 106X x temporary core x CMK x 24VDC	613E	RU
1	ElectroLynx Harness *(Install between power transfer and electrified lockset)*	QC-CXXX x required length		MK
1	Permanent Core	To match facility standard x MK	606	OT
1	Latch Protector	321	US10BE	RO
1	Closer	DC8210 A3	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Overhead Stop	9-X36 x 90 deg	613E	RF
1	Threshold	1715 D x DOW x MS & ES25		PE
1	Gasketing (Set)	316 DS x DOW x DOH		PE
1	Door Bottom Seal	345 DV x DOW		PE
1	Drip Strip	346 D x DOW + 4"		PE
1	Card Reader	Furnished and installed by security contractor		OT
1	Door Position Switch	DPS-M-BK		SU
1	Power Supply	AQD4		SU
1	Wiring Diagram	WD-SYSPK		RU

Card reader to be used by authorized persons to gain entry from the exterior side of the opening
Card reader to be used to unlock the pull side lever of the electrified lockset
Push side lever of the electrified lockset always free for immediate egress

Set: 41 – Mechanical Room

Doors: 854A

8	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Surface Bolt (Top)	630 x 24"	US10BE	RO
1	Surface Bolt	630 x 12"	US10BE	RO
1	Closer/Stop *(For active leaf of pair only)*	DC8210 A11	690	RU
1	Mounting Bracket	BKT075SP		PE
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
1	Overhead Stop *(For inactive leaf of pair only)*	9-X36 x 90 deg	613E	RF
1	Mounting Bracket	BKT075SP		PE

STC rated assembly-threshold, sound seal, automatic door bottoms and astragal furnished by door manufacturer

Set: 42 – Electric Room

Doors: 854B

8	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Exit Device	ED5470B x 106957ET x temporary core x M55 x M110 x CMK	613E	RU
1	Permanent Core	To match facility standard	606	OT
1	Exit Device	ED5470B x M55 x M110	613E	RU
2	Mounting Bracket	BKT075SP		PE
2	Closer/Stop	DC8210 A11	690	RU
2	Mounting Bracket	BKT075SP		PE
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO

STC rated assembly-threshold, sound seal, automatic door bottoms and astragal furnished by door manufacturer

Set: 43 – Electric Room

Doors: 854B.1

4	Hinge	T4A3786 5" x 4-1/2" NRP	USP	MK
1	Exit Device	ED5200A x 106957ET x temporary core x W048 x M110 x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Mounting Bracket	BKT075SP		PE
1	Closer/Stop	DC8210 A11	690	RU
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO

STC rated assembly-threshold, sound seal, automatic door bottoms and astragal furnished by door manufacturer

Set: 44 – Utility

Doors: 854E

4	Hinge	T4A3786 5" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer/Stop	DC8210 A11	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
3	Silencer	608-RKW		RO

Set: 45 – Toilet Stall

Doors: 856.2, 856.3, 856.4

4	Reverse Spring Hinge	1502R 4-1/2" x 4-1/2"	US10BE	MK
1	Privacy Set & Indicator	ML2060 106X x M19V	613E	RU
1	Mop Plate	K1050 4" x 1" LDW 4BE CSK	US10BE	RO
1	Wall Stop	406	US10BE	RO
3	Silencer	608-RKW		RO

Set: 46 – Dressing

Doors: 857, 858 **(ADDENDUM 01)**

4	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Privacy Set & Indicator	ML2060 106X x M19V	613E	RU
1	Closer	DC5230	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	**Wall Stop**	**406**	**US10BE**	**RO**
1	Door Stop	481	US10BE	RO
	(For door 858 only)			
1	Threshold	151 B x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Automatic Door Bottom	434 APKL x DOW		PE

Set: 47 – Utility

Doors: 881, 893

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Wall Stop	406	BSP	RO
1	Door Stop	481	BSP	RO
	(For door 881 only)			

STC rated assembly-threshold, sound seal, automatic door bottoms and astragal furnished by door manufacturer

Set: 48 – Control

Doors: 882

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Classroom Lockset	ML2055 106X x temporary core x CMK	BSP	RU

1	Permanent Core	To match facility standard x MK	606	OT
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Door Stop	481	BSP	RO

STC rated assembly-threshold, sound seal and automatic door bottom furnished by door manufacturer

Set: 49 – Lift

Doors: 883 **(ADDENDUM 01)**

3	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
	(Install cylinder on push side of door)			
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer/Stop	DC8210 A11	BSP	RU
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Threshold	151 BSP x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 BSPSN x DOW x DOH		PE
1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 50 – Stair

Doors: 884

4	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Overhead Stop	1-X36 x 90 deg	BSP	RF
1	Threshold	151 BSP x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 BSPSN x DOW x DOH		PE
1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 51 – Stair

Doors: 884.1, 894

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Passage Set	ML2010 106X	BSP	RU
1	Closer	DC5230	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Wall Stop	406	BSP	RO
1	Door Stop	481	BSP	RO
	(For door 894 only)			
1	Threshold	151 BSP x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 BSPSN x DOW x DOH		PE

1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 52 – Utility

Doors: 884A **(ADDENDUM 01)**

4	Hinge	TA2714 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Door Stop	481	BSP	RO
1	**Threshold**	**151 BSP x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 BSPSN x DOW x DOH**		**PE**
1	**Automatic Door Bottom**	**420 APKL x DOW**		**PE**

Set: 53 – Utility

Doors: 890C

3	Hinge	TA2714 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Overhead Stop	1-X36 x 90 deg	BSP	RF
3	Silencer	608-RKW		RO

Set: 53.1 – Utility

Doors: 896

3	Hinge	TA2714 4-1/2" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer/Stop	DC8210 A11	BSP	RU
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Threshold	151 BSP x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 BSPSN x DOW x DOH		PE
1	Automatic Door Bottom	420 APKL x DOW		PE

Set: 54 – Utility

Doors: 891

3	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT

1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Door Stop	481	BSP	RO

STC rated assembly-threshold, sound seal and automatic door bottom furnished by door manufacturer

Set: 55 – Storage

Doors: **885.1, 885.2 (ADDENDUM 01)**

4	Hinge	TA2714 4-1/2" x 4-1/2"	US10BE	MK
1	Storeroom Lockset	ML2057 x 106X x **M30** x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	**Flush Pull**	**94C**	**US10BE**	**RO**
1	**Closer/Stop**	**DC8200 A11**	**690**	**RU**
3	Silencer	609		RO

Set: 56 – **Utility (ADDENDUM 01)**

Doors: **804A**, 804B

2	Pivot (Set)	147	613E	RF
4	Intermediate Pivot	M19	613E	RF
2	Angle Stop	60131	613E	RF
1	Storeroom Lockset	ML2057 x 106X x **M30** x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
2	Flush Pull	94C	US10BE	RO
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Closer/Stop *(For active leaf of pair only)*	DC8210 A11	690	RO
1	Mounting Bracket	BKT075SP		PE
2	Armor Plate	K1050 16" x 1" LDW 4BE CSK	US10BE	RO
1	Overhead Stop	9-X36 x 90 deg	613E	RF
1	Mounting Bracket	BKT075SP		PE
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Threshold	2001 DT x DOW x MS & ES25		PE
1	Sound Seal (Set)	322 DSN x DOW x DOH		PE
1	Astragal	355 DS x DOH		PE

Set: 57 – Orchestra Pit

Doors: 841 **(ADDENDUM 01)**

4	Concealed Hinge	MK100	Black	MK
1	Classroom Lockset	ML2055 106X x temporary core x CMK	613E	RU

1	Permanent Core	To match facility standard x MK	606	OT
1	Closer/Stop	DC8210 A11	689	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
3	**Silencer**	**609**		**RO**

Set: 58 – Below Stage Access

Doors: 841.1, 841.2, 841.3, **841.4, 841.5 (ADDENDUM 01)**

2	**Pivot (Set)**	**370**	**613E**	**RF**
2	Angle Stop	60131	613E	RF
1	Deadlock	DL3013 x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
2	Flush Pull	94C	US10BE	RO
2	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
2	Overhead Stop	1-X36 x 90 deg	613E	RF

Wood astragal furnished by door manufacturer

Set: 59 – Storage

Doors: 844A **(ADDENDUM 01)**

8	Hinge	T4A3786 4-1/2" x 4-1/2"	US10BE	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Automatic Flush Bolt (Top)	2940	US10BE	RO
1	Flush Bolt	557	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
1	Closer	DC8200	690	RU
	(For active leaf of pair only)			
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
2	Door Stop	481	US10BE	RO
1	**Threshold**	**2001 DT x DOW x MS & ES25**		**PE**
1	**Sound Seal (Set)**	**322 DSN x DOW x DOH**		**PE**
1	**Astragal**	**355 DS x DOH**		**PE**

Set: 60 – Lift

Doors: 845.2 **(ADDENDUM 01)**

3	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	**Electric Hinge**	**T4A3786 4-1/2" x 4-1/2" QC-12**	**US10BE**	**MK**
	(Install at second from bottom hinge)			
1	**ElectroLynx Harness**	**QC-C1500P**		**MK**
	(Install between electric hinge and junction box)			
1	**Mortar Box**	**MG-16**	**US2C**	**MK**
1	**Electrified Lockset (Fail Secure)**	**ML20906-SEC x 106X x temporary**	**613E**	**RU**

core x CMK x 24VDC

1	**ElectroLynx Harness**	**QC-CXXX x required length**		**MK**
	(Install between electric hinge and electrified lockset)			
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC5230	690	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	Door Stop	481	US10BE	RO
3	Silencer	608		PE
1	**Door Position Switch**	**DPS-W-BK**		**SU**
1	**Power Supply**	**AQD4**		**SU**
1	**Wiring Diagram**	**WD-SYSPK**		**RU**

Electrified lockset to be tied into the lift system
Pull side lever of the electrified lockset to remain in the locked position until the lift is called to the upper lift position
Lift will not operate unless the door is in the closed position
Push side lever of the electrified lockset always free for immediate egress

Set: 61 – Lift

Doors: 845.3 **(ADDENDUM 01)**

3	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	US10BE	MK
1	**Electric Hinge**	**T4A3786 4-1/2" x 4-1/2" QC-12**	**US10BE**	**MK**
	(Install at second from bottom hinge)			
1	**ElectroLynx Harness**	**QC-C1500P**		**MK**
	(Install between electric hinge and junction box)			
1	**Mortar Box**	**MG-16**	**US2C**	**MK**
1	**Electrified Lockset (Fail Secure)**	**ML20906-SEC x 106X x temporary core x CMK x 24VDC**	**613E**	**RU**
1	**ElectroLynx Harness**	**QC-CXXX x required length**		**MK**
	(Install between electric hinge and electrified lockset)			
1	Permanent Core	To match facility standard x MK	606	OT
1	**Closer**	**DC5230**	**690**	**RU**
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	US10BE	RO
1	**Door Stop**	**481**	**US10BE**	**RO**
3	**Silencer**	**608**		**PE**
1	**Door Position Switch**	**DPS-W-BK**		**SU**
1	**Power Supply**	**Refer to Hardware Set 60**		**SU**
1	**Wiring Diagram**	**WD-SYSPK**		**RU**

Electrified lockset to be tied into the lift system
Pull side lever of the electrified lockset to remain in the locked position until the lift is called to the lower lift position
Lift will not operate unless the door is in the closed position
Push side lever of the electrified lockset always free for immediate egress

Set: 62 – Mechanical Room

Doors: 848

10	Hinge	T4A3786 4-1/2" x 4-1/2" NRP	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Flush Bolt (Top)	555 x 24"	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Closer/Stop	DC8210 A11	690	RU
	(For active leaf of pair only)			
1	Mounting Bracket	BKT075SP		PE
2	Kickplate	K1050 10" x 1" LDW 4BE CSK	US10BE	RO
1	Overhead Stop	9-X36 x 90 deg	613E	RF
	(For inactive leaf of pair only)			
1	Mounting Bracket	BKT075SP		PE

STC rated assembly-threshold, sound seal, automatic door bottoms and astragal furnished by door manufacturer

Set: 63 – Loading

Doors: 854F

2	Floor Closer	27SHO x 90 deg	613E	RF
6	Intermediate Pivot	M19	613E	RF
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	613E	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Automatic Flush Bolt (Top)	2840	US10BE	RO
1	Flush Bolt	555 x 12"	US10BE	RO
1	Dust Proof Strike	570	US10BE	RO
2	Armor Plate	K1050 16" x 1" LDW 4BE CSK	US10BE	RO
2	Overhead Holder	9-X26 x 90 deg	613E	RF
1	Gasketing (Set)	S88 BL x DOW x DOH		PE
2	Astragal	355 CS x DOH		PE
	(Install one each leaf)			

Set: 64 – Unknown

Doors: 882.1

4	Hinge	T4A3786 4-1/2" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO

1	Door Stop	481	BSP	RO

STC rated assembly-threshold, sound seal and automatic door bottom furnished by door manufacturer

Set: 65 – Utility

Doors: 885 **(ADDENDUM 01)**

4	Hinge	T4A3786 5" x 4-1/2"	USP	MK
1	Storeroom Lockset	ML2057 106X x temporary core x CMK	BSP	RU
1	Permanent Core	To match facility standard x MK	606	OT
1	Closer	DC8200	BSP	RU
1	Kickplate	K1050 10" x 2" LDW 4BE CSK	BSP	RO
1	Wall Stop	406	BSP	RO
3	**Silencer**	**608**		**RO**

Set: 65 – Existing Door

Doors: EX1

1	**Exit Device**	**To be determined**	**BSP**	**RU**
1	**Permanent Core**	**To match facility standard x MK**	**606**	**OT**
1	**Exit Device**	**To be determined**	**BSP**	**RU**

Existing door and frame to be relocated
Balance of hardware existing to remain

Set: 66 – Exterior Corridor (ADDENDUM 01)

Doors: 806.3

2	**Floor Closer**	**28NHO x 90 deg x less floor plate**	**BSP**	**RF**
2	**Angle Stop**	**60131**	**BSP**	**RF**
2	**Push/Pull**	**(2) RM2300 x 84" x MP x Type 13HD mounting**	**BSP**	**RO**
1	**Threshold**	**Type 1 x 700 x DOW x 1/4-20 ms & la**	**613E**	**RF**
2	**Door Bottom Seal**	**345 BSPV x DOW**		**PE**
2	**Electromagnetic Lock & Sensor**	**M680E-BDX x 24VDC**	**613E**	**SU**
1	**Emergency Push Button**	**EEB2 x 24VDC**		**SU**
1	**Power Supply**	**AQD4**		**SU**
1	**Wiring Diagram**	**WD-SYSPK**		**RU**

Gasketing and astragal furnished by frame manufacturer
No access from the exterior side of the opening

Motion sensor to deactivate the electromagnetic locks and allow for immediate egress at all times

Set: 67 – Storage (ADDENDUM 01)

Doors: 830A

8	**Hinge**	**TA2714 4-1/2" x 4-1/2" NRP**	**USP**	**MK**
1	**Storeroom Lockset**	**ML2057 106X x temporary core x CMK**	**613E**	**RU**
1	**Permanent Core**	**To match facility standard x MK**	**606**	**OT**
1	**Dummy Lever**	**ML2050 106X**	**613E**	**RU**
1	**Flush Bolt (Top)**	**555 x 24"**	**US10BE**	**RO**
1	**Flush Bolt**	**555 x 12"**	**US10BE**	**RO**
1	**Dust Proof Strike**	**570**	**US10BE**	**RO**
2	**Overhead Stop**	**9-X36 x 90 deg**	**613E**	**RF**
2	**Silencer**	**608-RKW**		**RO**

Wood astragal furnished by door manufacturer

Set: 68 – Lift (ADDENDUM 01)

Doors: 841A.2

3	**Hinge**	**T4A3786 4-1/2" x 4-1/2" NRP**	**USP**	**MK**
1	**Electric Hinge**	**T4A3786 4-1/2" x 4-1/2" QC-12**	**USP**	**MK**
	(Install at second from bottom hinge)			
1	**ElectroLynx Harness**	**QC-C1500P**		**MK**
	(Install between electric hinge and junction box)			
1	**Mortar Box**	**MG-16**	**US2C**	**MK**
1	**Electrified Lockset (Fail Secure)**	**ML20906-SEC x 106X x temporary core x CMK x 24VDC**	**613E**	**RU**
1	**ElectroLynx Harness**	**QC-CXXX x required length**		**MK**
	(Install between electric hinge and electrified lockset)			
1	**Permanent Core**	**To match facility standard x MK**	**606**	**OT**
1	**Closer**	**DC5230**	**690**	**RU**
1	**Kickplate**	**K1050 10" x 2" LDW 4BE CSK**	**US10BE**	**RO**
3	**Silencer**	**608**		**PE**
1	**Door Position Switch**	**DPS-M-BK**		**SU**
1	**Power Supply**	**AQD4**		**SU**
1	**Wiring Diagram**	**WD-SYSPK**		**RU**

Electrified lockset to be tied into the lift system
Pull side lever of the electrified lockset to remain in the locked position until the lift is called to the upper lift position
Lift will not operate unless the door is in the closed position
Push side lever of the electrified lockset always free for immediate egress

Set: 69 – Janitor (ADDENDUM 01)

Doors: 854C

4	**Hinge**	**T4A3786 5" x 4-1/2" NRP**	**USP**	**MK**
1	**Storeroom Lockset**	**ML2057 106X x temporary core x CMK**	**613E**	**RU**
1	**Permanent Core**	**To match facility standard x MK**	**606**	**OT**
1	**Kickplate**	**K1050 10" x 2" LDW 4BE CSK**	**US10BE**	**RO**
1	**Wall Stop**	**406**	**US10BE**	**RO**
3	**Silencer**	**608**		**RO**

END OF SECTION 087100

SECTION 101420 - SIGNAGE

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. Panel signs.
   2. Pin-mounted dimensional characters.
   3. Plaques.
   4. Field-applied, glass mounted graphic film.

B. Related Requirements:
   1. Refer to Drawings for sign types and locations.
   2. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary informational and directional signs.
   3. Section 220553 "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
   4. Section 230553 "Identification for HVAC Piping and Equipment" for labels, tags, and nameplates for HVAC systems and equipment.
   5. Section 260553 "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.
   6. Section 265213 "Emergency and Exit Lighting" for illuminated, self-luminous, and photoluminescent exit sign units.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard and to meet requirements of Authorities Having Jurisdiction.

B. Braille: Grade II Braille. Tactile is required whenever Braille is required.

C. Tactile: 1/32” raised capital letters without serifs at least 5/8” height and not more than 2” height based on upper case “X.” Braille is required whenever tactile is required.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign of size similar to that of the project.

D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.

E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Panel Signs: Full-size Sample.
   2. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
   3. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
   4. Exposed Accessories: Full-size Sample of each accessory type.

F. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, materials, and colors.
   a. When room numbers or names to appear on signs differ from those on the Drawings, include the drawing room number and name on schedule along with the room number and name that will appear on the sign.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled in name groups.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of embedded graphic image.
      c. Separation or delamination of sheet materials and components.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 PANEL SIGNS

A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Basis of Design: Subject to project requirements, Basis of Design is Access Interior Sign System, AG Systems, 302 Commerce Drive, Eaton, PA 19341, phone 610.363.8150.
   2. Solid-Sheet Sign: Aluminum or manufacturer's standard sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph and as follows:
      a. Thickness: Manufacturer's standard for size of sign.
      b. Surface-Applied, Flat Graphics: As indicated in Drawings, manufacturer's applied vinyl film or baked enamel or powder coat as suitable for application.
      c. Surface-Applied, Raised Graphics: Applied polymer characters and Braille.
   3. Sign-Panel Perimeter: Finish edges smooth.
      a. Edge Condition: As indicated on Drawings.
      b. Corner Condition in Elevation: As indicated on Drawings.
   4. Mounting: As indicated on Drawings and Manufacturer's standard method for substrates indicated with Manufacturer's concealed anchors suitable for application.
   5. Surface Finish and Applied Graphics:
      a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
      b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
      c. Integral Acrylic Sheet Color: As selected by Architect from full range of industry colors.
      d. Baked-Enamel or Powder-Coat Finish and Graphics: Manufacturer's standard, in color as indicated on Drawings.
   6. Text and Typeface: As indicated on Drawings with variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
   7. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus measured diagonally from corner to corner.

2.3 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

D. Polycarbonate Sheet: ASTM C1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

E. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.

F. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

G. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish nonferrous-metal, stainless-steel, or hot-dip galvanized Insert requirement devices unless otherwise indicated.
   3. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   4. Sign Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
      b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
      c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
   5. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.

B. Adhesive: As recommended by sign manufacturer.
   1. Adhesives shall have a VOC content of 70 g/L or less.
   2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

E. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 PIN-MOUNTED DIMENSIONAL CHARACTERS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
   1. Manufacturers: Subject to compliance with project requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. A.R.K. Ramos.
      b. Gemini Incorporated.
      c. Matthews International Corporation; Bronze Division.
      d. Metal Arts: Div. of L&H Mfg. Co.
      e. Nelson-Harkins Industries.
   2. Character Material: Cast aluminum, ASTM B26/B26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
   3. Character Height: As indicated on Drawings.
   4. Character Font: As indicated on Drawings.
   5. **Character Thickness: 1/4-inch or as recommended by Manufacturer for application. (ADDENDUM 01)**
   6. Finish and Color: ~~As indicated on Drawings.~~ **(ADDENDUM 01)**
      a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
      ~~b. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.~~
      ~~c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.~~
   7. Mounting: Typical: Concealed studs, projecting 1-inch from wall with aluminum tube spacers.

2.6 PLAQUES

A. Manufacturers: Subject to compliance with project requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. A.R.K. Ramos.
   b. Gemini Incorporated.

c. Matthews International Corporation; Bronze Division.
d. Metal Arts: Div. of L&H Mfg. Co.
e. Nelson-Harkins Industries.

B. Cast Plaque: Provide castings free of pits, scale, sand holes, and other defects and as follows:
a. Plaque Material: Bronze.
b. Location and Message: To be determined by Owner and Architect.
c. Size and Thickness: To be selected by Architect.
d. Color, Finish, Texture, and Font: To be selected by Architect.
e. Mounting: Concealed studs, non-corroding for substrates encountered.

2.7 FIELD-APPLIED, GLASS MOUNTED GRAPHIC FILM

A. Application: No smoking signs at entrance doors.

B. Basis of Design: Allstate Sign & Plaque, sticker: 70 Burt Drive, Deer Park, NY 11729, phone 631.242.2828; www.allstatesign.com.

C. Mounting: Reverse-applied to interior side of glass doors where indicated on plans.
a. Manufacturer's recommended adhesive bond for application.

D. Material: Manufacturer's premium grade indoor/outdoor vinyl.

2.8 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

C. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
   1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.

D. Brackets: Where applicable to project, fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
   1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color color unless otherwise indicated.

2.9 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.10 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.11 METALLIC-COATED STEEL FINISHES

A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.

C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.

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

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.

C. Mounting Methods: Use Manufacturer’s recommended mounting method for application.
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 102236 - OPERABLE PANEL PARTITIONS

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. Manually operated, acoustical panel partitions.
   2. Manually operated, fire-rated panel partitions.
   3. **Manually operated, acoustical panel partitions functioning as sliding door, indicated on Door Schedule as Door #809 in location indicated on Drawings. (ADDENDUM 01)**

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
   2. Section 092910 "Gypsum Board Assemblies" for fire-rated assemblies and sound barrier construction above the ceiling at track.
   3. Division 26 for emergency and exit lighting requirements.

1.3 DEFINITIONS

A. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
   2. Chain-of-Custody Qualification Data: For manufacturer and vendor.

C. Shop Drawings: For each operable panel partition indicated in Drawings.
   1. Include plans, elevations, sections, attachment details, accessories, and numbered panel installation sequence.
   2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware, hinges, and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
   3. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.

D. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
   1. Include Samples of accessories involving color and finish selection.

E. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
   1. Textile Facing Material: Full width by not less than 36-inch- long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
   2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
   3. Panel Edge Material: Not less than 3 inches long.
   4. Hardware: One of each exposed door-operating device.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Partition track, track supports and bracing, switches, turning space, and storage layout.
   2. Suspended ceiling components.
   3. Structural members to which suspension systems will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. HVAC ductwork, outlets, and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Smoke detectors.
      f. Access panels.
   6. Plenum fire and acoustical barriers.

B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

C. Qualification Data: For Installer. An experienced installer who is certified in writing by the operable partition manufacturer as qualified to install the manufacturer's partition systems for work similar in material, design, and extent indicated for this Project.

D. Seismic Qualification Certificates: Where applicable, for operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
   1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
   2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of operable panel partition, including flammability certification to meet requirements of Authorities Having Jurisdiction.

F. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

G. Field quality-control reports.

H. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
      b. Seals, hardware, track, track switches, carriers, and other operating components.
      c. Electric operator and controls.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.9 QUALITY ASSURANCE

A. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels. Protect panels during delivery, storage, and handling to comply with manufacturer's written instructions and as required to prevent damage.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of operable panel partitions.
      b. Deterioration of metals, metal finishes, and other materials beyond normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the partition panels will remain in place without separation of any parts when subjected to the seismic forces specified."

B. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
   1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.

C. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.
3. Textile interior finish materials shall be Class A in accordance with NFPA 101, 10.2.4.1. Flammability certification shall be available for the partitions (NFPA 101, 12.3.3.)

D. Fire Resistance: Provide fire-rated operable panel partition assemblies including pass doors complying with NFPA 80, based on testing according to UL 10B for fire-rated door assemblies.
1. Pass doors in fire-rated operable panel partition assemblies shall meet positive-pressure requirements.

2.2 OPERABLE ACOUSTICAL PANELS **(ADDENDUM 01)**

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
1. Basis of Design Manufacturer and Products: Subject to compliance with requirements, provide products by the following:
   a. Modernfold, Inc., Acousti-Seal #931 manually operated individual panel operable partition and Acousti-Seal #932 manually operated paired panel operable partition. Where indicated, fire-rated paired panel operable partition Basis of Design product is Acousti-Seal #912. **STC 50 or greater.**
   b. Modernfold, Inc., Acousti-Seal #931 with multiple equal-width panels connected by continuous invisible hinges for sliding door application (Door #809) as indicated in Drawings, STC 28.
2. Subject to meeting project requirements, additional manufacturers that may be considered are:
   a. Hufcor, Inc.
   b. Advanced Equipment Corporation.
   c. Panelfold Inc.

B. Panel Operation: Manually operated, individual and manually operated, paired **and multiple** panels where indicated on Drawings.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: Standard widths.

E. STC: ~~Not less than 50~~. **STC ratings as indicated above for application.**

F. Panel Weight: 8 lb/sq. ft. maximum **for operable partitions, 6 lb/sq. ft.. for sliding door application (Door number 809.)**

G. Panel Thickness: Nominal dimension of 3 inches.

H. Panel Materials:
1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
4. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.
5. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
   a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
6. Gypsum Board: ASTM C1396/C1396M.
7. Cement Board: ASTM C1288.
8. Particleboard: ANSI A208.1.
9. Medium-Density Fiberboard: ANSI A208.2.
10. Plywood: DOC PS 1.

I. Panel Closure: Manufacturer's standard unless otherwise indicated.

J. Panel Trim: Panel joints should have minimal groove visual appearance. No vertical trim permitted on edges of panels.

K. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish as selected by Architect from Manufacturer’s standards.
1. Hinges: Manufacturer's standard full leaf **invisible** hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame.
2. Hinges mounted into panel edge or vertical astragal are not acceptable.
3. Finish Facing: Fabric wall covering as selected by Architect **for operable partitions. Wood veneer finish for sliding door application.**

2.3 OPERABLE FIRE-RATED PANELS

A. Operable Fire-Rated Panels: Fire-rated, acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
   1. Basis of Design Manufacturer and Products: Subject to compliance with requirements, provide products by the following:
      a. Where indicated, fire-rated paired panel operable partition Basis of Design product is Acousti-Seal #912 manufactured by Modernfold, Inc.
   2. Subject to meeting project requirements, additional manufacturers that may be considered are:
      a. Hufcor, Inc.
      b. Advanced Equipment Corporation.
      c. Panelfold Inc.

B. Panel Operation: Manually operated, paired panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable fire-rated panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
   1. Panel Width: Standard widths.

E. Fire Rating: 1 hour(s).

F. STC: Not less than 50.

G. Panel Weight: 8 lb/sq. ft. maximum.

H. Panel Thickness: Nominal dimension of 3 inches.

I. Panel Materials:
   1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
   2. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
   3. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.

J. Panel Closure: Manufacturer's standard fire-rated closure unless otherwise indicated.

K. Hardware: Manufacturer's standard as required to operate fire-rated operable panel partition and accessories; with decorative, protective finish as selected by Architect from Manufacturer’s standards.

1. Hinges: Manufacturer's standard full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame.
2. Hinges mounted into panel edge or vertical astragal are not acceptable.
3. Finish Facing: Fabric wall covering as selected by Architect.

2.4 SEALS

A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:
   1. Manufacturer's standard seals unless otherwise indicated.
   2. Seals made from materials and in profiles that minimize sound leakage.
   3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Manufacturer’s deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous, resilient acoustical seal. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.

C. Horizontal Top Seals: Manufacturer’s standard continuous-contact, resilient seal exerting uniform constant pressure on track.

D. Horizontal Bottom Seals: Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

E. Horizontal Bottom Seals: Resilient, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
   1. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, providing nominal 2-inch clearance with an operating range of + 1/2-inch to – 1-1/2-inch, which automatically drop as panels are positioned, without the need for tools or cranks.

2.5 PANEL FINISH FACINGS

A. Description: Finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
   1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with no gaps or overlaps. Horizontal butted, edges, or seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
   2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.

3. Match facing pattern 72 inches above finished floor.

B. Fabric Wall Covering: As selected by Architect, meeting project requirements and, from same dye lot, treated to resist stains and required fire resistance ratings.
1. Color/Pattern: As selected by Architect.

C. Wood Veneer Finish: As selected by Architect, meeting project requirements.
1. Species and Grade: As selected by Architect. (ADDENDUM 01)

D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel

2.6 SUSPENSION SYSTEMS

A. Tracks: Manufacturer's standard steel mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
1. Panel Guide: Manufacturer's standard steel guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish as selected by Architect.
2. Head Closure Trim: As required for acoustical performance; with finish as selected by Architect for application.

B. Carriers: Steel trolley system as required for configuration type, size, and weight of partition and for easy operation; with steel tired ball-bearing wheels.
1. Single panel suspension system shall provide automatic indexing of panels into stack area using preprogrammed switches and trolleys without electrical, pneumatic, or mechanical activation.
2. Multidirectional Carriers: Capable of negotiating intersections without track switches.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel.
1. Exposed Track Soffit: Steel, removable

D. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.7 ACCESSORIES

A. Pass Doors: Swinging door built into and matching panel materials, construction, acoustical qualities, fire rating, finish and thickness, trimless, complete with frames and operating hardware. Hinges finished to match other exposed hardware. No threshold permitted.
   1. Accessibility Standard: Fabricate doors to comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design," the ABA standards of the Federal agency having jurisdiction and ICC A117.1.
   2. Pass-Door: Matching thickness and appearance of the panels, in locations indicated on Drawings.
   3. Pass-Door Hardware: Equip pass door with the following:
      a. Door Seals: Manufacturer’s standard for application.
      b. Panic or Fire exit hardware where indicated.
      c. Concealed door closer.
      d. Exit Sign: Recessed, self-illuminated.
      e. Latchset: Passage set.
      f. Lock: Deadlock to receive cylinder, operable from both sides of door. See Section 087100 "Door Hardware" for lock cylinder and keying requirements.

B. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.
   1. Manufacturer's standard method to secure storage pocket door in closed position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

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

3.2 INSTALLATION

A. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

B. Install panels in numbered sequence indicated on Shop Drawings.

C. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

D. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.3 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that insure operable partitions are without damage or deterioration at time of Substantial Completion.

3.4 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, or malfunction, throughout entire operational range. Lubricate as recommended by manufacturer.

B. Adjust pass doors and storage pocket doors to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102236

SECTION 116103 – THEATRICAL NETWORKED LIGHTING CONTROL SYSTEM

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. This Section includes all labor, materials, equipment and services necessary to manufacturer and deliver to job site, for installation by Electrical Contractor, a complete Lighting Control System as shown on the drawings and/or specified herein, including but not limited to the following:

1. Permanent dimmer racks for stage lighting.
2. Ethernet control system equipment rack, Ethernet taps, DMX gateways, and associated equipment.
3. DMX distribution system.
4. Computerized stage lighting control console and associated equipment.
5. House Light control stations.
6. Mains-fed lighting control panelboards (LCP-##) feeding architectural lighting.
7. Lighting control network equipment including:
    a. Lighting control processors
    b. Ethernet switches and patch bays with related cabling
    c. Rack-mount Ethernet-to-DMX gateway nodes for control of stage lighting fixtures and architectural lighting fixtures.
    d. DMX splitters with related cabling
    e. Interfaces with other building systems as required, such as building automation, A/V controls, fire alarm control panel, and related input/output interfaces.
    f. Equipment racks with uninterruptible power supply.
8. Computerized stage lighting control consoles and associated equipment.
9. Architectural lighting control stations (house light stations), including button stations and touchscreen stations.
10. Architectural lighting DMX distribution system including emergency control overrides (emergency lighting transfer specified elsewhere)

1.3 It shall be the responsibility of the Lighting Control System Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications whether or not such items are herein specified or indicated.

1.4 MANUFACTURING STANDARDS

A. All work shall be manufactured in accordance with the latest editions of applicable publications and standards of the following organizations:

1. National Electric Code (NEC) and all prevailing local and state regulations including:
   a. ANSI/NFPA 70: National Electrical Code
2. Entertainment Services and Technology Association (ESTA) including:
   a. ANSI/ESTA E1.3-2001(R2016): Lighting Control Systems – 0-10V Analog Control Specification
   b. ANSI/ESTA E1.11-2008 (R2018): USITT DMX512-A
   c. ANSI/ESTA E1.17-2015: Architecture for Control Networks (ACN)
   d. ANS/ESTA I E1.20-2010: Remote Device Management over USITT DMX512
   e. ANSI/ESTA E1.27-1-2006 (R2016): Portable Control Cables for DMX512
   f. ANSI/ESTA E1.27-2-2009 (R2014): Permanently Installed Control Cables for DMX512
   g. ANSI/ESTA E1.31-2018: ACN transport of DMX-512
3. Occupational Safety & Health Act (OSHA)

~~1.5 SUBMITTALS WITH BIDS~~

~~A. Submit with bid a schedule listing the following time estimates:~~
~~1. Length of time required to prepare shop drawings.~~
~~2. Length of time required to supply all equipment.~~ **(ADDENDUM 01)**

1.6 SUBMITTALS

A. Lighting Control System Manufacturer shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.

B. Product Data Sheets
1. For Manufacturer standard panels, enclosures, modules, devices, and other equipment, with options and other variables clearly noted on data sheets.

C. Shop Drawings
1. Shop drawings shall be reviewed by the Architect before fabrication may begin.
   a. Such review does not relieve the Lighting Control System Manufacturer of the responsibility of providing equipment in accordance with this Specification.
2. Shop drawings shall show optical or transformer isolation of all control data lines between relay panels and architectural lighting processor.

3. Shop drawings shall show materials, finishes, metal gauges, overall and detail dimensions, sizes, electrical and mechanical connections, fasteners, welds, provisions for the work of others, and similar information.
4. Shop drawings shall indicate complete details of equipment, including manufacturer's catalog numbers for components, and shall include complete wiring diagrams.
5. Any deviation from this Specification shall be "starred" and noted in letters a minimum 1/4" high.
    a. For a deviation to be considered, it shall upgrade the quality of the equipment or respond to a field condition.
6. The reviewed shop drawings shall be updated to show any changes made during manufacturing and assembly and shall be provided to the Architect before the equipment is delivered.

D. Lighting Control System Manufacturer shall provide installation instructions for all equipment. These instructions shall include connection diagrams, termination designations, etc.

E. Coordination Drawings:
1. Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
    a. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
    b. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

F. After the installation is complete, the Lighting Control System Manufacturer shall provide the Owner with Operations and Maintenance Manuals not more than 14 days after the checkout is completed.
1. One O&M manual shall be a printed hard copy and O&M manual shall also be provided in electronic format on two flash drives.
2. Each O&M manual shall include, but not be limited to, the following:
    a. Copies of all record shop drawings.
    b. Catalog cuts of all equipment provided.
    c. Recommendations for periodic maintenance.
    d. Catalog numbers and manufacturers’ names and addresses for perishable items such as pilot lamps and fuses.
    e. Diagnostic procedures.
    f. Internet address for online access to manuals, product literature, and troubleshooting guides.
    g. Emergency and normal repair telephone contact sheet for 7-day, 24-hour service.

3. Lighting Control System Manufacturer shall provide the Owner with three instruction manuals for each control console type.
    a. Instruction manual shall be supplied to the Owner’s Representative on the day of the Lighting Control System checkout.

b. Instruction manuals may be requested by the Owner's Representative at a date prior to the system checkout.

1.7 SYSTEM INTEGRATOR

A. System Integrator shall be responsible for scope outlined in this Specification and for the following related Specification sections:
   1. 116106 – Stage Wiring Devices
   2. 116109 – Stage Lighting Fixtures and Accessories

B. System Integrator must have minimum five years' experience with supply, installation, commissioning, and integration of theatrical and architectural lighting control systems. System Integrator must have at least 10 recent projects of similar scope and characteristics to those specified herein.

C. System integrator shall be responsible for furnishing factory authorized personnel for system startup, programming, commissioning, and Owner training.

   1. Approved Integrators for the Work of this Section include:

      a. Barbizon Chicago – Chicago, IL - 773-276-8500
      b. Clearwing Productions – Milwaukee, WI - 414-258-6333
      c. Gopher Stage Lighting – Minneapolis, MN - 877-871-0138
      d. Integrated Theatre Systems – Pittsburgh, PA - 412-441-8000
      e. Live Technologies – Columbus, OH - 614-278-7777
      f. Mainstage Theatrical Supply – Milwaukee, WI - 888-936-7687
      g. Scenic Solutions – West Carrollton, OH – 888-866-5062
      h. Texas Scenic – New York, NY - 718-402-2677
      i. Vincent Lighting Systems – Cleveland, OH - 800-922-5356

1.8 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0 degrees to 40 degrees C (32 degrees to 104 degrees F).
   2. Relative humidity: Maximum 90 percent, non-condensing.
   3. Lighting Control System must be protected from dust during installation.

1.9 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.
2. Coordinate lighting controls with BAS if applicable. Design display graphics showing building areas controlled; include the status of lighting controls in each area.
3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

B. Coordinate lighting control loads specified in this Section with components providing overcurrent protection as specified in Division 26 Section "Panelboards."

1.10 LABELING

A. Ethernet Taps and DMX devices shall have Control Device Number (i.e. ‘ET-5’) clearly indicated with minimum 1/4” tall white characters on black faceplate. Label shall be centered above control port(s).
1. All faceplate labels shall be as shown on the QT-series Drawings and verified in Shop Drawings.

B. Furnish and install removable adhesive labels for each Theatrical Control Device back box and rear of faceplate, indicating the Control Device Number (i.e. ‘ET-5’) and serial code to facilitate programming and commissioning.

1.11 DELIVERY

A. The Lighting Control System Manufacturer shall coordinate delivery of all equipment with the Construction Manager and/or Electrical Contractor.

B. If required by the Construction Manager or Electrical Contractor, equipment shall be delivered in a minimum of three separate shipments that shall include:

1. Shipment #1: All items into which conduit is terminated including equipment racks, panels, control station back boxes, etc.

2. Shipment #2: All items in which wiring is terminated including control station faceplates, etc.

3. Shipment #3: All items that are not required until system activation by the Lighting Control System Manufacturer's field service representative. This shall include electronics modules, control consoles, gateways, monitors, cables, etc.

C. Lighting Control System Manufacturer shall deliver all material to the job site suitably crated, packed, and protected, and bearing the manufacturer's identification label and the nomenclature of the product(s) found in each carton or crate.

D. If, through no fault of the Owner, the timely completion of the work of this Section is imperiled, the Lighting Control System Manufacturer shall prevent or minimize any delay by shipping the required product to the job site by air freight, at no additional cost to the Owner.

E. Bid price shall include full freight and insurance charges for all items to the job site.

1.12 JOB SUPERVISION

A. When Contractor wiring is complete but prior to energizing the system, the Lighting Control System Manufacturer shall send a Factory-Authorized Technician to the job site to test and adjust the system.

B. Factory-Authorized Technician shall instruct designated Owner's representatives in operation and maintenance of the Lighting Control System. Refer training requirements in Part 3.

1.13 QUALITY ASSURANCE

A. Manufacturer: Minimum 10 years' experience in manufacture of architectural and theatrical lighting controls.

B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.

C. Source Limitations: Obtain lighting control and power distribution components through one source from a single manufacturer wherever possible. All components shall be furnished by the Integrator regardless of source.

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

E. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

F. Comply with NFPA 70.

1.14 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years. Support shall include 24-hour telephone support with guaranteed callback time of less than one hour.

B. Upgrade Service: Update software and firmware to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading of software shall include operating systems where applicable. Upgrade shall include new or revised licenses for use of the software.
   1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.15 WARRANTY

A. Lighting Control System Manufacturer agrees to make all repairs, including replacement of components and parts, made necessary due to defects in design, workmanship, and materials without additional cost to the Owner for a period of two years from the date of acceptance of the completed system.

B. In the event of a system failure during the warranty period, manufacturer agrees to send to the job the necessary field service technician(s) within 24 hours of notification.
   1. Technician(s) shall remain on the job until all necessary repairs have been made and the system is operational to the satisfaction of the Owner.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL SYSTEM MANUFACTURER

A. Basis of Design Lighting Control System Manufacturer for the work of this Section shall be the following:

   a. Electronic Theatre Controls (ETC) – Including Echo, Sensor3, Unison, and Paradigm
   3031 Pleasant View Rd.
   Middleton, WI 53562

   Contact:
   1) Sylvia Sinclair – Regional Manager Midwest – ETC
      a) 608-824-5155
      b) Sylvia.sinclair@etcconnect.com
   2) Gabe Rice – Cross Light, Inc.
      a) 216-533-4806
      b) grice@crosslightinc.com

B. Additional basis of design manufacturers for individual items as noted.

C. Equal Manufacturers:
   1. Subject to Division 01 Specifications, other manufacturers may submit for consideration as equal to the design basis manufacturer products. Submittals for consideration must show conformance to project Specifications and system design requirements.
   2. Final determination of suitability shall be at the discretion of the Specifier.

2.2 DIMMER-PER-CIRCUIT RACKS FOR STAGE LIGHTING

A. Provide 2.4 kW capacity plug-in *ThruPower* modules, each with primary circuit breaker in quantities shown on the drawings.
   1. The following modules control systems shall be provided for use in the theater dimming system.
   Manufacturer Model Designation : ETC *Sensor3* / *CEM3* / *Sensor3 ThruPower* Modules /Unison *Paradigm*

B. In addition to those shown on the drawings, provide the following spare parts:
   1. Four (4) dual 2.4 kW *ThruPower* modules.
   2. One (1) control electronics module for each type provided.

2.3 DIMMING EQUIPMENT RACKS

A. All dimming equipment racks shall be UL listed and compatible with Ethernet and USITT DMX512 data transmission standards.

B. Mechanical: Plug-in type modules are required for dimmer-per-circuit racks.
   1. The dimmer racks shall be deadfront, and fully accessible from the front by means of removable cover panels with hinged, lockable doors. The dimmer-per-circuit racks shall be floor supported.
   2. Framework assembly shall be of all-welded steel construction enclosed by not less than code gauge steel panels.
   3. Provide vibration isolation pads at the bottom of the dimmer rack to reduce the transmission of noise and vibration. Isolation pads shall be Mason Industries Type ND neoprene isolators sized for 1/2" status deflection or equal.
   4. Each module position shall contain guide tracks/rails to receive the module chassis.
   5. The entire rack interior and exterior shall be furnished in Manufacturer's standard color baked enamel over acid wash primer.
   6. Racks shall be constructed and shipped to the job site in separate sections.

C. Ventilation:
   1. In order that the ambient temperature of the modules may be maintained at acceptable values, the Owner shall provide that the ambient temperature of the space in which the dimmer bank is located will not exceed 40 degrees Centigrade.
   2. Manufacturer shall construct the dimmer rack that shall permit a sufficient quantity of air to flow through the rack and maintain the dimmers at their optimum operating temperatures.
   3. Cooling may be affected either by convection or by forced air through the use of low speed exhaust fans.

D. Electrical:
   1. Provide CEM3 power control electronics module with each dimmer rack.
   2. All control data lines, including common, shall be optically isolated from the console as well as from dimmer rack to dimmer rack. Control data lines shall also be protected by internal, user changeable fuses.
   3. All internal wiring shall be completed at the factory and the system components shall be delivered to the job site fully assembled and pre-wired, ready for installation by the electrical contractor.
   4. Terminals of the proper rating shall be provided for all external connections. Each terminal shall be clearly and permanently marked and numbered to correspond with Manufacturer's drawings. Terminal identification numbers shall correspond to actual dimmer numbers. Terminal identification numbering of 1-96 in each rack shall not be acceptable.

5. All primary circuit breakers used throughout the system shall be fully magnetic, single pole, and silent acting when held. Secondary circuit breakers need not be fully magnetic type.
6. All equipment necessary for the operation of this lighting control system shall be furnished with overload and short circuit protection.
7. All equipment, control, and protection devices shall be properly identified with permanent engraved labels mechanically affixed. Adhesive backed labels shall not be used.
8. Electrical power and control connections between the dimmers and the mounting racks shall be through permanent connectors at the rear of the rack. Mountings shall be such that the dimmers can be installed from the front of the rack without requiring access to the connectors or wiring.
9. Bussing shall permit the use of 120/208 v, 3-phase, 4 wire input service.
10. Main busses for dimmer-per-circuit rack shall be fully rated and common bussing through all racks shall be provided if required. Provide short circuit protection within the dimmer rack in accordance with code requirements and as directed by the Architect and the Engineer.
11. The entire dimmer rack shall be fully grounded in accordance with code requirements.

2.4 ETC THRUPOWER MODULES

A. General:
1. The modules shall be Sensor3 *ThruPower* modules designed for complete flexibility of choice for dimmed, non-dim, or hot power on each 20A branch circuit. A single *ThruPower* module shall provide the following:
   a. Two dimmed outputs with 500 rise times, controlled by DMX, or
   b. Two air gap relay switched outputs controlled by DMX, or
   c. Two manual bypass constant power circuits controlled manually
2. The module may be configured to operate as two dimmers, two relays, or any combination of relay and dimmer from the CEM3 Power Control Module or from an ETC control console connected to a CEM3 system. Any single circuit may be set to bypass the dimmer using a switch on the front of the module.

B. Mechanical:
1. Module quantities shall be as shown on the drawings.
2. The dimmer-per-circuit racks, each individual *ThruPower* module shall be on a slide mount chassis. Each module shall slide into the dimmer-per-circuit rack and shall be provided with power and control connectors for plug-in to the mating receptacles that are permanently mounted. The face plate shall be provided with a handle for ease of withdrawal.
   a. The dimmer modules shall be finished in baked enamel to harmonize with the finish of the dimmer equipment rack.
3. Modules shall be designed to operate within a normal ambient temperature range of 0 degrees Centigrade to 40 degrees Centigrade and in normal humidity of 20% to 90% with no adverse effects from thermal cycling within these ranges.
4. The module shall operate satisfactorily on 50 to 60 Hz., 110 to 140v AC.

5. Modules shall be ventilated by means of low-noise design cooling fans. If cooling is accomplished through the use of fans, a thermal cutout shall be appropriately mounted in each dimmer rack and shall automatically act to shut down the dimmer rack upon overheating, for any reason, preventing operation until the overheating condition has been removed, at which point the device will automatically reset.
6. Modules of the same capacity in the dimmer-per-circuit racks shall be interchangeable. Connectors and receptacles of modules of different capacity shall be polarized so that modules of different capacity cannot be interchanged.
7. All power wiring within the module shall be 105-degree Centigrade 600v rated and multi-stranded to withstand heat and vibration. Power leads shall be a minimum of #10 for 2.4 kW units.

C. Electrical:
1. Each *ThruPower* module shall contain:
   a. Two circuit breakers
   b. SCR solid-state dimming
   c. Toroid filters
   d. Power and control connectors
   e. 120VAC remotely controllable mechanically latching air gap relay
   f. Low voltage dc manual bypass override switch
   g. One fuse per branch circuit for sufficient short circuit rating
2. Modules that use Triac dimming shall not be acceptable. Modules which utilize an SCR or triac solid state switch as a dimmer bypass may void warranty of products they are powering and shall not be an acceptable means of bypass.
3. Circuit breakers shall be fully magnetic, so the trip current is not affected by ambient temperature.
   a. Circuit breakers shall be rated for tungsten loads having an inrush rating of no less than 20 times normal current.
   b. Circuit breakers shall be rated for 100 percent switching duty applications.
4. Each module shall use a solid-state module (SSM) consisting of two silicon-controlled rectifiers (SCRs) in an inverse parallel configuration, and all required gating circuitry on the high voltage side of an integral, opto-coupled control voltage isolator.
   a. Rectifiers, copper leads and a ceramic substrate shall be reflow soldered to an integral heat sink for maximum heat dissipation.
   b. The SSM shall also contain a control LED, a thermistor for temperature sensing, and silver-plated control and load contacts.
   c. The SSM shall include an integral output LED, output voltage sensors and current sensors for feedback to the control module.
   d. The SSM shall provide a parallel output connection which completely bypasses all SCR dimming including toroid filters and shall intercept the output prior to connection of the load sensing circuit such that the advanced features are still active during bypass.
5. Each module shall have an associated, inductive type filter, mounted on acoustically damped vibration mounts, to accomplish the following:
   a. Limit objectionable harmonics.

b. Limit the conducted radio frequency interference on supply lines.
c. Reduce acoustical noise in the dimmer load that would otherwise create noise of an acoustical origin in the lamp filaments on the output circuit.

D. The rise time shall not be less than 500 microseconds measured at 90 degrees conduction angle from 10% to 90% of the output wave with the dimmer operating at maximum load.

2.5 INTEGRATED LIGHTING CONTROL PANELBOARDS (LCP-##)

A. General:
1. Each panelboard shall consist of up to 24 network-controlled ~~motorized~~ **(ADDENDUM 01)** breakers. System shall be UL listed and labeled.
2. Circuit breakers shall be configured for single pole load control as scheduled.
3. Breakers shall be remotely operated by network communication link.
4. Panelboard shall have the capability to act as a standalone lighting control system with the following capabilities:
   a. Internal Astronomical Time Clock for programmed events.
   b. Accepts input from external button stations for recall of presets
   c. Accepts input from external daylight sensors.
   d. Signal arbitration to prioritize inputs by source (sACN, DMX, Preset Stations, Time Clock, etc).
   e. Configurable loss-of-signal behavior including ‘hold last look’ and ‘activate preset’.
5. USB port for upload of configuration files and firmware updates.

B. Physical:
1. Cabinets and Enclosures: NEMA 1 enclosure sized to accept required relays. Surface mounted cover as required with captive screws in a hinged, lockable configuration.
2. Interior: Interiors shall be provided with installed and tested ~~motorized~~ **(ADDENDUM 01)** breakers and interface modules.
3. Panel side-mount enclosure shall provide low voltage control interface between network and ~~motorized~~ **(ADDENDUM 01)** breakers, compliant with partitioning requirements for separation of line and low voltage.

C. Electrical:
1. Some Panelboards shall be equipped with a hydraulic/magnetic full-load-rated main circuit breaker, as noted on each panel’s associated Panelboard Schedule on QT-series Drawings. AIC rating as specified by Electrical Engineer.
2. Power Supply: Transformer assembly shall include internal overcurrent protection with automatic reset and metal oxide varistor protection against power line spikes.
3. Circuit Breakers shall contain solenoid actuators to move poles between open and closed positions. Overcurrent conditions shall cause a closed contact to open into ‘tripped’ position for ready identification of state:
   a. Coil:
      1) Magnetically held, momentary coil activation (50 milliseconds)

2) 2.2 VA max per breaker to allow simultaneous or sequenced control of up to 10 breakers per control wire run.
3) Split coil - ½ for ON, ½ for OFF.

b. Power Contacts:
1) 20A or 30A tungsten and NEMA electronic ballast rated, as scheduled.
2) Rated for 50,000 ON/OFF cycles at full load.
3) Support #6 - #14 AWG solid or stranded wire.
4) 120V and 277V rated.
5) FCC approved for commercial use.

D. Control Electronics:
1. Control electronics shall be integral to the panel side enclosure, providing network and user interface for individual control of ~~motorized~~ **(ADDENDUM 01)** circuit breakers in panelboard.
2. Configuration of network addressing shall be by means of digital graphical display interface or by network port. Status LEDs shall indicate presence of Power and DMX signal.
3. Control and communication signals shall be accommodated by means of system network and DMX512 interfaces.
a. The system network interface shall serve as primary integrating means between the rack electronics and the lighting control network, and shall also support remote configuration, file storage, playback, and monitoring capabilities from other devices on the network.
b. There shall be at least one optically isolated DMX512 input and one optically isolated DMX512 output per panel.
4. Furnish ride-through power supply to permit electronics to remain energized during short duration loss of power, such as during transfer to backup generator.
5. Furnish 0-10v control interface card in each panel.

E. Basis of Design
1. Basis of Design for Integrated Lighting Control Panelboards shall be:
a. Electronic Theatre Controls series as indicated on drawings.

2.6 EMERGENCY LIGHTING TRANSFER SYSTEM (ELTS-##)

A. General:
1. The Emergency Lighting Transfer System shall provide automatic transfer of branch circuits from normal to emergency power when normal power fails. Each system shall consist of power transfer switches and control circuitry interconnected to provide complete, automatic protection
2. The ELTS shall transfer designated lighting load branch circuits from dimmers or secondary control outputs to a second power source in the event of a loss of power, a normal system failure, or activation of fire alarm.

3. The system shall comply with ANSI / UL1008 Transfer Switch Equipment, ANSI / NFPA 110 Standard for Emergency and Standby Power Systems, and ANSI / NFPA 70 (NEC), including Article 700 safety standards. Emergency transfer systems that do not comply with the below stated NEC articles and sections shall not be permitted

    a. Satisfies requirements of the National Electrical Code (NFPA 70):

        1) Article 700 – Emergency Systems

        2) Section 518.3(C) – Assembly Occupancies

        3) Section 520.7 – Theatres and Similar Locations

4. The ELTS shall be a self-contained system for up to 24 circuits at 20 amps and available for single or three phase power (120/208V). The unit shall be available with discrete emergency branch circuit feeds from an external circuit breaker panel.

B. Transfer Switch

1. The switch shall be a UL 1008 LISTED, electrically operated and mechanically held (maintained) transfer switch.

2. The switch shall be positively locked and unaffected by voltage variations or momentary outages so constant contact pressure is maintained and temperature rise at the contacts is minimized.

3. The switch shall be mechanically interlocked to ensure only one of the two possible positions, either Normal or Emergency.

4. Each switch shall be configured as guaranteed break-before-make

5. Built-in fuses shall provide up to 65000A Short Circuit Current Rating (SCCR) on connected emergency circuits.

6. Built-in fuses class G shall be provided on each output for compliance with NEC Section 700 Coordination – larger upstream breakers cannot be tripped by downstream branch circuit faults.

7. Switch contacts shall withstand transfer without welding, with 180º phase displacement between Normal and Emergency power sources, both sources energized and with 80% load.

8. Transfer switch contacts shall be rated for mixed loads, including electric discharge lamps and tungsten filament lamps.

9. Transfer switches shall be rated for 6000 cycles at full tungsten load.

C. Control Circuit

1. The control circuitry shall direct the operation of the transfer switch.

2. User configurable timing delays shall be provided for power transfer between:

   a. loss of normal power and the transfer to emergency up to 10 seconds.

   b. restoration of normal power and the transfer from emergency back to normal power up to 60 seconds.

3. A normally closed dry contact closure fire alarm input shall be provided.

D. Operation

1. Transfer to alternate supply will occur when normal supply voltage drops below 80V, for the A phase, the B, or C phase.

2. A self-supervising isolated signal input shall be provided for connection to the facility fire alarm. The ELTS shall automatically transfer the loads to the Emergency power source when the facility fire alarm is activated as part of a normally-closed loop.

3. A key-operated switch shall be provided to manually control the ELTS. All automatic functions shall override this control. Two indicator lights shall be provided to show the position of the transfer switch.

4. All automatic functions shall override remote control functions. Any combination of open or shorted wiring to remote stations shall not affect automatic functions, or disable the local switch.

E. Enclosure

1. The ELTS shall be mounted in a NEMA 1 type enclosure finished in textured epoxy paint. It shall be equipped with a hinged locking door. Material shall be no less than 14 gauge steel.

2. An enclosure containing no more than 12 (twelve) 20A circuits shall be 36”H x 24”W x 8.5”D.

3. An enclosure containing up to 24 (twenty-four) 20A circuits shall be 48”H x 30”W x 8.5”D.

4. The enclosure shall provide power distribution and branch circuit protection for all emergency power circuits. Systems requiring external emergency power circuit protection shall not be acceptable.

5. The enclosure shall be separate and independent of all other equipment. In no instance shall the ELTS be enclosed in a dimmer rack or in an enclosure containing other equipment.

6. The system shall be provided with an approved overlay mounted on the front of the enclosure, stating, “EMERGENCY LIGHTING TRANSFER SYSTEM”.

7. The enclosure shall be provided with an approved label indicating that the system is UL1008 LISTED.

2.7 LIGHTING CONTROL NETWORK AND INTERFACE

A. General:

1. Furnish and install a complete lighting control network system, capable of supporting the specified relay panels, stage lighting control consoles, architectural control stations, time and calendar schedules, and related network devices indicated on the drawings and in this Specification.
2. The network shall use Category 5e Ethernet distribution to communicate between control consoles, panels, nodes, and computers.
3. Manufacturer specified wiring and topology shall be used to communicate with control stations, sensor devices and relay panels.

B. Network Components:
1. Control Processors:
   a. Provide architectural processor as required to interface lighting control relay panels, control stations, sensors, system I/O contacts, and any appurtenant devices or equipment required for system to function fully as intended. Processor shall provide necessary programming interface for setup and configuration of system and system components.
   b. Furnish one backup processor, which may be used as a replacement processor for either performance venue.

2. Ethernet switches and patch bays:
   a. Provide Ethernet Switches in port quantities as required for devices in system, plus 25% spare for future expansion at each rack location.
   b. Provide patch bays in port quantities as required for devices in system, plus 25% spare for future expansion at each rack location.
3. DMX signal splitters:
   a. Provide ANSI/USITT E1.1-2008 compliant DMX512 opto-isolating splitters, in quantity and configuration of inputs and outputs as required for system.
   b. All DMX signal cables terminating at the splitter location shall be outfitted with 5-pin XLR connectors or RJ45 connectors as necessary to permit user patching where required. This includes signals to Ethernet-to-DMX gateway node receptacles, dimmers, and relay panels.
4. Equipment Racks:
   a. Provide wall or floor mounted 19” equipment racks with mounting rails, hinged locking door, and sized to accommodate all required processing equipment including that indicated above in quantities shown on drawings plus any additional required for complete system.
   b. Each rack shall have minimum of one four-space contiguous blank section with cover plate for future equipment addition.
   c. Each rack shall be furnished with a three-space pull out drawer for storage of manuals, patch cabling, and user notes.
   d. Racks shall be Middle Atlantic SR series, EWR series or equal.
   e. Racks shall be furnished with an uninterruptible power supply (UPS) battery backup.
   f. Coordinate electrical power connections for rack contents.
5. Ethernet cabling:
   a. Ethernet cabling used in theatrical lighting control network shall have the following properties:

1) Comply with NEMA WC-63.1 Category 5e, UL verified.
2) Comply with TIA 568.C.2.
3) Outer jacket shall be PURPLE in color.

b. Furnish and install RJ45 Category 5e patch cables as necessary to fully patch between all network switch ports and patch bay ports in each rack location, plus 20% spares.

c. Furnish additional RJ45 Category 5e patch cables to allow connection of distributed Ethernet ports to node devices in the performance spaces. Refer to Theatrical Lighting Fixtures and Accessories Schedule on drawings for lengths and quantities to be furnished.

6. DMX Network Cabling:
   a. Furnish and install 5-pin XLR M/F DMX jumper patch cables as necessary to fully patch between all DMX-512 splitter ports and DMX patch points, racks, or other DMX devices at equipment racks.
   b. Furnish additional 5-pin XLR M/F DMX jumper cables to allow connection of DMX node devices to stage lighting fixtures and other DMX-controlled devices in the performance spaces. Refer to Theatrical Lighting Fixtures and Accessories Schedule on drawings for lengths and quantities to be furnished.
7. Ethernet Taps:
   a. Mounting type as shown on drawings
   b. Each tap shall have two RJ45 Ethernet connectors discretely fed from patch panel, unless otherwise noted.
8. Ethernet Nodes:
   a. Mounting as shown on drawings, furnish with necessary hardware.
   b. Each node with one, two, or four each 5-pin XLR connectors configurable for DMX512 input or output, or for ESTA/ANSI E1.20 two-way communication. Each connector may be addressed to discrete universes.
   c. Surface-mount nodes shall have Ethernet wire feed from patch panel to device.
   d. Portable nodes shall have one RJ45 Ethernet connection to permit patching into any Ethernet tap shown on drawings. Each shall be outfitted with Light Source MAB mega clamp or equal aluminum pipe clamp.
   e. Refer to drawings and schedules for quantity of each node type to be furnished.
9. Input/Output devices for communication with other systems:
   a. Provide dry contact closures configurable as input or output signals as needed to connect with fire alarm system, effects controls, shading systems, and future interfaces.

2.8 STAGE LIGHTING CONTROL CONSOLES

A. General

1. For each console, furnish all power and interface devices, cabling, and accessories necessary for a fully functioning system.
2. Furnish the following with each console (unless otherwise noted):
   a. Rolling road case

b. Dust cover
c. Portable UPS battery backup
d. Power cables
e. Ethernet patch cable or DMX512 patch cable (where applicable), 30’-0” in length
f. USB keyboard and mouse (where applicable)
g. Two (2) USB drives for show file storage

B. Proscenium Theater
1. ETC – Ion XE 2K
2. Eos FW 20 Fader Wing
3. Accessories
a. Two 17” Multi-Touch Monitors
b. Two LED gooseneck task lights with XLR connectors
c. Wi-Fi router and Ethernet patch cable, for remote connection from Owner-provided mobile devices.

C. Multipurpose Room
1. ETC – Element 2 1k
2. Accessories
a. Two 17” Monitors

2.9 ARCHITECTURAL LIGHTING CONTROL STATIONS (HOUSE LIGHT STATIONS)

A. General
1. Stations shall serve as user interface to recall and manipulate common room lighting presets via the lighting control network. Stations shall occur in the following styles:

a. Preset stations with buttons and faders
1) Preset stations shall have an LED constantly illuminated when the system is powered.
2) When a preset is activated, LED shall be illuminated on every preset control station capable of controlling that preset.
3) Control station faceplates shall be in color shown on the drawings with engravings as noted.
4) Preset/Fader stations shall fit in an industry standard back box furnished by Electrical Contractor and shall have faceplates with no visible fasteners.
5) Faceplates shall be engraved with custom labeling as determined by Owner and/or Specifier during shop drawing review.
6) Each preset and fader can be discretely programmed for scene recall, timed fades, on/off toggle, pile-on, and macro sequences, as indicated on drawings and by Owner and/or Specifier during system commissioning.
7) Stations shall operate on low voltage network bus as specified by Manufacturer, or on Category 5e cable with P.O.E., and shall be programmable via this network.

b. Fixed Touchscreen stations
   1) Minimum 16-bit color with resolution of minimum 600x360. Station screens shall have auto-fade with adjustable timeout and shall adjust brightness proportionally to room ambient light levels.
   2) Station programming shall support up to 10 discrete screen shots configurable for preset recall, virtual faders, clock and time scheduling functions, dynamic color wheel for LED fixture color selection, and group selection and assignment. Station shall be configured with code lockout on home page.
   3) Design display graphics showing building areas controlled; include the status of lighting controls in each area.

2.10 ARCHITECTURAL LIGHTING DMX DISTRIBUTION SYSTEM

A. Provide bi-directional DMX repeater(s) as required with sufficient DMX outputs for control of DMX enabled architectural lighting fixtures.

B. Provide emergency DMX bypass device(s) as noted on drawings, for lighting control override during loss of power or emergency evacuations. Bypass device(s) shall receive the following feeds:
   1. Panic signal from Fire Alarm Control Panel
   2. Loss of power signal from Emergency Bypass Detection Kit with power sense feed

PART 3 EXECUTION

3.5 EXECUTION

A. Verify that surfaces are ready to receive work.

B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing conditions.

E. Install in accordance with manufacturer's instructions and approved shop drawings.

F. All wiring shall be installed in conduit.

G. All branch load circuits shall be live tested before connecting the loads to the lighting control panels.

3.6 SUPPORT SERVICES

A. System Startup
1. Upon completion of installation, Contractor shall notify the Lighting Control System manufacturer that the system is ready for formal checkout and programming. No power shall be applied to the Lighting Control System unless specifically authorized by written instructions from the manufacturer.
2. Manufacturer shall provide Factory-Authorized Technician to confirm proper installation and operation of all system components.

B. Testing:
1. System shall undergo complete functional testing by a Factory-Authorized Technician. All loads shall be tested live for continuity and freedom from defects and all control wiring shall be tested for continuity and connections prior to energizing the system components.
2. Contractor shall be responsible for correction of any improper wiring or component installation as identified by the Factory-Authorized Technician during testing. Contractor shall be responsible for any return visits by Factory-Authorized Technician resulting from lack of system readiness for checkout or from any incomplete or incorrect wiring or installation.

C. Initial Programming
1. Programming of initial button assignments, touch screen page layouts, normal and emergency presets, control priorities, sensor settings, time clock events, etc, shall be performed by a Factory-Authorized Technician. Consultant may provide, in Contract Drawings, supplemental materials, or both, instructions for initial programming; however, all final decisions regarding programming shall be at the direction of the Owner.

3.7 OWNER TRAINING

A. General
1. Manufacturer’s authorized technician shall perform Owner Training.
2. Class size is limited to 12 participants.
   a. Owner shall provide a list of participants by title.
3. The Lighting System Integrator shall schedule instruction with the Owner's designated representatives. Agenda shall be sent in advance. All O&M materials, as designated in this Specification, shall be available at the time of training.
4. Instruction shall not necessarily follow immediately after the system check-out and activation.
5. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
6. Written documentation of Owner training shall be provided to the Owner upon completion.
   a. Form to include:
      1) The date, time, and location of training.
      2) Name, title, company, and signature of trainer.
      3) Name, title, and signature of all participants.

4) Topics covered at training.

b. If training is non-continuous, provide one form for each training segment.

7. Training may be video and audio recorded by the Owner at the Owner's expense.

B. Training Sessions

1. Up to 24 hours of Owner training to include the following:

a. Minimum of three (3) separate training sessions with Owner, as follows:

1) First session shall occur at conclusion of startup and system commissioning and shall include eight hours training time with Owner representatives. This session shall include the following general subjects, but shall be tailored to Owner's preference at time of training:

a) General system overview
b) Routine care and maintenance
c) Operation of relay panels
d) House Light Station operation and configuration, including review of initial programming provided by Consultant
e) Lighting Control Console introduction and basic programming
f) Review of warranty and software updates

2) Second session shall occur no less than two weeks following substantial completion, but within one month of initial training. This session shall include up to an additional eight hours training time with Owner representatives. This session shall include the following general subjects, but shall be tailored to Owner's preference at time of training:

a) In-depth Lighting Control Console operation and programming
b) House Light Station preset review and adjustment to reflect actual operational needs
c) Other review as requested by Owner

3) Third session of additional eight hours training time shall occur no less than one month after substantial completion, but within three months of initial training. Format and timeline shall be similar to the second session.

END OF SECTION 116103

SECTION 116106 – THEATRICAL WIRING DEVICES

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. This Section includes all labor, materials, equipment, and services necessary to manufacture and deliver to job site Theatrical Wiring Devices for stage lighting circuits, for installation by Electrical Contractor, as shown on the drawings and/or specified herein, including but not limited to the following:
   1. Recessed receptacle boxes (including backboxes)
   2. Surface-mount receptacle boxes
   3. Pipe-mount receptacle boxes
   4. Batten-mount connector strips with cable management

B. It shall be the responsibility of the Theatrical Wiring Device Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of the drawings and Specifications whether or not such items are herein specified or indicated.

~~1.3 SUBMITTALS WITH BIDS~~

~~A. Submit with bid a schedule listing the following time estimates:~~
   ~~1. Length of time required to prepare shop drawings.~~
   ~~2. Length of time required to supply all equipment.~~ **(ADDENDUM 01)**

1.4 SUBMITTALS

A. Theatrical Wiring Device Manufacturer shall prepare and submit complete shop drawings according to requirements set forth in the Contract Documents, to include the following:
   1. Shop drawings shall show bussing for each outlet box and shall utilize the exact circuit numbering method detailed on the drawings.
   2. Provide equipment data sheets for all components being furnished, clearly indicating specific part number, options, and accessories. Data shall include construction materials, dimensions, sizes, listings, electrical and mechanical connections, fasteners, and associated information pertinent to identifying function and quality of the components.

B. Furnish catalog cuts, drawings, and/or descriptive material of catalog items as requested by the Architect.

C. Furnish all the above for review by the Architect prior to commencing any work.

1. Such review does not relieve the Theatrical Wiring Device Manufacturer of the responsibility of providing equipment in accordance with this Specification.

D. Any deviation from this Specification is to be "starred" and noted in letters a minimum 1/4" high.
1. For a deviation to be considered it shall upgrade the quality of the equipment or respond to a field condition.

E. It is the responsibility of the Theatrical Wiring Device Manufacturer to submit shop drawings on a schedule that allows for adequate time for review. Proposals for contract time extensions due to delayed shop drawing submittals shall not be allowed.

1.5 MANUFACTURING STANDARDS

A. All work shall be manufactured in accordance with the latest editions of applicable publications and standards of the following organizations:
1. National Electric Code (NEC) and all prevailing local and state regulations including:
   a. ANSI/NFPA 70: National Electrical Code
2. National Electrical Manufacturers Association (NEMA) including:
   a. NEMA WD 1: General Purpose Wiring Devices
   b. NEMA WD 6: Wiring Device Configurations
3. Entertainment Services and Technology Association (ESTA) including:
   a. ANSI/ESTA E1.24-2012 (R2017): Dimensional Requirements for Stage Pin Connectors
4. Occupational Safety & Health Act (OSHA)

B. All applicable products shall bear label of Underwriters Laboratories (UL).

C. All equipment shall be thoroughly tested in Manufacturer's shop prior to shipment to insure mechanical and electrical integrity.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery shall be as required in Construction Documents.

B. The Theatrical Wiring Device Manufacturer shall coordinate delivery of all equipment with the Construction Manager and/or Electrical Contractor.

C. Theatrical Wiring Device Manufacturer shall, if requested by the Construction Manager and/or Electrical Contractor, deliver Theatrical Wiring Devices items in the following two separate shipments:

1. Shipment #1: Shipment shall include back boxes for all Theatrical Wiring Device items so that the Electrical Contractor may terminate all conduit.
2. Shipment #2: Shipment shall include faceplates for all Theatrical Wiring Device items.
3. Theatrical Wiring Device Manufacturer shall notify the Construction Manager and/or Electrical Contractor 24 hours prior to delivery of equipment.

D. Deliver all material to the job site suitably crated, packed, and protected.
1. Each crate or carton shall be clearly marked on the outside with the Manufacturer's identification label and the nomenclature of the product contained within.

E. Bid price shall include full freight and insurance charges for all items to the job site.

F. If, through no fault of the Owner, the timely completion of the work of this section is imperiled, the Theatrical Wiring Device Manufacturer shall prevent or minimize any delay by shipping the required products to the job site by air freight at no additional cost to the Owner.

1.7 WARRANTY

A. The Theatrical Wiring Device Manufacturer shall assure that this equipment is provided free of defects in materials and workmanship and shall provide a warranty under this contract for a period of two year from the date of final acceptance.

B. During the warranty period, repair or replacement of defective materials and/or repair of faulty workmanship shall be provided, at no cost to the Owner, within 10 days written notice of the defect(s).

1.8 THEATRICAL WIRING DEVICE MANUFACTURERS

A. Theatrical Wiring Device Manufacturers for work of this section shall include:

1. Altman Lighting
57 Alexander St.
Yonkers, NY 10701
Contact: Nick Champion nchampion@altmanltg.com
800-425-8626

2. Electronic Theatre Controls (ETC)
3031 Pleasant View Road
Middleton, WI 53562
Contact: Rob Raff rob.raff@etcconnect.com

3. Lex Products
15 Progress Dr.
Shelton, CT 06484
Contact: Tom Siko tsiko@lexproducts.com
800-643-4460

4. Performance Electric Inc.
   126A McDougall Ct.
   Greenville, SC 29607
   Contact: Larry Easterday save@performancedistro.com
   864-288-2021

5. SSRC
   170 Fortis Dr.
   Duncan, SC 29334
   Contact: Aaron Clark aclark@ssrconline.com
   864-848-9770

6. Stagecraft Industries Inc.
   5051 N. Lagoon Ave.
   Portland, OR 97217
   Contact: Kevin Shetterly kevins@stagecraftindustries.com
   503-286-1600

PART 2 - PRODUCTS

2.1 GENERAL

A. Load Connectors
   1. Load connectors for stage lighting circuits shall be stage pin (2P&G). Connectors and Receptacles shall be spaced and mounted as indicated.
   2. Multicable receptacles shall be Amphenol Socapex 419-AR series. Provide screw-on dust cover with attachment cable for each multicable receptacle.

2.2 LABELING

A. All Theatrical Wiring Devices containing load connectors shall have circuit numbering clearly labeled.
   1. Surface, recessed, and pipe-mount boxes:
      a. 1/4” tall white numbers engraved directly into a black lamicoid or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
      b. Flush receptacles: label shall be directly above receptacle
      c. Pigtail connectors: label shall be directly above pigtail entry to box
      d. Receptacles and labels shall face the direction indicated on drawings.
   2. Connector Strips
      a. 2” tall white numbers.
      b. Flush receptacles: label shall be located directly above receptacle
      c. Pigtail connectors: label shall be located directly on pigtail connectors and directly above pigtail entry to raceway.

B. All low voltage control devices within Theatrical Wiring Devices shall have device name clearly labeled with minimum 1/4" tall white characters on black background. Label shall be directly above control port.

C. All faceplate labels shall be as shown on the drawings and verified in Shop Drawings.

D. Furnish and install removable adhesive labels for each Theatrical Wiring Device faceplate and back box, indicating the Wiring Device Number (i.e. 'WD-5') and serial code to facilitate programming and commissioning.

2.3 RECESSED AND SURFACE-MOUNT RECEPTACLE BOXES

A. Provide recessed and surface-mount receptacle boxes as listed herein and shown on the drawings.

B. Recessed box covers shall flange over the back-box by no less than ½" per side.

C. Steel face plates with receptacles shall be constructed of minimum 18-gauge steel, finished with a powder-coat paint treatment in the color noted on drawings.
1. Circuit numbers shall be engraved directly into a black lamicoid or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
2. Provide mounting holes on face plate.

D. Provide solid copper buss bars for each receptacle plate as follows:
1. Adjacent neutral pairs for each circuit.
2. Adjacent hot leg pairs for each circuit.
3. Grounds for each receptacle plate.

E. Boxes shall be prewired with 125 degrees Celsius high temperature wire to molded barrier terminal blocks.

F. Connector type shall be shown on drawings.

G. Back boxes for surface and recessed mounted receptacle boxes shall be constructed of minimum 18-gauge steel, finished with a powder-coat paint treatment in the color noted on drawings.

H. Pigtails (where applicable) shall be fabricated of 12/3 or 12/4 SOW type cable with appropriate strain reliefs.

2.4 PIPE-MOUNTED RECEPTACLE BOXES

A. Provide pipe-mount receptacle boxes as listed herein and shown on the drawings.

B. Steel face plates with receptacles shall be constructed of minimum 18-gauge steel, finished with a powder-coat paint treatment in the color noted on drawings.

1. Circuit numbers shall be engraved directly into a black lamicoid or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
2. Provide mounting holes on face plate.

C. Provide solid copper buss bars for each receptacle plate as follows:
1. Adjacent neutral pairs for each circuit.
2. Adjacent hot leg pairs for each circuit.
3. Grounds for each receptacle plate.

D. Boxes shall be prewired with 125 degrees Celsius high temperature wire to molded barrier terminal blocks.

E. Connector type shall be shown on drawings.

F. Back boxes shall be constructed of minimum 18-gauge steel, finished with a powder-coat paint treatment in the color noted on drawings.

G. Boxes shall attach to pipes with U-bolts.

H. Pigtails (where applicable) shall be fabricated of 12/3 or 12/4 SOW type cable with appropriate strain reliefs.

2.5 SURFACE MOUNT BOXES WITH ANGLE MOUNT MULTICABLE RECEPTACLES

A. Provide surface mount multicable outlet boxes as listed herein and shown on the drawings.

B. Steel face plates with receptacles shall be constructed of min. 18 gauge steel, painted black.
1. Provide mounting holes on faceplate.
2. White circuit numbers, 1/4" in height, shall be engraved directly into a black lamicoid or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
a. Embossed, adhesive backed, plastic tape labels shall not be accepted.

C. Boxes shall be prewired with 125º Celsius high temperature wire from molded barrier terminal blocks to the multipin connectors.

D. Connectors shall be Socapex 6 circuit, 19 pin, 25A, angled panel mount female type as shown on the drawings. Verify type in shop drawings.

E. Provide back boxes constructed of min. 18 gauge steel, painted black.
1. Back boxes shall be labeled with circuit numbers to avoid mismatches in the field. (ADDENDUM 01)

2.6 PIPE-MOUNTED CONNECTOR STRIPS WITH CABLE MANAGEMENT

A. Provide pipe batten mount continuous connector strips with flush mounted receptacles as listed herein and as shown on the drawings.
   1. For each connector strip, provide mounting brackets and associated hardware as required to hang the connector strip on the stage rigging system 1-1/2" NPS steel pipe batten.
   2. Brackets for attachment to or suspension from structure or rigging shall be fabricated from ASTM A36 steel and shall use grade 5 rated hardware. Attachment spacing shall be no greater than 5’-0” on center and shall comply with Manufacturer’s installation instructions.

B. Connector strips shall be constructed of minimum 18-gauge steel or minimum 1/8" aluminum, finished with a powder-coat paint treatment in the color noted on drawings.

C. Flush receptacles shall be mounted at spacings as shown on the drawings.

D. Data receptacles (such as RJ45 ports or DMX Outputs) shall be provided as indicated on drawings, mounted at spacings as shown on drawings, and shall be flush-mounted to the box cover.
   1. Control terminations and distribution shall be within a portion of the raceway that is separated by a voltage barrier from the line-voltage portion.

E. Connector strip shall be factory pre-wired with 125 degrees Celsius high temperature wire to double sided, numbered molded barrier terminal strips at end of each connector strip.

F. Circuit numbers shall be provided as shown on the drawings.

G. Where connector strips are too long for shipping, the strips shall be shipped in segments and folded over one another with the internal wiring intact.
   1. Provide splice hardware as required.

H. Provide cable management devices for certain linesets, where indicated on drawings.
   1. Theatrical Wiring Device Manufacturer shall coordinate gridiron junction box location with Electrical Contractor.

I. Pigtails (where applicable) shall be fabricated of 12/3 or 12/4 SOW type cable with appropriate strain reliefs.

2.7 BATTEN-LAY BREAKOUTS

A. Provide 6 circuit, batten-lay type multicable break-outs as shown on the drawings.

B. Provide a male Socapex, 6 circuit, 19 pin, 25A connectors, with all-metal back shell and strain relief.
   1. On the multipin connector end of each batten lay, circuit numbers shall be identified by min. 1/2" adhesive labels covered with clear shrink tube either on the connector or on the cable.

C. At the opposite end of the breakout, each circuit shall have 12/3 SJOW-A cable "tail" terminating in a standard 20A theatrical 2 pin and ground female connector with strain relief.

1. Tail lengths on each batten-lay break-out shall be 2'-6", 4'-0", 5'-6", 7'-0", 8'-6" and 10'-0".

2. Each female pin connector shall have its circuit number identified by minimum 1/4" circuit numbers on the connector or with 1/4 adhesive labels covered with clear shrink tube. (ADDENDUM 01)

2.8 MULTICABLES

A. Provide 6 circuit, 20A, #12 type SO or SJ multicables in quantities and lengths shown on the drawings.

B. Each multicable shall each have male and female Socapex VSC, 6 circuit, 19 pin, 25A connectors, equipped with wire mesh strain reliefs.

C. Provide circuit number identification labels on each multi-pin connector as shown on the drawings.

1. Circuit numbers shall be identified on each end of the multicable by min. 1/2" adhesive labels covered with clear shrink tube either on the connector or on the cable, 2" from the connector.

D. Verify lengths prior to fabrication. (ADDENDUM 01)

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that equipment is properly wired, terminated, and ready for electrical connection and energization.

3.2 PREPARATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of devices. Coordinate details of equipment connections with supplier and Specifier.

3.3 INSTALLATION

A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment where appropriate.

3.4 OPERATION AND MAINTENANCE MANUALS

A. Upon completion of installation, the Manufacturer shall compile Operation and Maintenance manuals in quantity identified in Division 1, bound in hard ring binders. Minimum of three manuals shall be furnished to Owner, one hard copy and two electronically on portable USB drives.

B. Complete updated copy of record shop drawings, indicating all changes and modifications implemented during installation.

C. Catalog cut sheets for all device types.

D. Maintenance and care instructions and recommendations.

E. Warranty information.

END OF SECTION 116106

ADDENDUM 01, 11 DECEMBER 2019

SECTION 116109 – THEATRICAL LIGHTING FIXTURES AND ACCESSORIES (FOR INFORMATIONAL PURPOSES ONLY) (ADDENDUM 01)

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. This Section includes all labor, materials, equipment and services necessary to furnish and deliver to the job site, for installation by others, the Stage Lighting Fixtures and Accessories Package as indicated in the drawings, including but not limited to, the following:
   1. Stage lighting fixtures and accessories.
   2. Hanging hardware.
   3. Power and data cable jumpers.
   4. Miscellaneous items.

B. RELATED DRAWINGS
   1. Refer the following schedules on the drawings for a list of Stage Lighting Fixtures and Accessories to be provided.

1.3 SUBMITTALS WITH BID

A. Stage Lighting Fixture Supplier shall provide a list of all items with manufacturer's catalog numbers for each item.

B. Bid shall include a unit price for each item listed in the Stage Lighting Fixtures and Accessories Package
   1. Unit pricing may be used by the Owner to determine the value of any additions to or deletions from the equipment list.
   2. Failure to provide unit pricing may result in the disqualification of the bid.

~~C. Stage Lighting Fixture Supplier shall submit with bid the following time estimates~~
   ~~1. Length of time required to supply all equipment.~~
   ~~2. Length of time required to install all equipment.~~ **(ADDENDUM 01)**

1.4 SUBMITTALS

A. Stage Lighting Fixture Supplier shall submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Shop drawings shall include catalogue cuts of all items included in the Stage Lighting Fixtures and Accessories Package.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery shall be as required in the Contract Documents.
   1. Stage Lighting Fixture Supplier shall confirm the delivery dates with the Construction Manager and/or Owner a minimum of 30 days in advance of scheduled delivery.

B. Bid price shall include full freight and insurance charges for delivery of all equipment to the job site.

C. Deliver all material to the job site suitably crated, packed, and protected.
   1. Each crate or carton shall be clearly marked on the outside with the manufacturer's identification labels and the nomenclature of the product contained within.

D. Delivery and placement shall be coordinated with job site conditions, delivered prior to substantial completion yet after general construction and cleanup has been completed, so that fixtures remain in factory condition and safe from work site hazards.

E. Stage Lighting Fixtures and Accessories shall not be delivered until the job site is suitable. Equipment shall not be exposed to dust, paint, weather, or similar damaging conditions.

1.6 WARRANTY

A. The Stage Lighting Fixture Supplier shall assure that this equipment is provided free of defects in materials and workmanship and shall provide a warranty under this contract agreeing to make all applicable repairs, including replacement of materials, at no cost to the Owner for a period of one year from the date of final acceptance.

B. If, through no fault on the part of the Owner, the Stage Lighting Fixture Supplier is unable to meet the required delivery dates established at the time of the signing of an agreement, Stage Lighting Fixture Supplier agrees to furnish substitute equipment of the same quantity and of comparable type and quality to the job site.
   1. This equipment will be extended to the Owner at no additional cost until specified equipment is delivered.

1.7 MANUFACTURING STANDARDS

A. All work shall be manufactured in accordance with the latest editions of applicable publications and standards of the following organizations:
   1. National Electric Code (NEC) and all prevailing local and state regulations including:
      a. ANSI/NFPA 70: National Electrical Code
   2. Entertainment Services and Technology Association (ESTA) including:
      a. ANSI/ESTA E1.11-2008: USITT DMX512-A
      b. ANS/ESTA I E1.20-2010: Remote Device Management over USITT DMX512
      c. ANSI/ESTA E1.24-2012 (R2017): Dimensional Requirements for Stage Pin Connectors
      d. ANSI/ESTA E1.27-1-2006 (R2016): Portable Control Cables for DMX512

PART 2 - PRODUCTS

A. STAGE LIGHTING FIXTURES
   1. Stage lighting fixtures shall be supplied with all standard equipment, including the following, unless otherwise noted:
      a. Connector type as scheduled, with min 36”, three-wire lead, including separate power input lead with scheduled connector, if required.
      b. Center pivot type "C" clamp and yoke, or other hanging hardware as scheduled.
      c. One lamp per lamp socket, where applicable, as scheduled.
      d. One black safety cable.
      e. Gel frame
      f. All other accessories as noted on the Stage Lighting Fixtures and Accessories Schedules

B. POWER JUMPER CABLES
   1. Unless otherwise noted, all power jumpers shall be made of black type "SO" (extra hard usage) #12 cable and installed connectors as scheduled.
      a. All jumpers shall be made with strict observance of polarity.

   2. Two-fers shall be of black type "SJ" (junior hard service), three-conductor, #12 cable with installed connectors as scheduled.
      a. All two-fers shall be made with strict observance of polarity.
      b. ‘Y’ type splitters shall have molded splitter block.

   3. All PowerCON to PowerCON fixture to fixture Power Thru jumper cables shall be made of black type "SJ" (junior hard service), three-conductor, #12 cable with installed standard Neutrik PowerCON connectors.

C. DATA JUMPER CABLES
   1. Category Cable Jumpers
      a. Unless otherwise noted, all Category Cable data cable jumpers covered by this Specification shall be ‘tour-grade’ with RJ45 Ethercon connectors and heavy-duty jackets.
   2. DMX Cable Jumpers

a. Unless otherwise noted, all DMX data cable jumpers covered by this Specification shall be 'tour-grade' with 5-pin XLR connectors and heavy-duty jackets.

D. STAGE LIGHTING FIXTURES & ACCESSORIES

1. Provide the following fixtures and accessories for the Proscenium Theater:

Quantity	Description	Manufacturer & Model
36	575W Ellipsoidal spotlight	ETC Source 4
18	**19° lens tube for above**	**ETC (ADDENDUM 01)**
10	**26° lens tube for above**	**ETC (ADDENDUM 01)**
6	**14° lens tube for above**	**ETC (ADDENDUM 01)**
2	**36° lens tube for above**	**ETC (ADDENDUM 01)**
36	LED Spotlight	ETC ColorSource Spot
18	**19° lens tube for above**	**ETC (ADDENDUM 01)**
10	**26° lens tube for above**	**ETC (ADDENDUM 01)**
6	**14° lens tube for above**	**ETC (ADDENDUM 01)**
2	**36° lens tube for above**	**ETC (ADDENDUM 01)**
60	Pattern holders	
92	Top hats	
36	Barn doors	
12	Work light	Altman LED worklight
1	Ghost light	
1	HTI Followspot	**Lycian Super Arc 400 (ADDENDUM 01)**
24	5' **stage pin** jumper cable **(ADDENDUM 01)**	
24	10' **stage pin** jumper cable **(ADDENDUM 01)**	
24	25'**stage pin** jumper cable **(ADDENDUM 01)**	
18	50' **stage pin** jumper cable **(ADDENDUM 01)**	
8	100' **stage pin** jumper cable **(ADDENDUM 01)**	
24	**5' DMX jumper cable (ADDENDUM 01)**	
24	**10' DMX jumper cable (ADDENDUM 01)**	
24	**25' DMX jumper cable (ADDENDUM 01)**	
12	**50' DMX jumper cable (ADDENDUM 01)**	
6	**100' DMX jumper cable (ADDENDUM 01)**	
12	5' LED fixture daisy-chain cable	ETC PowerThru cable
12	10' LED fixture daisy-chain	ETC PowerThru cable
6	**2-port Portable DMX Gateway**	**ETC (ADDENDUM 01)**

2. Provide the following fixtures and accessories for the Multi-Purpose Room:

Quantity	Description	Manufacturer & Model
36	575W Ellipsoidal spotlight	ETC Source 4
12	5’ jumper cable	
12	10’ jumper cable	
12	25’ jumper cable	
8	50’ jumper cable	
4	100’ jumper cable	

PART 3 - EXECUTION

3.1 LIGHTING FIXTURE PREPARATION

A. After delivery, each stage lighting fixture shall undergo the following:
1. Unpacking from carton.
2. Assembly as required.
3. Installation of lamp
4. Installation of scheduled connector.
5. Installation of C-clamp and all associated hardware, including safety cable.
6. Software configuration and firmware updates as required.

3.2 INSTALLATION

A. Deliver Stage Lighting Fixtures and Accessories for Owner’s use and installation. Installation labor is not included in the scope of this Specification.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Upon delivery, the Manufacturer shall provide Operation and Maintenance manuals in quantity identified in Division 1, bound in hard ring binders. Minimum of three manuals shall be furnished to Owner, one bound hard copy and two electronically on portable USB drives.
1. Inventory of Stage Lighting Fixtures and Accessories delivered.
2. Catalog cut sheets for all device types.
3. Maintenance and care instructions and recommendations.
4. Warranty information.

END OF SECTION 116109

ADDENDUM 01, 11 DECEMBER 2019

SECTION 116113 – THEATRICAL DRAPERY AND TRACK (FOR INFORMATIONAL PURPOSES ONLY) (ADDENDUM 01)

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section includes all labor, materials, equipment, and services necessary to manufacture and deliver to job site and install the stage drapery as shown on the drawings and/or specified herein, including, but not limited to, the following:
   1. Velour bi-parting curtains and associated fully-rigged split traveler tracks.
   2. Velour leg, tab, border, and blackout curtain panels.
   3. Muslin cyclorama panels and associated bottom weight pipe.
   4. Cotton scrim and associated bottom weight pipe.
   5. Walk-along curtain track and hardware.
   6. Storage hampers.

B. It shall be the responsibility of the Stage Drapery Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications whether or not such items are herein specified or indicated.

1.2 GENERAL

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

B. Related work in other Sections
   1. Division 11: Theatrical Rigging Systems; Theatrical Pipe Grid.

C. Site Conditions: Contractor shall be responsible for verifying that the job conditions are ready to receive work in this section. Contractor must alert the Construction Manager to any existing conditions that may adversely affect execution of work, so that resolution may be reached before commencement of installation.

1.3 SUBMITTALS

A. Submittals shall be according to the Conditions of the Contract and Division Specification Sections.

B. Prior to fabrication, Stage Drapery Manufacturer shall submit for review a 1/2 yard x full width minimum size sample of each color of each fabric type.
   1. Each sample shall be provided with labels listing Manufacturer and Manufacturer's identification numbers.
   2. Work shall not commence on fabrication until review of samples has been transmitted to the Stage Drapery Manufacturer.
   3. Submit Manufacturer's color line samples to the Specifier to verify color selections.

a. Dye lot to be guaranteed by Manufacturer.

4. For custom color drapery, submit Manufacturer's lab dip sample matching control sample furnished by Architect.

a. Lab dip dye lot to be guaranteed and maintained by Manufacturer after approval.

C. Prior to providing shop drawings and fabrication, dimensions shall be verified by field measurements.

1. After field measurements are taken, Stage Drapery Manufacturer shall provide information as to exact dimensions of drapery items and areas affecting drapery sizes.
2. This information will be used to coordinate work with other trades and to verify that all drapery items have been accounted for.
3. No extras will be allowed due to the Stage Drapery Manufacturer's misunderstanding as to the amount of work involved or lack of knowledge of any field conditions based on neglect or failure to make field measurements or thorough investigation of the job site.

D. Shop Drawings shall be submitted for review before fabrication can begin. Such review does not relieve the Stage Drapery Manufacturer of the responsibility of providing equipment in accordance with this Specification.

1. Shop Drawings shall show each type of curtain track plus the method and equipment to be used in hanging the curtain track.
2. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
3. Where welded connections or concrete or masonry inserts are required to receive work, shop drawings shall show exact locations required and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts.
4. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.

E. Furnish Operations and Maintenance manuals containing record shop drawings, operation instructions and recommended maintenance procedures for all equipment, in quantity outlined in Division 01.

1.4 WARRANTY

A. Manufacturer agrees to make all repairs, including replacement of materials, made necessary due to defects in workmanship and materials without additional cost to the Owner for a period of two years from the date of acceptance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 01 – Work-Related Requirements for transporting, handling, storing, and protecting products.

B. Bid price shall include full freight and insurance charges for the delivery of all drapery items to the job site.

C. If, through no fault of the Owner, the timely completion of the work of this section is imperiled, the Drapery Manufacturer shall prevent or minimize any delay by shipping the required products by airfreight, at no additional cost to the Owner.
   1. This requirement covers initial delivery of fabrics to the Drapery Manufacturer, and delivery of finished drapery to the job site.

D. Each drapery item shall be carefully wrapped and sealed tight for shipment in rigid and waterproof wrapping material to insure against impact and water damage during shipment.

1.6 MANUFACTURERS

A. Manufacturers for work in this section shall include the following:
   1. Beck Studios, Inc – Milford, OH
   2. BellaTEX Stage Curtains – Jackson, TN
   3. iWeiss, Inc. – Fairview, NJ
   4. Rose Brand East – Secaucus, NJ
   5. Stage Decoration and Supplies – Greensboro, NC
   6. Tiffin Scenic, Tiffin, OH

1.7 INSTALLATION CONTRACTORS

A. The Stage Drapery Contractor shall have been continuously engaged in the installation of stage drapery for at least 10 years.

B. The Stage Drapery Contractor shall have installed a total of not less than five installations of equal or greater scope to system specified herein, manufactured and installed by the bidder.

C. Pre-approved Stage Drapery Contractor for Work of this Section shall include:
   1. Beck Studios Inc.
      1001 Tech Drive
      Milford, OH 45150
      Contact: Dan Ilhardt dan@beckstudios.net
      513-831-6650

   2. Chicago Flyhouse
      2925 W. Carroll Ave.
      Chicago, IL 60612
      Contact: Benjamin Cohen bcohen@flyhouse.com
      773-533-1590

   3. I. Weiss
      815 Fairview Avenue, Unit 10
      Fairview, NJ 07022
      Contact: Jennifer Tankleff JenniferT@iweiss.com
      888-325-7192

4. J.R. Clancy, Inc.
   7041 Interstate Island Rd.
   Syracuse, NY 13209
   Contact: Mike Murphy mikemurphy@jrclancy.com
   800-836-1885

5. Scenic Solutions
   355 Gargrave Road
   West Carrollton, OH 45449
   Contact: Andrew Persson Andrew.Persson@scenicsolutions.com
   941-806-7798

6. Stage Rigging Services (SRS)
   831 Winston Street
   Greensboro, NC 27405
   Contact: Les Martin lmartin@srsrigging.com
   336-370-1900

7. Texas Scenic
   5423 Jackwood Dr.
   San Antonio, TX
   Contact: Roy Harline r.harline@texasscenic.com
   800-292-7490

8. Tiffin Scenic Studios
   P.O. Box 39
   Tiffin, OH 44883
   Contact: Steve Everhart severhart@tiffinscenic.com
   800-445-1546

~~1.8 The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:~~
~~A. 11 61 23 - Theatrical Rigging~~
~~B. 11 61 29 - Pipe Grids~~ **(ADDENDUM 01)**

PART 2 - PRODUCTS

2.1 FABRICS

A. All fabrics shall be inherently flame retardant and shall meet all requirements of NFPA #701, Large and Small Scale.
   1. All finished goods shall be furnished by the Stage Drapery Manufacturer to the Owner with proper affidavit of flame proofing in the form acceptable to local authorities.

B. The following fabrics are approved for drapery use:
   1. Stage legs, borders, blackouts, and acoustic drapes shall be in manufacturer standard colors to be selected by Specifier, using following fabric:
      a. *Charisma*, 25 oz. Trevira CS, 54" wide, IFR, supplied by KM Fabrics, Greenville, SC.

2. Muslin cyclorama shall be white Travira IFR, seamless.
3. Scrim shall be black cotton sharkstooth weave, FR, seamless.

2.3 TIE LINE, GROMMETS, WEBBING

A. Grommets shall be #2 or #3 brass type.

B. Tie lines shall be #4 braided masonry line, 36" long and black in color, unless otherwise noted.

C. Webbing shall be 3” wide, polypropylene type.

2.4 DRAPERY

A. General:
1. All velour shall be stitched with nylon thread and shall be without flaws, with each width of cloth continuous for the full height of the drapery with no horizontal seams or piercing.

B. Velour Bi-Part Curtain Panels:
1. Each panel shall be sewn with vertical seams and fullness as noted on drapery schedule.
2. Sew on to webbing 12” o.c. with snap hooks attached with nylon straps and two (2) rivets per hook.
3. Provide a minimum 4" turn back on offstage side edge.
4. Provide a minimum 26” turn back on onstage side edge.
5. Provide a 6" deep hem at the bottom with a separate, chain filled #8 canvas or nylon pocket.

C. Velour Borders:
1. Each panel shall be sewn with vertical seams and fullness as noted on drapery schedule.
2. Sew fullness into the fabric using box pleats.
3. On pleated drapes, vertical seams are to be hidden within the folds of the fabric.
4. Sew onto webbing with grommets at 12" o.c. with tie lines attached for each.
5. Provide a 4" turn back on each side edge.
6. Provide a 6" deep hem at the bottom with a separate, chain filled #8 canvas or nylon pocket.

D. Velour Legs, Tabs and Blackouts:
1. Each panel shall be sewn with vertical seams and fullness pleated in as noted on drapery schedule.
2. Sew fullness into the fabric using box pleats.
3. On pleated drapes, vertical seams are to be hidden within the folds of the fabric.
4. Sew onto webbing with grommets at 12" o.c. with tie lines attached for each.
5. In addition to tie lines, sew on to webbing 12” o.c. with snap hooks attached with nylon straps and two (2) rivets per hook.
6. Provide a 4" turn back on each side of legs.

7. Provide a 6" deep hem at the bottom with a separate, chain filled #8 canvas or nylon pocket.

E. Sharkstooth Scrims:
1. Scrim shall be made up of seamless sharkstooth scrim material in color noted on drapery schedule.
2. Sew scrim onto webbing at the top and face the scrim with a piece of 3" wide #8 canvas sewn through the scrim to the webbing with grommets at 12” o.c., furnished with tie lines.
3. Scrim to have a 6" bottom hem which acts as a "flap" to mask pipe and chain pockets.
4. Provide a 4" #8 canvas or nylon pocket for 1/2" pipe sewn onto the back of the scrim at the bottom. Provide reinforced openings in pocket at 10’ centers for optional partial piping.
6. At each side of the scrim, provide a 4" reinforced turn back hem.

F. Cyclorama Panels:
1. Cyclorama shall be sewn from IFR muslin, 128” width, dyed to CBS gray color.
2. Sew onto webbing at the top with double layer hemmed fabric, with grommets at 12” o.c., furnished with white tie lines.
3. Cyc panel to have a 6" hem which acts as a "flap" to mask pipe and chain pockets.
4. Provide a 4" #8 canvas or nylon pocket for 1/2" pipe sewn onto the back of the bottom hem. Provide reinforced openings in pocket at 10’ centers for optional partial piping.
5. At each side of the cyc panel, provide a 4" reinforced turn back hem.

2.5 DRAPERY SCHEDULES

A. Refer to drawings for drapery panel schedule indicating quantity, width, height, and type.

B. Drapery Manufacturer shall field verify all dimensions prior to fabrication. Any errors in finished size due to failure to properly verify field conditions will result in re-manufacture of any draperies not in compliance, at sole expense of the Manufacturer.

C. Labeling of each drapery panel shall be by means of a cotton or synthetic duck tag sewn securely to the webbing at top right hand corner of each finished piece. Each tag shall contain the following, marked using indelible black ink:
1. Type of panel (ex: Leg, Traveler #1 S.R., etc.)
2. Panel dimensions (ex: 8’-0”w x 24’-0”h)
3. Material type and weight (ex: 25oz IFR Velour)

D. Border, Scrim, and Cyclorama panels shall have the panel center line indelibly marked on the top rear webbing, and shall have a contrasting color center tie line.

2.6 CURTAIN TRACKS

A. Bi-Parting Traveler Drapery Curtain Tracks:

1. Furnish and install all hardware required for cord operated ADC #282 or H&H #416S curtain track system in lengths and locations as shown on the drawings.
   a. Track shall be furnished in minimum 14 gauge galvanized steel construction.
   b. Equip with backpack/rear fold devices for offstage curtain gathering.
2. System shall be suspended from structure or pipe battens as indicated on drawings, in a manner that permits adjustment of height as well as simple re-positioning of the system when required for various productions.
3. Track shall be in a continuous straight length, with minimum number of segments joined to complete the lengths indicated.
4. Support tracks from suspended pipe battens or from building structure at manufacturers recommend spacing as required. Additional supports required within 1’ of the end of any track.
5. System shall be furnished complete with all necessary accessories (CWANA), including hanging clamps, track splices, master carriers, single carriers, rubber bumpers, center pipe supports, back-pack guides, and end stops for all tracks.
   a. Furnish adequate carriers to serve number of drapery grommets indicated for drapery scheduled for each track system, plus 10% spare carriers

A. Walk Along Curtain Tracks:
1. Furnish and install all hardware required for walk along ADC #143 or H&H #301W curtain track system in lengths and locations as shown on the drawings.
2. Where tracks are suspended, as indicated on drawings, they shall be hung in a manner that permits adjustment of height as well as simple re-positioning of the system when required for various productions.
3. Track shall be in a continuous straight length, with minimum number of segments joined to complete the lengths indicated. Provide curves as shown on drawings.
4. Support tracks from suspended pipe battens or from building structure at manufacturers recommend spacing as required. Additional supports required at each track bend, switch location, and within 1’ of the end of any track.
5. System shall be furnished complete with all necessary accessories (CWANA), including factory curves (trim to adjust as required), hanging clamps, track splices, master carriers, single carriers, rubber bumpers, and end stops for all tracks.
   a. Furnish adequate carriers to serve number of drapery grommets indicated for drapery scheduled for each track system, plus 10% spare carriers
6. Furnish track switchers in quantity and orientation indicated on drawings. Switchers shall be configured for rope and pole operation options, to permit Owner to choose method of use.
   a. Furnish one operating pole for each switcher.

B. Verify all track lengths in the field before fabrication.

2.7 ACCESSORIES

A. Furnish 1/2" NPS schedule 40 steel pipe or 3/4” IMT conduit, threaded and coupled, for use as curtain panel bottom stretcher.
1. Provide enough 10’ lengths of bottom pipe for all items listed in the schedules as having a pipe pocket.

2. Provide six additional 10’-0” lengths, and four 5’-0” lengths.
2. Provide one end cap and one pipe coupler for each pipe segment, to protect fabric during insertion of pipe and to permit joining of segments.

B. Furnish five 16-bushel rolling storage hampers with canvas liner and plywood hinged lid, for storage of stage drapery when not in use.
1. Liner shall be heavy duck canvas, plain white color, sewn onto frame with top reinforcement. Fabric loop handles shall be sewn at each end of liner.
2. Hamper frame shall be spring steel, welded to bottom plate steel.
3. Chassis shall be hardwood runners with caster boards.
4. Casters shall be 4” diameter swiveling with rubber or phenolic treads.
5. Basis-of-Design Manufacturer: Dandux by C. R. Daniels Inc.

PART 3 EXECUTION

3.1 GENERAL

A. Examine all conditions under which all items in the section shall be installed and notify the Construction Manager in writing of any condition detrimental to the proper and timely completion of the installation.

B. Responsibility for the satisfactory completion of the work in this section shall rest solely and exclusively with the Stage Drapery Manufacturer.

C. Field verify condition of delivered goods, and repair or replace any components not in factory new condition. All materials shall remain covered or protected from debris, dust, paint, and other site hazards throughout the period between delivery to site and Owner training.

D. Manufacturer shall be responsible for repairing any damage to jobsite surroundings during installation.

E. Installation and training shall be supervised by the Stage Drapery Manufacturer’s experienced supervisor, who shall have extensive installation experience with systems similar to those specified herein. This same supervisor shall remain in charge throughout the entire installation and training process, with exception only for circumstances completely beyond the control of the Manufacturer.

F. All components shall be installed plumb, straight, and true, and shall function as designed. Anchors, connecting members, brackets, and associated fastening means and methods for properly supporting and bracing equipment shall be furnished and installed following best suitable practice for each condition.

G. Prior to the completion of the installation, the Stage Drapery Manufacturer shall notify the Construction Manager to arrange on a date for inspection of the system.
1. At the time of the inspection, the Stage Drapery Manufacturer shall furnish sufficient personnel to operate all equipment and to perform adjustments and tests as may be required by the Owner's representatives.

2. Any equipment that fails to meet with the Specifications shall be repaired or replaced with new equipment, and the inspection shall be re-scheduled under the same conditions listed previously.
3. Final review will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every circumstance.

3.2 OWNER TRAINING

A. Manufacturer's installation Supervisor shall perform up to four hours of Owner training to the Owner's representatives.

B. Training shall include:
1. Operation of curtain tracks and switchers.
2. Installation, dismantling, and storage of draperies.
3. Care and maintenance.
4. Warranty review.

C. Class size is limited to six participants/crew and shall include at minimum:
1. Technical Director
2. Scene Shop Supervisor

D. Contractor shall schedule instruction with the Owner's designated representatives.

E. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.

F. Written documentation of Owner training shall be provided to the Owner upon completion.
1. Form to include:
a. The date, time, and location of training.
b. Name, title, company and signature of trainer.
c. Name, title, and signature of all participants.
d. Topics covered at training.
2. If training is non-continuous, provide one form for each training segment.

G. Training may be video and audio recorded by the owner at the owner's expense.

END OF SECTION 116113

SECTION 116123 – THEATRICAL RIGGING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK OF THIS SECTION

A. This Section includes all labor, materials, equipment, and services necessary to furnish and install the Stage Rigging System as shown on the drawings and/or specified herein, including but not limited to the following:
   1. Rigging of stage lighting system multicables.
   2. Seven variable speed motorized package hoists.
   3. Emergency stops.
   4. One automated rigging controller with remote.
   5. One push-button rigging controller.
   6. 16 dead-hung pipe battens.
   7. Fixed lighting pipes.
   8. Pin rails.
   9. Miscellaneous equipment listed herein and on schedules, for installation by others.
   10. Mule blocks, idler sheaves, cable rollers or guides as required assuring proper alignment and operation of the rigging system.

B. It shall be the responsibility of the Stage Rigging Contractor to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications whether or not such items are herein specified or indicated.

1.3 PROJECT CONDITIONS

A. All dimensions shall be verified in the field prior to fabrication by the Stage Rigging Contractor, who shall make at least one visit to the job site prior to preparation of shop drawings.

B. No extras will be allowed due to the Stage Rigging Contractor's misunderstanding of the work involved or its lack of knowledge of any field conditions due to failure to make accurate field measurements or a thorough investigation of the job site.

1.4 SUBMITTALS

A. Stage Rigging Contractor shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.

B. Shop Drawings shall be submitted for review by the Architect before fabrication can begin. Such review does not relieve the Stage Rigging Contractor of the responsibility of providing equipment in accordance with this Specification.

C. Shop Drawings:
1. Shop Drawings shall show dimensions, sizes, gauges, thicknesses, finishes, joining, attachments and relationship of work to adjoining construction.
2. Shop drawings shall clearly show power, wire, and conduit requirements for all work to be provided by the Stage Rigging Contractor.
3. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
4. Where other materials must be set to exact locations to receive rigging, furnish assistance and directions necessary to permit other trades to locate their work.
5. Where welded connections, concrete or masonry inserts are required to receive work, shop drawings shall show exact locations required and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts.
6. Show locations of all lubrication points.
7. Shop drawings for motorized equipment shall include engineering and load calculations as well as stamp and seal of a registered professional engineer.
8. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.
9. Shop drawings shall include a copy of the installation superintendent’s ETCP Certified Rigger - Theatre certification. A copy of the installation superintendent’s ETCP certification shall be available on the job site for the length of the installation.

D. Any deviation from this Specification shall be "starred" and noted in letters a minimum 1/4" high.
1. For a deviation to be considered, it must upgrade the quality of the equipment or respond to a field condition.

E. The Stage Rigging Contractor shall, if requested by the Owner or Architect, furnish satisfactory evidence as to the kind and quality of materials he proposes to furnish by submission of exact samples of hardware to be used in this contract.
1. The samples shall be retained by the Owner until such time that this contract has been completed and accepted.

F. Upon completion of installation, Stage Rigging Contractor shall provide Operation and Maintenance manuals that shall include record shop drawings, parts lists, operational instruction, service/maintenance recommendations, component working load limits, etc.
1. One O&M manual shall be a printed hard copy.
2. O&M manual shall also be provided in electronic format on two flash drives.

G. Rigging System Log Book:
1. At Owner training, furnish a system log book, configured to permit Owner tracking of inspections, system issues and maintenance history. Provide overview of observations and actions that should be documented for appropriate record keeping and compliance with industry standards for safety. Log book shall include:
a. Schedule and ID of all installed rigging sets (manual and motorized).

b. Identification of design parameters for each set, including high and low trim limits, set live loading capacity, hoist configuration settings, etc.
c. Log sheet for periodic system-wide inspections, including commissioning date of system as first entry.
d. Journal fields for each set to document date, status, observations, actions taken, and resolution.

1.5 WARRANTY

A. The Stage Rigging Contractor shall assure that the rigging is properly installed, free of defects in materials and workmanship and shall provide a warranty on all equipment and workmanship provided under this contract for a period of two years from the date of the final acceptance.

B. During the warranty period, repair or replacement of defective materials and faulty workmanship shall be provided, at no cost to the Owner, within 10 days of written notification of defects(s).

C. Post Installation Safety Inspection:
1. One year after the date of final acceptance by the Owner, the Stage Rigging Contractor Supervisor shall return to the job site to conduct a thorough inspection of the rigging installation.
   a. All bolts shall be checked and tightened as required, cables and all cable connections inspected, and all items given a thorough safety inspection in compliance with ANSI E1.47, Entertainment Technology – Recommended Guidelines for Entertainment Rigging System Inspections.
   b. All damage not caused by negligence on the part of the Owner shall be repaired and/or damaged components replaced.
   c. If the original supervisor is unavailable either because the supervisor no longer works for the contractor or due to issues fully beyond the control of the contractor, then an alternate rigger superintendent shall perform the inspection, under the following conditions:
      1) The alternate superintendent shall be ETCP-RT certified.
      2) The alternate superintendent shall have experience supervising installation on projects of similar scope and scale.
2. All materials, superintendent labor, transportation and living expenses for this work shall be furnished by the Stage Rigging Contractor at no additional cost to the Owner.
   a. The inspection and repair work shall be conducted during normal working hours at a time mutually agreed upon by the Owner and the Stage Rigging Contractor.
3. Within two weeks of the completion of the inspection, the Stage Rigging Contractor shall provide the Owner and Architect with a written report stating the findings of the inspection.

1.6 STAGE RIGGING MANUFACTURERS / STAGE RIGGING CONTRACTORS

A. The Stage Rigging Contractor shall have been continuously engaged in the production of theatrical stage rigging equipment for at least 15 years.

B. The Stage Rigging Contractor shall have installed a total of not less than five installations of equal or greater scope to system specified herein, which have been in service for a minimum of one year and a maximum of 10 years.
   1. Each of the listed stage rigging installations shall be in service in fully professional commercial theatres being operated by professional technicians.

C. Stage Rigging Manufacturers for work of this section shall include:
   1. Electronic Theatre Controls (ETC)
      3031 Pleasant View Rd.
      Middleton, WI 53562
      Contact: Gary Henley gary.henley@etcconnect.com
      800-688-4116

   2. J.R. Clancy, Inc.
      7041 Interstate Island Rd.
      Syracuse, NY 13209
      Contact: Mike Murphy mikemurphy@jrclancy.com
      800-836-1885

D. Stage Rigging Contractors for work of this section shall include:

   1. Integrated Theater Systems
      117 Roup Avenue
      Pittsburgh, PA 15206
      (412) 441 8000

   2. Vincent Lighting
      920 Vista Park Dr.
      Pittsburgh, PA 15205
      (412) 788-5250

   3. Chicago Flyhouse
      2925 W. Carroll Ave.
      Chicago, IL 60612
      773-533-1590

   4. J.R. Clancy, Inc.
      7041 Interstate Island Rd.
      Syracuse, NY 13209
      800-836-1885

   5. Stage Rigging Services (SRS)
      831 Winston Street
      Greensboro, NC 27405
      336-370-1900

6. Texas Scenic
   611 Lofstrand Ln #A
   Rockville, MD 20850
   (301) 874-1747

7. 4Wall Entertainment
   9525 Berger Rd,
   Columbia, MD 21046
   (410) 242-3322

8. Barbizon Lighting
   6437 General Green Way #2413
   Alexandria, VA 22312
   (703) 750-3900

E. The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
   ~~1. 11 61 13 – Theatrical Drapery and Track~~ **(ADDENDUM 01)**
   1. 11 61 29 – Pipe Grids and Fixed Lighting Pipes

PART 2 PRODUCTS

2.1 MATERIALS

A. Ferrous materials and accessories shall conform to the following ASTM and ANSI standard specifications:
   1. Standard structural steel shapes and plates: ASTM A-36.
   2. Miscellaneous steel items: ASTM A-283, grade optional.
   3. Steel pipe: ASTM A-120
   4. Gray iron castings: ASTM A-48, Class 30 unless otherwise specified.
   5. Malleable iron castings: ASTM A-47
   6. Bolts and nuts: B18.2.1&2
   7. Welding electrodes shall be as permitted by AWS Code D1.0.

B. Wire Rope and Fittings
   1. Wire rope shall be 7x19 construction, utility cable, sized as required, that meets Federal Specification RR-W-410E.
      a. Damaged or deformed cables shall not be used.
   2. Cable fittings shall be Nicopress copper sleeves or forged steel clips and conform to wire rope manufacturer's recommendations as to size, number and method of installation.

C. Aluminum Materials and Accessories
   1. Thicknesses, gauges and tempers of aluminum products shall be as required for proper forming operations and to meet structural standards.
   2. Aluminum Castings: 214 or 356 alloy as per strength requirements.

3. Fasteners: Include bolts, nuts, washers, screws, nails, rivets and other fastenings necessary for proper erection and/or assembly of aluminum work.
4. Fabrication shall be by AWS certified welders.

D. Finishes for Items Without Factory Finish
1. Welds, burrs, and rough surfaces on all interior ferrous metals shall be ground smooth and the completed assembly cleaned, and all metal surfaces shall be given a minimum one coat of finish paint.
2. No painted finish is required on aluminum finishes.
3. All exposed fastenings shall match color and finish of adjacent material.

2.2 SAFETY STANDARDS

A. To establish minimum standards of safety, the following factors shall be used:

1.	Cables and fittings	8:1 Safety Factor
2.	Terminating hardware:	5:1, or not exceeding WLL, whichever is more restrictive.
3.	Trim chain assembly:	5:1, or not exceeding WLL, whichever is more restrictive.
4.	Batten clamps:	5:1, or not exceeding WLL, whichever is more restrictive.
5.	Motors:	1.0 Service factor
6.	Gearboxes:	1.25 Mechanical Strength Service Factor
7.	Cable bending ratio:	Sheave diameter is 30 times diameter of cable
8.	Tread pressures:	500# for cast iron, 900# for Nylatron ,1000# for steel
9.	Maximum fleet angle:	1-1/2 degrees
10.	Steel:	1/5 of yield
11.	Bearings:	L10 life of 2000 hours at two times required load at full speed
12.	Bolts:	Grade 5 or better, plated

2.3 SIGNAGE

A. Provide and install signs with white background and 3/8" high red letters to be mounted on the wall on the stage level, fly gallery level, and loading bridge level at a position that is conspicuous to workers performing rigging work.
1. The signs shall read as shown on the drawings.
2. “Date of Last Inspection” and “Date of Next Required Inspection” information shall be in erasable marker.

2.4 VARIABLE SPEED MOTORIZED LINESETS

A. Provide four motorized, 1,200# capacity linesets, each with variable speed motorized winch, head blocks, loft blocks, 7x19 pickup cables, and pipe batten as shown on the drawings.
1. Manufacturer shall be responsible for steel, hardware, etc. required to provide means of attachment of the motorized linesets to building structure.

B. Provide three motorized, 1,800# capacity linesets, each with fixed speed motorized winch, head blocks, loft blocks, 7x19 pickup cables, and pipe batten as shown on the drawings.
1. Manufacturer shall be responsible for steel, hardware, etc. required to provide means of attachment of the motorized linesets to building structure.

C. Each motorized set shall be U.L. approved and include the following:
   1. Electric motor with gearbox, starter and brake-motor.
      a. The motor shall be 480-volt type and have a minimum AGMA service factor for 1.0 for continuous operation and the gearing service factor shall be a minimum of 1.0 with a mechanical strength factor of 1.3.
      b. Motor shall have ramp up/down providing “soft start” and “soft stop” capability to lessen impact load when motor starts and stops
   2. The variable hoist lifting speed shall be variable from 0’ to 120’ per minute.
   3. Provide minimum 5 mechanical limit switches including over travel high, high, low and over travel low.
   4. Linesets shall have overload sensors on each lift cable.
   5. Linesets shall have slack line detection sensors on each lift cable.

D. Head blocks:
   1. Each head block shall be underhung, multi-sheave type and have at least six pipe spacers, through bolted to the side plates, to prevent cables escaping from the sheave grooves.
   2. The 12" diameter cast or nylon sheaves shall be machined, faced, lathe turned and grooved for the liftline cable.
      a. Grooves shall conform to cable manufacturer's recommendations.
   3. The sheaves shall operate on a 1" diameter steel shaft mounted in tapered roller bearings with felt seals press fitted in the head block bore.
      a. The head block shaft shall be keyed to one side plate or otherwise restrained to prevent rotation.
      b. Proper adjustment of the bearings to be accomplished by "Flexloc" self-locking nut on the opposite side of the shaft.
   4. Side plates shall be fabricated of not less than 10-gauge steel and each side plate shall be welded to the base angle.
   5. Each head block shall be furnished with support angle irons, sized to support the specified loads.
      a. Provide a minimum of two bolts per base angle, sized for the specific load, or mounting clips of sufficient size.
   6. When completely installed, each head block shall be aligned so that each sheave, its center and sides, remain in the same vertical axis when the sheave is rotated.

E. Loft blocks:
   1. Loft blocks shall be underhung and shall have an 8" diameter nylon sheave with a hub of at least 2" in diameter.
   2. Sheaves shall have a lathe turned cable groove of required size plus 1/64" clearance.
      a. The sheaves shall be machined, faced and bored for shaft and bearings.
   3. Each loft block sheave shall contain two tapered roller bearing assembles operating on a 1/2" diameter steel shaft or sealed precision ball bearings on a 5/8" diameter steel shaft.
      a. The head of the shaft to be keyed to one side plate and the opposite end of the shaft shall be threaded and equipped with "Flexloc" self-locking nut to prevent shaft from rotating.
      b. Side plates shall be a minimum of 11-gauge steel.

F. Mule blocks:

1. The component parts of all mule blocks shall meet the same specifications as the head blocks, except that sheave shall be 10" in diameter, provided with suitable universal joint swivel bases and mounting stands or bracket to meet the job conditions.

G. Idler blocks:
1. Idler blocks shall consist of one or more sheaves contained within an assembly to provide only vertical support of the lift lines.
2. Idler blocks shall be mounted to loft blocks or from building structure.

H. Pipe Battens:
1. Single pipe battens shall be constructed of 1-1/2” NPS, schedule 40 steel pipe.
2. All joints shall be sleeve spliced with 18" long sleeves, 9" extending into each pipe. The pipe sections of each set shall be bolted through the sleeve with two 3/8" x 1” hex head, grade 5 bolts. Holes shall be drilled in pipes and sleeves so that all pipe sections are interchangeable.
3. Battens shall be painted black. The last 12” at each end of the truss and pipe batten shall be painted white or shall have yellow plastic end caps.
4. Each batten shall have its centerline marked with a 1/2” painted yellow line around the circumference of the bottom pipe.
5. Each batten shall have 1’ increments marked around the circumference of the batten, starting at center and working out to the ends, with 1/2” wide, white painted lines.
6. At each liftline point, provide a red tape mark on each side of the trim chain for the full circumference of the top pipe.
7. Each batten shall have its line set number in 1” high white numerals on the top and bottom of each batten 18” from each end, and 12” stage left of the centerline mark.
8. Liftline batten connections shall be trim chains.

I. Liftline Cables:
1. All liftline cables shall be 7 x 19 utility cable and shall be free of oil. Certification will be required.

J. Trim Chains:
1. Trim chain shall be either J.R. Clancy Grade 63 *AlphaChain* or SECOA *STC* chain, with 3,250# working load and meeting OSHA 1910.184(e)(5) – Sling use, 36" long, and used at the batten end of the pickup cables.
2. One end of the trim chain shall connect to liftline with thimbles and Nicopress sleeves.
3. The other end of the trim chain shall be fitted with a 1/4" screw-pin shackle.

2.5 VARIABLE-SPEED AND FIXED-SPEED STAGE RIGGING CONTROL PANEL:

A. General:
1. The controller shall be wall mounted at a height to provide ADA mandated accessibility.
2. Controller shall have remote control pendant with 30’-0” cable and plug in locations at stage left and stage right.

B. Control Interface:
1. An operator control panel shall be provided that features “Go Up”, “Go Down”, and “Go Target” pushbuttons and a Joystick for dynamic override of pre-programmed speeds.
2. Dual Playback Controls

a. Two separate GO buttons and a joystick. Any system that does not allow dynamic change of recorded hoist speed is not acceptable.

3. Show data shall be backed up automatically at regular intervals, and by user command to a solid-state flash drive system.
4. Five modes of operation shall be supported:
   a. Direct Operation - One or more sets can be selected and operated manually
   b. Single Target - One or more sets may be selected and sent to a common target height
   c. Multiple Targets – Multiple sets may be selected and sent to differing target heights
   d. Relative Target - One or more sets can be selected and sent to specific distances from their present positions.
   e. Current Position as Target – One or more sets may be moved, then returned to their starting positions. For example, a stage electric might be lowered to change gels, then accurately returned to its previous position.

C. Recorded Cues and Presets:
1. An operator recording cues and presets may specify:
   a. Target position – a specific target position, a relative move (e.g. go out 10′), or a match to a present or previous position.
   b. Acceleration – a set specific rate or a default value
   c. Speed - a velocity, a percentage of full speed, or a travel time. Default values also supported.
   d. Deceleration - A set specific rate or a default value
   e. Number of hoists controlled – each with its own speed and target
   f. Synchronized Groups
   g. Cue and preset names and labeling

D. Safety Requirements:
1. For safety, movement may be initiated only by hold to run (dead man) hardware pushbuttons or joysticks.
2. A console-controlled limit function shall allow the operator to set “soft” upper, lower and preset limits for each encoder-equipped hoist.
3. Where the load monitoring option is specified, the control system shall be capable of “learning” the load characteristics and monitoring load changes. The load monitoring system shall accommodate change to the suspended weight of electric cables and other predictable variables, without false tripping.
4. The system shall include password-protected for “Access”, “Edit” and “System” levels of operation at a minimum. Additional user levels shall be password-protected and created as directed by Owner.
5. Height and distance data may be entered as feet and inches, decimal feet, or metric units as directed by the Owner.
6. A mushroom head "EMERGENCY STOP" button wired to a failsafe circuit that conforms to NPFA 79 requirements shall be provided.
7. An "ON/OFF" key operated switch shall be provided that removes power to the console, motor starters and drives. Any control system that requires motors and drives energized while the system is not in use is not acceptable.

E. Remote Hand-Held Pendant Controller w/ E-Stop:

1. Provide one remote motorized winch line set controller that allows separate control of the line sets and contains the same programming modules as the Main Controller.
2. Pendant shall have an E-stop that meets the requirements above.
3. Provide Pendant Controller with 30’-0” of control cable.
4. Pendant controller shall connect into the main controller and remote-control receptacles.

2.6 FIXED, DEAD-HUNG, PIPE BATTENS

A. Provide 16 fixed, dead-hung pipe battens and 7x19 pickup cables as shown on the drawings.

B. Manufacturer shall be responsible for steel, hardware, etc. required to provide means of attachment of the fixed battens to building structure.

2.7 FIXED LIGHTING PIPES

A. Provide fixed lighting pipes in the proscenium theater as shown on the drawings at the following locations:
1. House left near and far box booms
2. House right near and far box booms
3. Front wall of control room

B. Manufacturer shall be responsible for steel, hardware, etc. required to provide means of attachment of the fixed lighting pipes to building structure.

C. Coordinate with structural and architectural finishes.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine all conditions under which all theatrical rigging items shall be installed and notify the Construction Manager in writing of any condition detrimental to the proper and timely completion of the work.

B. Responsibility for the satisfactory completion of this rigging system shall rest solely and exclusively with the Stage Rigging Contractor.

C. The Stage Rigging Contractor shall supply all tools required for the successful installation of the equipment herein.

D. The Stage Rigging Contractor shall be responsible for storage of all equipment and tools during the period of installation and shall be responsible for collecting and removing from the job site all packing materials, trash, scrap materials, etc.

E. The Stage Rigging Contractor shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.

F. Prior to the completion of the installation, the Stage Rigging Contractor shall notify the Construction Manager and Architect to schedule an inspection of the system.
   1. At the time of the inspection, the Stage Rigging Contractor shall furnish sufficient personnel to operate all equipment and to perform adjustments and tests as may be required by the Architect and/or the Owner's representatives.
   2. Any equipment that fails to meet with the Specifications shall be repaired or replaced with new equipment, and the inspection shall be re-scheduled under the same conditions listed previously.
   3. All temporary equipment shall be removed to permit full operation and access to all equipment.
   4. Final acceptance will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every circumstance.

G. The Stage Rigging Contractor’s installation Supervisor shall provide up to 12 hours of instruction. Up to eight hours of instruction shall cover the safe and proper operation of the equipment, including limit switch placement and adjustment, use of the control panel, etc., to the Owner's designated representative. An additional four hours of training for up to six users shall be dedicated to demonstrating an ANSI inspection of one lineset of each type. ANSI inspection training shall cover what to look and listen for, how to identify common problems in each rigging system, and when a problem needs to be addressed immediately by a professional rigger.
   1. Stage Rigging Contractor shall schedule instruction with the Owner's designated representatives.
   2. Instruction shall not necessarily follow immediately after the system check-out and activation.
   3. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
   4. Instruction, at Owner’s discretion, may occur in multiple time blocks.
   5. Written documentation of Owner training shall be provided to the Owner upon completion.
      a. Form to include:
         1) The date, time, and location of training.
         2) Name, title, company and signature of trainer.
         3) Name, title, and signature of all participants.
         4) Topics covered at training.
      b. If training is non-continuous, provide one form for each training segment.
   6. Training may be video and audio recorded by the owner at the owner’s expense.

3.2 INSTALLATION SUPERVISION

A. Installation of the rigging systems shall be supervised by the Rigging System Contractor's own experienced superintendent having extensive experience in installing work of this kind.
   1. Superintendent shall be an Entertainment Technician Certification Program (ETCP) Certified Rigger - Theatre.
      a. Rigging System Contractor shall provide the Architect with a copy of the superintendent’s ETCP certification and shall make a copy of this certification available on the job site for the length of the installation.

2. An ETCP Certified Rigger - Theatre shall be present at all times during the rigging system installation.

B. The same individual shall remain in charge of the work throughout the installation of the rigging system until work is completed excepting only the intervention of circumstances completely beyond the control of the Stage Rigging Contractor.

C. The superintendent shall represent the Rigging System Contractor and all directions given to him shall be binding as if given to the Rigging System Contractor.
1. The Rigging System Contractor may require the Owner to confirm such directions in writing.

3.3 FIELD QUALITY CONTROL

A. Rigging System shall be installed in accordance with OSHA Safety and Health Standards and all local codes. All welding shall be in full compliance with the most recent edition of the Structural Welding Code (ANSI / AWS D1.1).

B. All equipment shall be installed in locations shown on Construction Drawings and shall be installed plumb, straight and true, and shall function as designed.

C. All components shall be installed to prevent abrasion of moving items against any part of the building structure or other equipment.
1. Sheaves shall be so aligned as to provide fleet angles of the cables not exceeding two degrees.
2. Provide mule blocks, cable rollers, and guides as required to provide proper alignment and movement around obstructions.

D. Eyes at cable terminations shall be formed over thimbles of correct size.

E. The Stage Rigging Contractor shall perform all drilling and fitting required in the setting of materials and all cutting and fitting required in the fitting of materials to the adjoining work of other Contractors.

END OF SECTION 116123

SECTION 116129 – PIPE GRID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK OF THIS SECTION

A. This Section includes all labor, materials, equipment, and services necessary to furnish and install the Pipe Grid Multi-Purpose Room as shown on the drawings and/or specified herein, including:
   1. Multi-Purpose Room Pipe Grid

B. It shall be the responsibility of the Stage Rigging Contractor to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications whether or not such items are herein specified or indicated.

1.3 PROJECT CONDITIONS

A. All dimensions shall be verified in the field prior to fabrication by the Contractor, who shall make at least one visit to the job site prior to preparation of shop drawings.

B. No extras will be allowed due to the Contractor’s misunderstanding of the work involved or its lack of knowledge of any field conditions due to failure to make accurate field measurements or a thorough investigation of the job site.

1.4 SUBMITTALS

A. Contractor shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.

B. Shop Drawings shall be submitted for review by the Architect before fabrication can begin. Such review does not relieve the Contractor of the responsibility of providing equipment in accordance with this Specification.

C. Shop Drawings:
   1. Shop Drawings shall show dimensions, sizes, gauges, thicknesses, finishes, joining, attachments and relationship of work to adjoining construction.
   2. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
   3. Where other materials must be set to exact locations to receive pipe grid, furnish assistance and directions necessary to permit other trades to locate their work.

4. Where welded connections, concrete or masonry inserts are required to receive work, shop drawings shall show exact locations required.
5. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.

D. The Contractor shall, if requested by the Owner or Architect, furnish satisfactory evidence as to the kind and quality of materials he proposes to furnish by submission of exact samples of hardware to be used in this contract.

E. Upon completion of installation, Stage Rigging Contractor shall provide Operation and Maintenance manuals that shall include record shop drawings, parts lists, operational instruction, service/maintenance recommendations, component working load limits, etc. One O&M manual shall be a printed hard copy O&M manual shall also be provided in electronic format on two flash drives.

1.5 WARRANTY

A. The Contractor shall assure that the pipe grid is properly installed, free of defects in materials and workmanship and shall provide a warranty on all equipment and workmanship provided under this contract for a period of two years from the date of the final acceptance.

1.6 CONTRACTORS

A. The Contractor shall have been continuously engaged in the installation of theatrical stage rigging equipment for at least 10 years.

B. The Contractor shall have installed a total of not less than five installations of equal or greater scope to system specified herein, manufactured and installed by the bidder.

C. Pre-approved Contractors for Work of this Section shall include:

1. Integrated Theater Systems
   117 Roup Avenue
   Pittsburgh, PA 15206
   (412) 441 8000

2. Vincent Lighting
   920 Vista Park Dr.
   Pittsburgh, PA 15205
   (412) 788-5250

3. Chicago Flyhouse
   2925 W. Carroll Ave.
   Chicago, IL 60612
   773-533-1590

4. J.R. Clancy, Inc.
   7041 Interstate Island Rd.
   Syracuse, NY 13209
   800-836-1885

5. Stage Rigging Services (SRS)
   831 Winston Street
   Greensboro, NC 27405
   336-370-1900

6. Texas Scenic
   611 Lofstrand Ln #A
   Rockville, MD 20850
   (301) 874-1747

7. 4Wall Entertainment
   9525 Berger Rd,
   Columbia, MD 21046
   (410) 242-3322

8. Barbizon Lighting
   6437 General Green Way #2413
   Alexandria, VA 22312
   (703) 750-3900

D. The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
   ~~1. 11 61 13 – Theatrical Drapery and Track~~ **(ADDENDUM 01)**
   1. 11 61 23 – Theatrical Rigging

PART 2 - PRODUCTS

2.1 MATERIALS

A. Ferrous materials and accessories shall conform to the following ASTM and ANSI standard specifications:

Standard structural steel shapes and plates:	ASTM A-36.
Miscellaneous steel items:	ASTM A-283, grade optional.
Steel pipe:	ASTM A-120
Gray iron castings:	ASTM A-48, Class 30 unless otherwise specified.
Malleable iron castings:	ASTM A-47
Bolts and nuts:	B18.2.1&2

Welding electrodes shall be as permitted by AWS Code D1.0.

B. Aluminum Materials and Accessories

Thicknesses, gauges and tempers of aluminum products shall be as required for proper forming operations and to meet structural standards.

Aluminum Castings: 214 or 356 alloy as per strength requirements.

Fasteners: Include bolts, nuts, washers, screws, nails, rivets and other fastenings necessary for proper erection and/or assembly of aluminum work.

Fabrication shall be by AWS certified welders.

C. Finishes for Items Without Factory Finish

Welds, burrs and rough surfaces on all interior ferrous metals shall be ground smooth and the completed assembly cleaned and all metal surfaces given a minimum one coat of finish paint.

All exposed fastenings shall match color and finish of adjacent material.

2.2 SAFETY STANDARDS

A. To establish minimum standards of safety, the following factors shall be used:

Cables and fittings 8:1 Safety Factor
Terminating hardware: 5:1, or not exceeding WLL, whichever is more restrictive.
Steel 1/5 of yield
Bolts Grade 5 or better, plated

2.3 PIPE GRID

A. Pipe grid shall be constructed of 1-1/2" NPS schedule 40 steel pipe as shown on the drawings.

B. Pipes and all mounting hardware shall be painted black.

C. All joints shall be sleeve spliced with 18" long sleeves with 9" extending into each pipe and held by two hex bolts and lock nuts on each side of the joint.

D. Grid shall be installed with pipes intersecting on centers shown on the drawings.

1. All intersections shall be connected using a right angle or variable angle intersection clamps as required.
2. Intersection clamps shall be made of two 3/16” thick, painted steel plates formed to grip 1-1/2” NPS schedule 40 pipes at right angles.
3. Intersection clamps shall be complete with four 3/8" x 1" hex bolts with lock nuts.
4. Intersection clamps shall have a recommended working load of at least 1500#.

E. Each pipe shall terminate short of the walls.

1. Attach minimum two pipes per side to wall using pipe-end brackets as shown on drawings.
2. Secure pipe to wall bracket with u-bolt, sized to pipe O.D.
3. Anchor all brackets to structural walls. Where acoustic material is applied over the wall, notch acoustic material around pipe.
   a. All notches shall be neat and uniform.

F. The grid shall be hung from the building structure using 1/4" 7x19 galvanized utility cable, proof coil chain, or 1/2” diameter all-thread rod ending attached to pipe clamps.

1. At each point, the cable, chain or all-thread rod shall attach to the overhead steel with an appropriate fitting.
2. Cables shall be formed over thimbles of correct size and fastened with Nicopress sleeves crimped to manufacturers' recommendations.
3. Where turnbuckles are used, all turnbuckles shall be moused after final trimming of the pipe grid.
4. Hanger hardware shall be rated to support either a 40 plf distributed load on the pipe grid or 450 lbs, whichever is greater.
5. Install hangers plumb in all directions.

G. Pipe grid shall hang plumb and level in all directions.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine all conditions under which all items shall be installed and notify the Owner and Architect in writing of any condition detrimental to the proper and timely completion of the work.

B. Responsibility for the satisfactory completion of this work shall rest solely and exclusively with the Contractor.

C. The Contractor shall be responsible for storage of all equipment and tools during the period of installation and shall be responsible for collecting and removing from the job site all packing materials, trash, scrap materials, etc.

D. The Contractor shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.

3.2 INSTALLATION SUPERVISION

A. Installation of the items described in this section shall be supervised by the Contractor's own experienced superintendent having extensive experience in installing work of this kind.
   1. Superintendent shall be an Entertainment Technician Certification Program (ETCP) Certified Rigger - Theatre.
      a. Rigging System Contractor shall provide the Architect with a copy of the superintendent's ETCP certification and shall make a copy of this certification available on the job site for the length of the installation.
   2. An ETCP Certified Rigger - Theatre shall be present at all times during the pipe grid installation.

B. The same individual shall remain in charge of the work throughout the installation until work is completed excepting only the intervention of circumstances completely beyond the control of the Contractor.

C. The superintendent shall represent the Contractor and all directions given to him shall be binding as if given to the Contractor.

1. The Contractor may require the Owner to confirm such directions in writing.

3.3 FIELD QUALITY CONTROL

A. All equipment shall be installed in locations shown on Construction Drawings.

B. Installations shall be performed in accordance with OSHA Safety and Health Standards and all local codes.

C. All welding shall be in full compliance with the most recent edition of the Structural Welding Code (ANSI / AWS D1.1).

D. All components shall function as designed and be installed plumb, straight and true.

E. The Contractor shall do all drilling and fitting required in the setting of materials in place, and shall do all cutting and fitting required in connection with the fitting of his materials to the adjoining work of other Contractors.

F. The Contractor shall provide all connecting members, brackets, etc., as required for properly supporting and securing his work to the masonry, joints, walls, structural members, or other parts of the building as may be best suited for each condition.

G. Install the items described in this section in locations shown on the drawings.

END OF SECTION 116129

SECTION 116163 – ORCHESTRA SHELL (FOR INFORMATIONAL PURPOSES ONLY) (ADDENDUM 01)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes all labor, materials, equipment, and services necessary to manufacture, deliver and install an Orchestra Shell System as shown on the drawings and specified herein, including but not limited to the following:
   1. Rolling side towers.
   2. Overhead ceiling panels.

B. It shall be the responsibility of the Orchestra Shell Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

1.2 GENERAL

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

B. Related work in other Sections
   1. Division 11: Stage Rigging Systems

C. Site Conditions: Contractor shall be responsible for verifying that the job conditions are ready to receive work in this section. Contractor must alert the Construction Manager to any existing conditions that may adversely affect execution of work, so that resolution may be reached before commencement of installation.

1.3 SUBMITTALS

A. Submittals shall be according to the Conditions of the Contract and Division Specification Sections.

B. Orchestra Shell Manufacturer shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.

C. Shop Drawings shall be submitted and reviewed by the Architect before fabrication can begin.
   1. Such review does not relieve the Orchestra Shell Manufacturer of the responsibility of providing equipment in accordance with this Specification.

D. Shop Drawings shall include layout, fabrication, and installation drawings showing product components in assembly with adjacent materials and products

E. Shop Drawings shall show dimensions, sizes, weights, gauges, thicknesses, finishes, circuiting, joining, attachments, lubrication points, and relationship of work to adjoining construction.

F. The Orchestra Shell Manufacturer shall, if requested by the Owner or Architect, furnish satisfactory evidence as to the kind and quality of materials to be furnished by submission of exact samples of equipment to be used in this contract.
   1. The samples shall be retained by the Owner until such time that all items contracted for have been installed and accepted.

G. Upon completion of installation, Orchestra Shell Manufacturer shall submit three copies of an Operation and Maintenance manual which shall include as-built shop drawings, parts lists, operational instruction, maintenance recommendations, etc.
   1. One O&M manual shall be a printed hard copy.
   2. O&M manual shall also be provided in electronic format on two flash drives.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery and installation of the Orchestra Shell System shall be as required in the Construction Documents.

B. Factory assemble and finish components prior to shipment.

C. Deliver all materials to the job site suitably crated, packed and protected, and bearing the manufacturer's identification label and the nomenclature of the product(s) found in the carton.

D. Orchestra Shell Manufacturer shall confirm delivery dates with the Owner/Construction Manager a minimum of 30 days in advance of scheduled delivery.

1.5 WARRANTY

A. The Orchestra Shell System shall conform to all applicable code requirements and shall be in conformance with industry standards of operations and practice.
   1. All materials, arrangements, and procedures shall comply with applicable OSHA requirements.

B. The Orchestra Shell Manufacturer shall assure that the shell is properly installed, free of defects in materials and workmanship, and shall provide a warranty on all equipment and workmanship provided under this contract for a minimum two years from the date of the final acceptance by the Owner.

C. During the warranty period, repair or replacement of defective materials and/or repairs of faulty workmanship shall be provided, at no cost to the Owner, within 10 days of written notification of defects(s).

1.6 MANUFACTURERS

A. Manufacturers and orchestra shell systems for work of this Section shall include:

1. Wenger Corporation
   1078-S Wenger Building
   Owatonna, Minn. 55060
   Contact: Steve Bright steve.bright@wengercorp.com
   800-733-0393
2. SECOA
   8650 109th Avenue North
   Champlin, MN 55316
   Contact: Jeff Jones j.jones@secoa.com
   800-328-5519
3. StageRight Corp.
   495 Holley Drive
   Clare, MN 48617
   Contact: Bill Gareiss info@stageright.com
   800-438-4499
4. Staging Concepts
   7008 Northland Drive, Suite 150
   Minneapolis, MN 55428
   Contact: Matt Huebsch mhuebsch@stagingconcepts.com
   763-231-7112

B. Products of other manufacturers may be acceptable. However, manufacturers capable of providing specified products shall not, for convenience of their normal production methods, vary from the specification. Manufacturers listed as “alternative” are not relieved of the responsibility of meeting these specifications. Owner and Architect shall be the sole parties capable of determining bidder’s compliance with specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Acoustical Shell System shall consist of a full stage symphonic enclosure made up of rolling side towers and overhead ceiling panels of sufficient size and density to control and reflect a maximum range of audible frequencies.

B. The Shell System shall permit adjustment of reflector height and size to accommodate varying performance types and acoustical requirements. Acoustical panels shall be adjusted for angle and position to assure proper blending and projection of sound.

C. The Shell System shall be designed to permit easy storage without dismantling.

D. Orchestra shell towers and ceiling panels shall be stressed-skin composite type with a minimum of STC 23 to meet performance requirements

1. The core of the towers and ceiling panels shall be 1-1/2” thick honeycomb material that has an open geometric pattern with cell walls vertical to panel skins and defined by alternating straight and sine wave layers.
    a. Height of sine wave shall be 1/2”, wall thickness shall correspond to 60 lb Kraft.
    b. Bonding of core material to panel faces shall be with permanently cured urethane adhesive. Foam core materials and contact adhesives shall not be permitted.

E. The face of the panels shall be plastic laminate top surface on 3/16-inch-thick hardboard stressed skin. Plastic laminate shall be in color selected by Owner, with no exposed fasteners.

F. Back of each panel shall be 3/16” thick hardboard stressed skin, painted black.

G. Straight panel edges shall be reinforced with extruded aluminum edge frame.

2.2 ROLLING SIDE TOWERS

A. Side towers shall be self-supporting, sound reflecting structures equipped with leveling, nesting "A-shaped" counterweighted bases and all hardware necessary to safely transport them to and from storage and lock into place when in "performance" position.

B. Provide rolling wall towers in sizes as shown on the drawing.

C. The wall tower base shall incorporate a counterweight of required weight to allow the towers to be moved safely about the stage.

D. Structural frames shall incorporate tower wing hinges.

E. Each tower shall be movable by transporter(s) that lock onto and lift the towers and allows them to move safely about the stage.
    1. Transporter shall allow towers to be moved in any direction.

F. Each tower base shall have multiple, adjustable height levelers to allow for irregularities in the stage floor.

G. Numbered markers shall be inserted flush with the stage floor indicating the location of each tower insuring consistent setup.

H. Towers shall consist of three panels hinged together to obtain tower width as indicated on drawings.

I. Designated side wall towers shall be equipped with doors for entering and exiting the performing area. Doorways shall have a minimum of 3'-0" wide open clearance.
    1. Doors shall have self-lubricating bearings for quiet operation.

J. All instructions pertaining to the safe handling and operation of the towers shall be affixed to the tower in plain view.

2.3 OVERHEAD CEILING PANELS

A. Stage overhead ceiling panels shall be sound reflective and include integral hardware for storage without interference with adjacent stage equipment.
   1. Ceiling panel shall be in sizes as shown on the drawings.
   2. Verify dimensions in shop drawings.

B. Overhead panels shall be removable and also designed to fold vertically permitting storage on the stage rigging system. The overhead panel design shall allow each panel to be rotated by two people.

C. Each overhead panel shall be equipped with necessary hardware to hang from a stage rigging lineset 1-1/2" NPS schedule 40 pipe batten.
   1. Method of attachment to batten must allow for installation or removal of each overhead panel.
   2. Hardware must permit angular adjustment from horizontal plane to 40 degrees.
   3. The hardware must also have the capability of locking the panels in a vertical position so that they may be stored on the batten.

D. Integral light fixtures shall be incorporated into the ceiling to provide an even, general down light wash of the stage. Shop drawings shall reflect Shell Manufacturer suggested fixture locations.
   1. Fixture wiring shall be spliced or two-fers provided so that fixtures can connect to three 20A jumper cables per ceiling panel.
   2. Cables shall connect to the stage left end of the ceiling panel.
   3. Provide 20A jumpers made of black, type “SO” (extra hard usage), three-conductor, #12 cable equipped with 20A theatrical 3-pole stage pin connectors.
   4. Jumper cables shall be sized to reach to the stage left end of each ceiling panel plus an additional 35’-0”. Verify cable lengths in shop drawings.
   5. A mechanical tilt switch shall be provided at each light fixture to prevent accidental activation when the ceiling panel is in the vertical, storage position.

E. When the panels are stored on the rigging batten, the maximum upstage/down stage storage space required shall be 14”.

F. Each complete row of ceiling panels shall weigh a maximum of 3000#. Verify weight in shop drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine all conditions under which all Orchestra Shell items shall be installed and notify the Construction Manager in writing of any condition detrimental to the proper and timely completion of the work.

B. Responsibility for the manufacture and installation of the orchestra shell shall rest solely and exclusively with the Orchestra Shell Manufacturer.

C. The Orchestra Shell System Manufacturer shall be responsible for storage of all equipment and tools during the period of installation.

D. The Orchestra Shell Manufacturer shall be responsible for collecting and removing all packing materials, trash, scrap materials, etc. from the job site.

E. The Orchestra Shell Manufacturer shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.

F. Prior to the completion of the installation, the Orchestra Shell Manufacturer shall notify the Construction Manager to arrange on a date for observation of the system.
   1. At the time of the observation, the Orchestra Shell Manufacturer shall furnish sufficient personnel to operate all equipment and to perform adjustments as required by the Owner's representatives.

3.2 INSTALLATION

A. Installation of the orchestra shell shall be supervised by the Orchestra Shell Manufacturer's own experienced superintendent having extensive experience in installing work of this kind.

B. Orchestra shell overhead ceiling panels shall be installed on motorized line sets provided by the Rigging Manufacturer/Installer in locations shown on the drawings.

C. Verify setting of units in performance and storage positions.

D. Verify adjustability of units.

E. Install and test integral lighting.

F. The superintendent or other Orchestra Shell Manufacturer's representative shall provide minimum four hours of instruction to Owner's designated representative(s) in the safe, efficient operation of the Orchestra Shell System.

3.3 FIELD QUALITY CONTROL

A. All equipment shall be installed in locations shown on Construction Drawings and shall be installed plumb, straight and true, and function as designed, safely and quietly, in accordance with manufacturer’s recommendations and approved submittals.

B. All lighting fixtures shall be focused by the Orchestra Shell Manufacturer to provide an even, general down light wash of the stage.

C. Clean exposed surfaces of acoustical shells. Comply with manufacturer’s written instructions for cleaning and touchup of minor finish damage.

D. Repair or replace defective work as directed by Architect upon inspection.

END OF SECTION 116163

SECTION 126113 –UPHOLSTERED FIXED AUDIENCE SEATING

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. This Section includes all labor, materials, equipment, and services necessary to manufacture, deliver to job site, and install floor-mounted fixed seating as specified herein. This Specification shall apply to upholstered fixed audience seating in the Proscenium Theater.

1.2 GENERAL REQUIREMENTS

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

B. Related work in other Sections:
   1. Electrical Drawings and Specifications
   2. Architect's Finish/Color Schedule

1.3 SUBMITTAL WITH BID

A. The Fixed Seating Manufacturer shall submit a list of not less than five installations of similar scope and size, installed by the bidder, that have been in service for a minimum of one year and a maximum of five years.

B. The Fixed Seating Manufacturer shall also submit for review by the Architect the following samples and certificates:
   1. One notarized certificate of compliance with ASTM A-48 Class 25 for all gray iron castings.
   2. One notarized certificate of compliance with California Bulletin #117.

C. The Fixed Seating Manufacturer shall submit with its proposal illustrations, specifications, and other data pertinent to the construction of its product.

~~D. Furnish with bid a schedule of the following:~~
   ~~1. Length of time required to prepare shop drawings.~~
   ~~2. Length of time required to supply all equipment.~~
   ~~3. Length of time required to install all equipment.~~ **(ADDENDUM 01)**

E. With bid submittal, Fixed Seating Manufacturer shall provide new fixed seating product literature with standard styles offered, in the event that the Owner wishes to make alternative selections.

1.4 SUBMITTALS

A. Fixed Seating Manufacturer shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.

1. Shop drawings shall be submitted to and reviewed by the Architect before fabrication begins. Such review does not relieve the Fixed Seating Manufacturer of the responsibility to provide equipment in accordance with this Specification.

2. Shop drawings shall include ¼" scale plans showing complete field dimensions, including accurate measurements of actual row lengths and row spacing, and measurements from edge of stage to back of each row.
   a. Where field dimensions differ from Construction Drawings, shops drawings shall indicate Fixed Seating Manufacturer's proposed changes in seat width layout based on accurate field measurements.
   b. Proposed changes are subject to review by Architect.

3. Seat anchorage details shall clearly indicate the method used and the devices employed for attaching anchors to existing concrete and wood floors.

4. All materials, finishes, and construction of fixed seating shall be detailed in the shop drawings including but not limited to:
   a. Seat pans and upholstery
   b. Seat backs and upholstery
   c. Aisle standards and middle standards, including ADA-compliant aisle standards
   d. Armrests
   e. Aisle lighting, including transformer, noting color temperature
   f. Number, letter, and donor plates

5. Shop drawings shall include the following related to electrical work:
   a. Detail showing mounting of aisle light to aisle standard
   b. Detail showing mounting of aisle light junction box and conduit
   c. Aisle lighting wiring diagram showing all interconnections

6. Any deviation from this Specification shall be noted in letters a minimum ¼" high. For a deviation to be considered, it must upgrade the quality of the equipment or respond to a field condition.

B. Before fabrication shall begin, the Fixed Seating Manufacturer shall submit for review an assembled sample of a new fixed chair with construction, fabric, and finishes meeting all requirements set forth in this Specification.

1. Sample shall include the following:
   a. One complete chair 22" wide
   b. Row number plate and aisle letter plate installed (no donor plate)
   c. One aisle standard with aisle light
   d. One center standard
   e. Aisle light transformer with plug

2. In addition to the above, provide as a separate assembly one ADA-compliant aisle standard with aisle light.

3. Sample chair shall be retained for quality comparison with actual installation.

C. After installation, Fixed Seating Manufacturer shall provide the Owner with Operations and Maintenance (O&M) Manuals.

1. Provide one printed hard copy manual

2. Provide two flash drives with manual in electronic format

3. Each O&M Manual shall include the following:
   a. Contact name, phone number, and fax number
   b. Record shop drawings
   c. Catalog cuts and complete parts list of installed equipment
   d. Recommended maintenance procedures
   e. Fabric manufacturer, product number, color, weight, width, and manufacture date

1.5 MANUFACTURER'S RESPONSIBILITIES

A. Fixed Seating Manufacturer shall study the Contract Drawings and Specifications with regard to the work as shown and required under this Section to ensure its completeness.

B. Fixed Seating Manufacturer shall pay particular attention to all architectural and structural drawings relevant to construction of the flooring and substructure of all floor areas that will receive seating.

C. Fixed Seating Manufacturer shall verify by field measurement all dimensions affecting the work.

1. The approved seating plan shall be reproduced on the floor and dimensions and layout shall be checked against the conditions encountered in the field.

2. Field dimensions that are at variance with those on the approved shop drawings shall be brought to the attention of the Architect. If required, the decision regarding corrective measures shall be obtained before the start of fabrication of the affected items.

D. Fixed Seating Manufacturer shall examine all surfaces and conditions to which this work shall be attached.

1. Notify the Construction Manager, in advance of commencement of installation, if any conditions or surfaces exist which the Fixed Seating Manufacturers considers detrimental to the proper and expeditious installation of its work.

2. Starting of the installation shall imply acceptance of the surfaces and conditions to perform the work as specified.

E. Fixed Seating Manufacturer shall cooperate in the coordination and scheduling of the delivery and installation of fixed seating with the Construction Manager and/or General Contractor.

F. It shall be the responsibility of the Fixed Seating Manufacturer to furnish equipment complete in all respects, including any additional equipment required to fulfill the design intent of these Specifications, regardless of whether such items are herein specified or indicated.

G. Fixed Seating Manufacturer shall be responsible for verifying that the job conditions are ready to receive work in this Section. Fixed Seating Manufacturer must notify the Construction Manager of any existing conditions that may adversely affect execution of work, so that resolution may be reached before commencement of installation.

1.6 DELIVERY

A. Delivery and Installation shall be as required in the Contract Documents.

B. Bid price to include full freight and insurance charges for delivery of equipment to job site.

C. The approved seating shall be delivered to the job site fully fabricated and ready for installation, in the Fixed Seating Manufacturer's protective packaging.
1. Spare parts and attic stock shall be packaged separately and provided on the last day of installation.

D. Seating shall not be delivered to the job site until the construction has reached a stage to accept the installation.

1.7 WARRANTY

A. The Fixed Seating Manufacturer shall assure that equipment is provided free of defects in materials and workmanship and shall provide a warranty agreeing to make all applicable repairs, including replacement of materials, at no cost to the Owner for a minimum of three years from the date of final acceptance.

1.8 FIXED SEATING MANUFACTURER AND MODEL

A. The Basis of Design Manufacturer for the work of this Section shall be the following:
1. Irwin Seating Co.
Box 2429
3251 Fruit Ridge Road N.W.
Grand Rapids, MI 49501
Contact: Spence Benedict
616-574-7341
spence.benedict@irwingseating.com
a. Seat model: TBD

B. Alternate equivalent manufacturers and products shall be:
1. Series Seating
20900 NE 30th Ave Suite 901
Miami, FL 33180
Contact: Thomas Boyd
574-265-6455
tboyd@seriesseating.com
a. Seat model: TBD

2. Hussey Seating
38 Dyer Street Extension

North Berwick, ME 03906
Contact: 800-341-0401
a. Seat model: TBD

PART 2 PRODUCTS

2.1 GENERAL

A. Fixed seats shall be floor-mounted type with:
1. Wood veneer plywood back with upholstered panel
2. Plastic ¾ fold seat pan with upholstered cushion
3. Solid hardwood aisle standards
4. ADA compliant transfer aisle standard (where indicated)
5. Solid steel middle standard
6. Warm white LED aisle light mounted to aisle standard (where indicated)
7. Solid hardwood armrests
8. Plates for row letters (aisle standard), seat numbers (seat pan), ADA-compliance (aisle standard)

2.2 QUANTITIES

A. Fixed Seating Manufacturer shall provide new fixed seats in quantities required.

B. The final determination of the total number of seats of each width cannot be made until the Fixed Seating Manufacturer produces shop drawings for the project based upon accurate field measurements.

C. Provide chairs in widths of 20”, 21”, 22”, and 23” as shown on the seating layout drawings or required based on field measurements.

D. At the completion of installation, provide the following ‘attic stock’ spare parts in separate packing cartons with labels:
1. Two Complete seat backs in each width provided
2. Two Complete seat pans in each width provided
3. Four seat back cushion covers in each width provided
4. Four seat pan cushion covers in each width provided
5. Two aisle standards, oriented right, with armrest and aisle light
6. Two aisle standards, oriented left, with armrest and aisle light
7. One ADA transfer aisle standard, oriented right, with armrest and aisle light
8. One ADA transfer aisle standard, oriented left, with armrest and aisle light
9. Four middle standards
10. Eight armrests for middle standard
11. One quart of each paint used on metal surfaces
12. Five yards fabric of each type used.
    a. Fabric shall be from same dye lot and installed on seats and shall include labels identifying manufacturer, weight, product number, color, and manufacture date.

2.3 MATERIALS

A. Wood shall be solid white oak hardwood, rift cut, clear finish, open-pore.

B. Glue used to join all plywood and composite wood components shall have no added urea-formaldehyde and meet the following:
1. ASTM designation D-805-63
2. 20 dry shear test pulls, not less than 300 lbs per square inch
3. 10 wet shear test pulls after forty-eight hour immersion, not less than 200 lbs per square inch

C. Finishes

1. Wood Surfaces
   a. Wood parts stain finish shall match Architect's control sample.
   b. All exposed wood surfaces shall be coated with a lacquer of sufficient film depth to afford adequate protection in use.

2. Metal Surfaces
   a. All metal surfaces shall be painted black.
   b. Metal parts shall be cleaned with hot alkyd spray and hot water rinse and the iron phosphate treated before finishing with powdered epoxy paint in color selected by Architect. Cured powder coating shall meet or exceed the following requirements:
      i. Dry Film Thickness: Average coating of 2 mils as per ASTM-D-1400-81.
      ii. Hardness (Pencil): Assure an H pencil hardness as per ASTM-D-3363-74.
      iii. Abrasion: Taber/Abraser Test to assure a maximum of 60 mg weight loss to the tested part after 1,000 cycles with a CS-10 wheel weighing 1,000 grams.
   c. Painted parts shall be gas oven baked after application of base color at a minimum of 350 degrees Fahrenheit for twenty minutes to assure an even, smooth and fully cured finish. Additional detail paint requirements in Section 2.4-A.

D. Upholstery Fabric
1. For seat back cushion cover: ~~Refer to Finish Color Schedule~~ **Guilford of Maine Jane 9085 Pomegranate 4081 (ADDENDUM 01)**
2. For seat pan cushion cover: ~~Refer to Finish Color Schedule~~ **Guilford of Maine Jane 9085 Pomegranate 4081 (ADDENDUM 01)**

E. Padding
1. Foam padding shall be of cold-cure polyurethane foam.
2. Padding material shall comply with the flammability requirements outlined in California Technical Information Bulletin #17 Resilient Cellular Materials, Section A & D, dated 2/75, when tested in accordance with Federal Test Method Standard 191, Method 5903.2.

2.4 CONSTRUCTION DETAILS

A. Aisle Standards

1. Full-height, panel extends to floor
2. Constructed of solid hardwood 2" thick
3. Hardwood edging at all sides
4. Recess for row letter plate at aisle side of panel
5. Configured for aisle light within armrest
6. Designed to properly support the adjacent seat at the correct height and pitch
7. Provided with lugs for attachment of aisle standard armrests
8. Metal foot for floor mounting. Foot shall allow for attachment to the floor and for severe tightening and shock without fracture.
9. No visible fasteners
10. Wood veneer per Finish Color Schedule

B. ADA-compliant swing-out aisle standards
   1. Same as above, with swing-out panel to accommodate ADA transfer
   2. Recess for ADA plate at aisle side of panel

C. Seat Back
   1. 0.75" Thickness
   2. Hardwood edging at all sides
   3. Foam cushion with fabric cover, fabric selection by Architect. No visible stitching or decorative channel.
   4. Back Pitch: TBD
   5. No visible fasteners
   6. Bottom edge of the panel shall be aligned with the lowest point of the seat bottom in its raised position.
   7. Same width as seat bottom so that spaces between adjacent backs are consistent.
   8. Wood veneer per Finish Color Schedule

D. Seat Pan – Fixed Seats
   1. Molded plastic; ~~Custom gray~~ ~~to match Architect's control sample~~ **Manufacturer's standard black. (ADDENDUM 01)**
   2. Foam cushion with fabric cover per Finish Color Schedule.
   3. No visible fasteners
   4. When unoccupied, the seat shall automatically rise to a ¾ fold position, and with rearward pressure shall achieve full fold position.

~~E. Seat Pan – Jump Seats~~
   ~~1. Plywood and wood veneer per Finish Color Schedule~~
   ~~2. Foam cushion with fabric cover per Finish Color Schedule.~~
   ~~3. No visible fasteners~~
   ~~4. When unoccupied, the seat shall automatically rise to fully fold position.~~ **(ADDENDUM 01)**

F. Armrest
   1. Solid hardwood construction
   2. Flat top and rounded corners
   3. Recess for aisle light
   4. No visible fasteners

5. Stain color per Finish Color Schedule

G. Aisle Light
1. Low-voltage Warm White (2700K-3000K) LED linear source
2. Recessed into grooved channel at the underside of aisle standard armrests
3. Provides sufficient beam spread and intensity to meet code required minimum foot candle level in path of egress
4. Aisle light shall be properly grounded and pre-wired with conductors enclosed in a minimum 3/8" diameter flexible steel conduit extending a minimum of 18" beyond the foot of the aisle standard.
   a. Wiring shall be provided with a 90-degree angle connector
5. Provide adequately sized transformer housed in a steel enclosure and equipped with primary and secondary fuses or circuit breakers, terminal blocks, and safety disconnect.
6. Provide instructions and details for termination by Electrical Contractor.

H. Seat Number and Row Letter Plates
1. Text color and typeface to be confirmed by Architect.
2. Plate finish and dimensions to be confirmed by Architect.

PART 3 – EXECUTION

3.1 GENERAL

A. Installation shall be supervised by the Fixed Seating Manufacturer's own experienced superintendent in strict conformance with the approved seating layout shop drawings.

1. The same individual shall remain in charge throughout the installation.

2. The superintendent shall represent the Fixed Seating Manufacturer and all directions given to the superintendent shall be binding as if given to the Fixed Seating Manufacturer.

B. Fixed Seating Manufacturer shall be responsible for storage of tools, equipment, and materials during the period of the installation.

3.2 INSTALLATION

A. Standards shall be anchored to concrete using two bolts and anchors per standard.

B. Properly sized fasteners shall be used. Breaking off oversized bolts on seat pan and seat back connections shall not be permitted.
1. Cap nuts shall be used on bolts connecting back wings to standards.

C. Aisle lights shall be installed in designated locations.

D. All seating shall be securely installed in designated locations, shall be rigid, plumb, accurately aligned, and neatly executed.

E. All movable parts shall operate smoothly and quietly, and all seats, when not occupied, shall be upright and at the same angle.

F. The backs and the seats (in upright position) shall be neatly aligned.

G. Prior to acceptance, each seat shall be tested and inspected to assure the following:
1. Each seat is working properly.
2. Number and letter plates are securely fastened in place without raised or jagged edges.
3. Applied finishes are free from scratches or abrasions.
4. Seat functions properly with unoccupied seat bottom automatically returning to the 3/4 folded position.
5. Seat and row identification plates are correct.

3.3 PROTECTION AND CLEANING

A. Fixed Seating Manufacturer shall protect installed seating by carefully covering the seats with 4 MIL plastic sheets secured at corners to prevent damage to the installed work.

B. Damages that do occur to the fixed seats shall be repaired and/or replaced as directed by the Owner and/or the Architect at no additional cost to the Owner.

C. Fixed Seating Manufacturer shall provide barriers as required to protect the surfaces or equipment provided by other contractors from damage during the seat installation.

D. At completion of installation, surfaces and materials of the fixed seating shall be cleaned of debris, dirt, and foreign materials.

E. The Fixed Seating Manufacturer shall be responsible for cleanup, including removal of packing materials from job site etc. and the protection of surfaces or equipment provided by other contractors.

END OF SECTION 126113

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.
8. Ultrasonic, thermal-energy meters.

1.3 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Palmer Wahl Instrumentation Group.
    d. Tel-Tru Manufacturing Company.
    e. Trerice, H. O. Co.
    f. Weiss Instruments, Inc.
    g. Winters Instruments - U.S.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.

4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.
    k. Trerice, H. O. Co.
    l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    m. Weiss Instruments, Inc.
    n. WIKA Instrument Corporation - USA.
    o. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Sealed Solid-front, pressure relief type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Flo Fab Inc.
    d. Marsh Bellofram.
    e. Miljoco Corporation.
    f. Noshok.
    g. Palmer Wahl Instrumentation Group.
    h. REOTEMP Instrument Corporation.
    i. Tel-Tru Manufacturing Company.
    j. Trerice, H. O. Co.
    k. Weiss Instruments, Inc.
    l. WIKA Instrument Corporation - USA.
    m. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 6-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.
    k. Trerice, H. O. Co.
    l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    m. Weiss Instruments, Inc.

n. WIKA Instrument Corporation - USA.
o. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Sealed type; cast aluminum or drawn steel; 6-inch nominal diameter with front flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMETEK, Inc.; U.S. Gauge.
b. Ashcroft Inc.
c. Miljoco Corporation.
d. Noshok.
e. Palmer Wahl Instrumentation Group.
f. REOTEMP Instrument Corporation.
g. Tel-Tru Manufacturing Company.
h. Trerice, H. O. Co.
i. Weiss Instruments, Inc.
j. WIKA Instrument Corporation - USA.
k. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 6-inch nominal diameter with front flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston -type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

8. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.8 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig .

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.9 FLOW METERS AND THERMAL-ENERGY METERS

A. Ultrasonic, Thermal-Energy Meters:

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. EMCO Flow Systems; a division of Spirax Sarco, Inc.
   b. Flexim Fluxus F704, Basis of Design
   c. Siemens Energy & Automation, Inc.
   d. ONICON Inc. (ADDENDUM 01)

2. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
3. Flow Sensor: Transit-time ultrasonic type with transmitter.
4. Temperature Sensors: Insertion-type or strap-on transducer.
5. Indicator: Solid-state, integrating-type meter.
   a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
   b. Battery Pack: Five-year lithium battery.
6. Accuracy: Plus or minus 1 percent.
7. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
8. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water connection.
3. Suction and discharge of each pump.
4. Where lines enter and exit mechanical rooms.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:
1. Industrial-style, liquid-in-glass type.

B. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:
1. Industrial-style, liquid-in-glass type.

C. Thermometers at inlets and outlets of each chiller shall be one of the following:
1. Industrial-style, liquid-in-glass type.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
1. Industrial-style, liquid-in-glass type.

E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:
1. Industrial-style, liquid-in-glass type.

F. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:
1. Industrial-style, liquid-in-glass type.

G. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.

B. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F.

C. Scale Range for Air Ducts: 0 to 150 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be one of the following:

1. Sealed, direct -mounted, metal case.

B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:

1. Sealed, direct -mounted, metal case.

C. Pressure gages at suction and discharge of each pump shall be one of the following:

1. Sealed, direct -mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi.

B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Chilled-Water Piping: Ultrasonic type.

B. Flowmeters for Heating, Hot-Water Piping: Ultrasonic type.

3.9 THERMAL-ENERGY METER SCHEDULE

A. Thermal-Energy Meters for Chilled-Water Piping: Ultrasonic type, integrated to building automation system.

B. Thermal-Energy Meters for Heating, Hot-Water Piping: Ultrasonic type, integrated to building automation system.

END OF SECTION 230519

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SECTION 260913 - ELECTRICAL POWER MONITORING AND CONTROL

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. Electrical Metering: The international Green Construction Code, 2012 603.1 requires the distribution system to isolate load types, to install or allow for future installation of meters and data acquisition system and the installation or the ability to provide public displays and other appropriate reporting mechanisms in the future. Loads will be metered at locations as indicated on the drawings. The Electrical Power Monitoring System shall meter individual loads as shown on drawings and shall summarize building loads in the following load categories as defined by code for building load analysis:

HVAC System: energy used to heat, cool, and ventilate building including fans, pumps, boilers, chillers,

Water Heating.

Lighting System: energy used for interior and exterior lighting.

Plug Load System: energy used by devices, appliances and equipment connected to convenience receptacles.

Process Load System: energy use by any single load associated with activities within the building such as data centers, etc that exceed 5 percent of the peak connected load of the building. (theatrical lighting, stage rigging, performance power, and AV system loads.)

Building Operations/Miscellaneous Loads: vertical transportation systems, snow melt, exterior lighting mounted on building, and other loads that don’t fall into other categories.

B. Section includes equipment and systems used to monitor and control electrical consumption:

1. Multifunction meters.
2. Power meters.
3. Circuit meters and monitors.
4. Circuit meters and explorer instruments.
5. Electrical power monitoring system software.
6. Monitoring of power distribution equipment.
7. System operator interfaces.
8. Integration into BMS system workstations.
9. Raceways and boxes.

10. Wires and cables.
11. Identification.

1.3 DEFINITIONS

A. Active Power: The average power consumed by a unit. Also known as "real power."

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. Apparent (Phasor) Power: "S = VI" where "S" is the apparent power, "V" is the rms value of the voltage, and "I" is the rms value of the current.

D. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

E. KY Pulse: A method of measuring consumption of electricity that is based on a relay operating like a SPST switch.

F. KYZ Pulse: A method of measuring consumption of electricity based on a relay operating like a SPDT switch.

G. LAN: Local area network.

H. L-G: Line to ground.

I. L-L: Line to line.

J. L-N: Line to neutral.

K. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.

L. Modbus TCP/IP: An open protocol for exchange of process data.

M. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

N. N-G: Neutral to ground.

O. Power Factor: The ratio of active power to apparent power, sometimes expressed in percentage.

P. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

Q. TCP/IP: Transport control protocol/Internet.

R. UPS: Uninterruptible power supply; used both in singular and plural context.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for power monitoring and control.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For power monitoring and control equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, method of field assembly, components, and location and size of each field connection.

a. Attach copies of approved Product Data submittals for products (such as switchboards, switchgear, and motor-control centers) that describe the following:

1) Location of the meters and gateways, and routing of the connecting wiring.
2) Details of power monitoring features to illustrate coordination among related equipment and power monitoring.

3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
4. Network naming and numbering scheme.
5. Include diagrams for power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
6. Specifications for workstations.
7. Surge Suppressors: Data for each device used and where applied.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Design Data:

1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format on compact disk or portable storage device with a USB interface.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.

d. Names, addresses, e-mail addresses, and 24-hour telephone numbers of Installer and service representatives for the system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to do the following:

1) Design and install new points, panels, and other hardware.
2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.

h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on compact disk or portable storage device with a USB interface.
j. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
k. Complete original-issue copies of furnished software, including operating systems, custom programming language, workstation software, and graphics software on compact disk or portable storage device with a USB interface.
l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
m. Owner training materials.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power monitoring and control units to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Software licenses.
3. Software service agreement.
4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Provide separately for each PC.
5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on compact disk or portable storage device with a USB interface of the hard-copy submittal.
6. Program Software Backup: On compact disk or portable storage device with a USB interface, complete with data files.
7. Device address list.

8. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Microprocessor-based monitoring of electrical power distribution system(s) that includes the following:

1. Electrical meters that monitor, and connect to the data transmission network.
2. LAN: High-speed, multi-access, open, nonproprietary, industry-standard communication protocols.
3. Include Integration of Electrical Power Monitoring system into BMS system PC-based workstation with web access, with its operating system and application software, connected to data transmission network.

B. The electrical power monitoring system shall be Internet based.

1. System software shall be based on server thin-client architecture, designed around open standards of internet technology.
2. Intent of thin-client architecture is to provide operators complete access to power monitoring and control system via an Internet browser. No special software other than an Internet browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
3. Internet access shall be password protected.

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

D. UL Compliance: Listed and labeled as complying with UL 61010-1.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.

B. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

C. Interface with DDC System for HVAC: Provide factory-installed hardware and software to enable the DDC system for HVAC to monitor, display, and record data for use in processing reports.

1. Hardwired Monitoring Points: metering points as defined on drawings.
2. Industry-accepted, open-protocol communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely monitor meter information from a DDC system for HVAC workstation. Control features and monitoring points displayed locally at metering panel shall be available through the DDC system for HVAC.

2.3 MULTIFUNCTION ENERGY METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens
2. ABB/General Electric Company.
3. Schneider Electric USA, Inc.
4. **Eaton (ADDENDUM 01)**

B. Multifunction Energy Meter: Separately mounted, modular, permanently installed, solid-state, digital I/O instrument for power and energy metering and monitoring; complying with UL 61010-1.

1. Capable of metering 4-wire Y, 3-wire Y, 3-wire delta, and single-phase power systems.
2. Equipped with security lock to protect revenue related metering from unauthorized and accidental changes.

C. Environment: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in nontemperature-controlled spaces that have environmental controls to maintain ambient conditions of minus 4 deg to 158 deg F (minus 20 to plus 70 deg C) dry bulb and 5 to 95 percent relative humidity, noncondensing.

D. Overvoltage: Comply with UL 61010-1 overvoltage withstand rating for CAT III.

E. Accuracy:

1. Comply with ANSI C12.20, Class 0.5.
2. Neutral Current Measurement: Not more than 0.65 percent.
3. Power Factor: 1.0 percent.
4. Frequency: 0.1 percent.
5. THD: 1.0 percent.
6. Waveform Sampling: 64 per cycle.

F. Data Link:

1. Protocol shall be BACnet for integration with the existing Johnson Controls Metasys building automation system.

G. Meter Physical Characteristics:

1. Display: Backlit LCD with antiglare and scratch-resistant lens.
2. Display of Metered Values:

a. One screen to show at least three user-selected values displayed at the same time. Selections available to display shall include the following:

1) All meters.
2) Measurements.
3) THD.
4) Energy.
5) Demand.
6) Minimum and maximum values.
7) Power demand.

H. Sampling Rate: Continuously sample and record voltage and current at a rate not less than 64 samples per cycle, simultaneously on all voltage and current channels of the meter.

I. Meters:

1. Instantaneous, rms:

a. Current: Each phase, neutral and three-phase average.
b. Voltage: L-L each phase, L-L three-phase average, L-N each phase, and L-N three-phase average.
c. Active Power (kW): Each phase and three-phase total.
d. Reactive Power (kVAR): Each phase and three-phase total.
e. Apparent Power (kVA): Each phase and three-phase total.

f. Power Factor: Each phase and three-phase total.

2. Energy:

a. Active Energy (kWh): Three-phase total.

3. Demand, Derived from Instantaneous rms Meters:

a. Current: Present and maximum.
b. Active: Present and maximum.
c. Reactive: Present and maximum.
d. Apparent: Present and maximum.

4. Power Quality Measurements:

a. THD: Current and voltage from measurements simultaneously from the same cycle, as can be calculated from the specified sampling rate.

J. I/O: Two optically isolated digital outputs for KY pulsing or control. Output signal characteristics shall be 150 mA at 200 V.

1. KY Pulse: Generate standard KY pulses for a user-defined increment of metered active energy as follows:

a. User-defined pulse output, associated with kWh.
b. User-defined pulse output, associated with kVARh.

K. Capacities and Characteristics:

1. Power Supply: from equipment metered.
2. Circuit Connections:

a. Voltage: Measurement autoranging, 60- to 400-V ac L-N. Connect directly to low-voltage (600 V and less) without using voltage transformers or connect to instrument grade potential transformers secondary at 120 V. Meter impedance shall be 2-megohm L-L or greater. Overload Tolerance: 1500-V ac, rms, continuously.
b. Current: Connect to instrument grade current transformer with a metering range of 5 mA to 6 A. Overcurrent tolerance of the instrument shall be 10 A continuous, 50 A for 10 seconds once per hour, and 120 A for one second per hour.
c. Frequency: 45 to 65 Hz.
d. Time: Input from a GPS receiver to synchronize the internal clock of the instrument and to time-synchronize this instrument with the network to a deviation of not greater than 1 ms.

2.4 POWER METERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens
2. ABB/General Electric Company.
3. Schneider Electric USA, Inc.

B. Description: Separately mounted, modular, permanently installed, solid-state, digital I/O instrument for power monitoring and control; complying with UL 61010-1.

1. Capable of metering 4-wire Y, 3-wire Y, 3-wire delta, and single-phase power systems.
2. Equipped with security lock to protect revenue related metering from unauthorized and accidental changes.

C. Environment: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in nontemperature-controlled spaces that have environmental controls to maintain ambient conditions of minus 13 to 158 deg F (minus 25 to plus 70 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

D. Overvoltage: Comply with UL 61010-1 overvoltage withstand rating for CAT III.

E. Accuracy:

1. Comply with ANSI C12.20, Class 0.5.
2. Neutral Current Measurement: Not more than 0.65 percent.
3. Power: 0.6 percent.
4. Power Factor: 0.5 percent.
5. Active Energy: 0.6 percent.
6. Reactive Energy: 2.5 percent.
7. Frequency: 0.05 percent.
8. THD: 1.0 percent.
9. Waveform Sampling: 32 per cycle.

F. Data Link:

1. Protocol shall match meter and integrated BMS system.

G. Meter Physical Characteristics:

1. Display: Backlit LCD with antiglare and scratch-resistant lens.
2. Display of Metered Values: One screen to show at least [**four**] <**Insert number**> lines of user-selected values on one screen at the same time. Provide graphical representation of user-selected values. The screen selections available at the display shall include the following:

a. All meters, including those listed under the following:

1) Measurements.
2) THD.
3) Energy.
4) Demand.
5) Minimum and maximum values.
6) Power demand.

H. Sampling Rate: Continuously sample and record voltage and current at a rate not less than 32 samples per cycle, simultaneously on all voltage and current channels of the meter.

I. Meters:

1. Measurements: Instantaneous, in real time, rms to the 15th harmonic.

a. Voltage: L-L each phase, L-N each phase, and three-phase average.
b. Current: Each phase, three-phase average, and neutral.
c. Unbalanced current, L-L V ac and L-N V ac.
d. Active Power (+/- kW): Each phase and three-phase total.
e. Reactive Power (+/- kVAR): Each phase and three-phase total.
f. Apparent Power (+/- kVA): Each phase and three-phase total.
g. Displacement Power Factor: Each phase and three-phase total.
h. Distortion Power Factor: Each phase and three-phase total.
i. Frequency.

2. THD from measurements simultaneously from the same cycle, through 15th harmonic.

a. Voltage THD: L-L each phase, L-N each phase, and three-phase average.
b. Current THD: Each phase and three-phase average.
c. Total demand distortion.

3. Energy: Accumulated, indicate whether in-flow or out-flow, net and absolute values. Store the values in instrument's nonvolatile memory.

a. Active kWh.
b. Reactive kVARh.
c. Apparent kVAh.

4. Demand: Present, last, predicted, peak.

a. Three-phase average current.
b. Three-phase total active power (kW).
c. Reactive power (kVAR).
d. Apparent power (kVA).

5. Minimum and Maximum Values:

a. L-L and L-N voltages.

b. Current in each phase.
c. Power factor.
d. Active power total.
e. Reactive power total.
f. Apparent power total.
g. THD L-L and L-N voltages.
h. THD current in each phase.
i. Frequency.

J. Power Demand, User Selectable:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:

    a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
    b. Fixed block that calculates demand at end of the interval.
    c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.

3. Demand Calculation Initiated by a Synchronization Signal:

    a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
    b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
    c. Provide for synchronizing the demand with the internal of this instrument.

K. Data Recording: Store the listed values in instrument's nonvolatile memory, indicate which of the three phases relates to the value. Attach a date and time stamp to the peak values and the alarms.

1. Minimum and maximum of real-time rms measurement.
2. Energy.
3. Demand values.
4. Alarms, store the last 40 events.

L. Alarms: Transmit a digital output and show on display when alarmed. Provide for no fewer than 15 metered items. Each alarm shall be user configured, by using the following options:

1. Date and time stamp.
2. Enable-disable (default) or enable.
3. Pickup magnitude.
4. Pickup time delay.
5. Dropout magnitude.
6. Dropout time delay.

7. Alarm type.
8. Alarm label.

M. Meter Face:

1. Display: Backlit LCD display, six lines, with antiglare and scratch-resistant lens.
2. Display of Metered Values: One screen to show at least four user-selected values on one screen at the same time.
3. Provide for the reset of metered peak values.

N. Capacities and Characteristics:

1. Power Supply: 120-V ac, 60 Hz.
2. Circuit Connections:

a. Voltage: Measurements autoranging, 60- to 400-V ac L-N. Connect directly to low-voltage (600 V and less) without using voltage transformers or connect to instrument grade potential transformers secondary at 120 V. Meter impedance shall be 2-megohm L-L or greater. Overload Tolerance: 1500-V ac, rms, continuously.
b. Current: Connect to instrument grade current transformer with a metering range of 5 mA to 6 A. Overcurrent tolerance of the instrument shall be 10 A continuous, 50 A for 10 seconds once per hour, and 120 A for one second per hour.
c. Frequency: 45 to 65 Hz.
d. Time: Input from a GPS receiver to synchronize the internal clock of the instrument and to time-synchronize this instrument with the network to a deviation of not greater than 1 ms.

2.5 CIRCUIT METERS AND MONITORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens
2. ABB/General Electric Company.
3. Schneider Electric USA, Inc.

B. Description: Separately mounted, modular, permanently installed, solid-state, digital I/O instrument for power monitoring and control; complying with UL 61010-1. Capable of metering 4-wire Y, 3-wire Y, 3-wire delta, and single-phase power systems.

1. Equipped with security lock to protect revenue related metering from unauthorized and accidental changes.

C. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 14 to 122 deg F (minus 10 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

D. Overvoltage: Comply with UL 61010-1 overvoltage withstand rating for CAT III.

E. Accuracy:

1. Comply with ANSI C12.20, Class 0.5.
2. For Voltage and Current: 0.5 percent of reading.
3. For Active Power: 0.2 percent.
4. For Active and Reactive Energy: ANSI 12.20, Class 0.2.
5. For Frequency: 0.01 Hz in the range of 45 to 65 Hz.
6. For Power Factor: 0.2 percent from 0.5 leading to 0.5 lagging.

F. Data Links:

1. Protocol shall match meter and integrated BMS system.

G. Meter Physical Characteristics:

1. Display: Backlit LCD screen with antiglare and scratch-resistant lens.
2. Display of Metered Values: One screen to show at least four lines of user-selected values on one screen at the same time. Provide graphical representation of user-selected values.
3. Allow user to select a date/time format and the ability to create additional screens for user-specified views and custom quantities without overwriting existing standard screens.

H. Sampling Rate:

1. Continuously sample and record voltage and current at a rate not less than 128 samples per cycle, simultaneously on all voltage and current channels of the meter.

I. Meters shall measure, record with time stamp, calculate, and on request display the following:

1. Measurements: Instantaneous, in real time, rms to the 31st harmonic:

a. Voltage: L-L each phase, L-L three-phase average, L-N each phase, and L-N three-phase average.
b. Current: Each phase, three-phase average, and neutral.
c. Active Power (kW): Each phase and three-phase total.
d. Reactive Power (kVAR): Each phase and three-phase total.
e. Apparent Power (kVA): Each phase and three-phase total.
f. Displacement Power Factor: Each phase and three-phase total.
g. Distortion Power Factor: Each phase and three-phase total.
h. Frequency.

2. THD from measurements simultaneously from the same cycle, through 31st harmonic:

a. Voltage: L-L each phase, L-L three-phase average, L-N each phase, and L-N three-phase average.
b. Current: Each phase, three-phase average, and neutral.

3. Energy: Accumulated, indicate in-flow or out-flow, net and absolute values. Store the values in instrument's nonvolatile memory. Provide for storing accumulated energy at user-defined intervals, up to three intervals per day.

a. Active kWh.
b. Reactive kVARh.
c. Apparent kVAh.

4. Demand: Three-phase totals, present, predicted, peak.

a. Average current.
b. Active power (kW).
c. Reactive power (kVAR).
d. Apparent power (kVA).

5. Average, Minimum and Maximum Values:

a. Record, date and time stamp, and save the minimum and maximum values of all rms metered values since the last reset.

J. Power Demand, User Selectable:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:

a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
b. Fixed block that calculates demand at end of the interval.
c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.

3. Demand Calculation Initiated by a Synchronization Signal:

a. Synchronize demand with receipt of a signal pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
b. Synchronize demand with receipt of a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
c. Provide for synchronization to the clock in the instrument.

K. Trend Curves: Provide for recording four trend curves at intervals of one minute, one hour, one day, or one month; and forecast values for the trended parameters.

1. Record minimum, maximum, and average values of eight user-selected parameters as follows:

    a. Every second for one minute for the one-minute curve.
    b. Every minute for one hour for the one-hour curve.
    c. Every hour for one day for the one-day curve.
    d. Every day for one month for the one-month curve.

2. Forecast the trended parameters for the following:

    a. The next four hours.
    b. The next four days.

L. Waveform Capture:

1. Steady State Waveform Capture: Manually initiated.

    a. Capture, record with time stamp, and store voltage and current waveforms for two cycles.
    b. Capture, record with time stamp, and store 128 digitally sampled data points for each cycle of each phase voltage. The number of waveform captures stored onboard shall be user configurable.
    c. Harmonic analysis performed on the captured waveforms shall resolve harmonics through the 63rd.
    d. Captured waveforms shall be recorded from actual circuit performance.

2. Disturbance Waveform Capture:

    a. Capture, record with time stamp, and store 128 digitally sampled data points for each cycle of each phase voltage. Disturbance waveform capture may be initiated manually, by an external contact closure, or by an alarm. The waveform captures shall be user configurable from 185 cycles on 1 channel at 16 points per cycle, to 3 cycles on 6 channels at 128 points per cycle.

M. Disturbance Detection and Alarm:

1. Detect and initiate alarm when detecting voltage or current sag and swell.

    a. Detect disturbance events of less than half-cycle in length, by monitoring and calculating rms magnitude of each half-cycle.
    b. Event detection shall be with user-defined parameters of threshold and delay. The threshold shall be user defined as a fixed or relative set point. With relative set point, the instrument will alarm based on the nominal current or voltage equal to its present average value. The instrument shall automatically adjust the nominal current and voltage values to avoid nuisance alarms caused by gradual daily variations of currents and voltages.
    c. When detecting an alarm condition:

        1) Initiate disturbance waveform capture.

2) Record the disturbance parameters into an onboard alarm log with a date and time stamp to the millisecond.
3) Alarm on shall be visible on the display and be transmitted over the data link.
4) Display the voltage sag/swell events on ITIC or SEMI graphs to quantify the event for accepted industry standards.

N. Harmonics Information:

1. Calculate the harmonic magnitudes and angles for each phase voltage and current through the 63rd harmonic. Provide harmonic power flows up to the 41st harmonic for active, reactive, and apparent power.
2. The current and voltage information for all phases shall be obtained simultaneously from the same cycle.
3. Report harmonic information as a percentage of the fundamental or as a percentage of the rms values, as selected by the user.

O. Alarms: Alarm events shall be user definable. Provide a minimum of 40 user-defined alarm conditions.

1. User Configuration Options:

a. Date and time stamp.
b. Enable-disable (default) or enable.
c. Pickup magnitude.
d. Pickup time delay.
e. Dropout magnitude.
f. Dropout time delay.
g. Alarm type.
h. Alarm label.

2. The following classes of events shall be available to be programmed as alarm events:

a. Over/under current.
b. Over/undervoltage.
c. Current imbalance.
d. Phase loss, current.
e. Phase loss, voltage.
f. Voltage imbalance.
g. Over kVA.
h. Over kW or kVAR into/out of load.
i. Over/under frequency.
j. Under power factor, true or displacement.
k. Over THD.
l. Over demand, current or power.
m. Reverse power.
n. Phase reversal.
o. Status input change.
p. End of incremental energy interval.

q. End of demand interval.
r. Over/under analog inputs.
s. Current sag/swell.
t. Voltage sag/swell.

3. For each over/under metered alarm value, provide for the user to define a pickup, dropout, and delay.
4. The circuit meter and monitor alarms response time shall be not less than one second.
5. Provide for up to four alarms to be combined to give a single result using Boolean algebra operations.

P. EN 50160 Evaluation: Report EN 50160 evaluation data in the following formats: summary of active evaluations, summary of evaluation status, detailed information for each evaluated parameter, and detailed information for each abnormal event.

Q. I/O Module: Modular, with multiple I/O options to accomplish specified performance and one or more spare positions for future.

1. KY Pulse: Generate a standard KY pulses for a user-defined increment of metered active energy as follows:

a. User-defined pulse output, associated with kWh.
b. Alarm pulse output, which turns on the pulsing at user-defined point.

2. Digital Inputs: As follows:

a. One input connection rated 24- to 125-V ac or -V dc, +/- 10 percent, less than 5-mA burden, 1350-V rms isolation.
b. Two input connections rated 20- to 150-V dc or -V ac, 2 mA maximum.

3. Analog inputs, no fewer than two, adjustable from 0- to 5-V dc or 4 to 20 mA.
4. Outputs to operate field-installed relays, no fewer than two, providing 6- to 240-V ac or 6- to 30-V dc, 2 A rms. 5 A maximum for 10 seconds per hour.
5. Analog outputs, no fewer than two, 4- to 20-mA dc into 600 ohms maximum.

R. Data Recording: Store the listed values in instrument's nonvolatile memory, indicate which of the three phases relates to the value. Attach a date and time stamp to the peak values and the alarms.

1. Data Logs, General: User configurable. Automatically stamp each entry to the millisecond with date and time.

a. Each log entry shall hold data of up to 96 parameters each.
b. Each log shall be user configurable to log data at a different user-defined schedule interval.
c. Provide each log with user-defined event or a minimum/maximum condition that will trigger log file entries.
d. Configure log entries to be recorded as Fill & Hold or Circular (First in, First out, or FIFO), as defined by the user.

2. Minimum/Maximum Logs:

    a. Minimum/Maximum/Average interval log also logs minimum/maximum/average of selected parameters on a selected interval from a user-selected interval length from 1 to 1440 seconds.
    b. Minimum/Maximum log shall include the time, date, and value for the minimum and maximum of each of the real-time metered values.

3. Alarm Log: Record time, date, event information, and coincident information for each user-defined and automatically initiated alarm or event. Record selected parameters at 100-ms intervals during events and alarms. Automatically stamp each entry to the millisecond with date and time.
4. Waveform Logs: Capture and store waveforms, from 185 cycles on one channel at 16 samples per cycle, up to 3 cycles on six channels at 128 samples per cycle as defined by the user. Waveform log entries shall be externally triggered or forced in response to a user-defined event. Configure log entries to be recorded as Fill & Hold or Circular (FIFO), as defined by the user.

S. Capacities and Characteristics:

1. Power Supply: from equipment metered.
2. Circuit Connections:

    a. Voltage: Measurement autoranging, 0- to 600-V ac L-L, 0- to 347-V ac L-N. Connect directly to low-voltage (600 V and less) without using voltage transformers or connect to instrument grade potential transformers secondary at 120 V. Meter impedance shall be 2-megohm L-L or greater. Overload Tolerance: 1500-V ac, rms, continuously.
    b. Current: Connect to instrument grade current transformer with a metering range of 5 mA to 6 A. Overcurrent tolerance of the instrument shall be 10 A continuous, 50 A for 10 seconds once per hour, and 120 A for one second per hour.
    c. Frequency: 45 to 65 Hz.
    d. Time: Input from a GPS receiver to synchronize the internal clock of the instrument and to time-synchronize this instrument with the network to a deviation of not greater than 1 ms.

2.6 NETWORKED PC OPERATING SYSTEM SOFTWARE

A. Description: System software shall monitor, analyze, display, control, and save parameters and features available at each of the connected meters.

B. Software: Configured to run on a single PC, with capability for accessing multiple devices simultaneously. Software shall include interactive graphics client and shall be web enabled.

C. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 32-bit operating system that allows concurrent multiple workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

D. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device, touchscreen, or mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from 1 to 60 minutes in 1-minute increments on a per operator basis.
5. Record operator sign-on and sign-off activity.
6. Security Access:

    a. Operator access to electrical monitoring and control system shall be under password control.
    b. An alphanumeric password shall be user assignable to each operator.
    c. Software shall have at least five access levels.

        1) View - View information. No change privileges allowed.
        2) User - Same as View, but is able to initiate control functions.
        3) Controller - Same as User, but is able to initiate communications.
        4) Operator - Same as Controller, but is able to modify configurations.
        5) Supervisor - Same as Operator, but is able to administer security privileges.

    d. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator-assigned access level(s) and menu-item access level(s) is required to gain access to menu item.
    e. Display menu items to operator with those menu items capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

E. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator.
2. Descriptors for graphics, points, alarms, and such shall be modified through workstation under password control.
3. Display operator accessed data on the monitor.

4. Help Features: On-line context-sensitive help utility to facilitate operator training and understanding.

2.7 POWER MONITORING SOFTWARE

A. Data Storage and Data Sharing:

1. Query and download logs of interval data stored on metering devices.
2. Query and download logs of alarm and event data stored on metering devices.
3. Query and download logs of waveform capture data stored on metering devices.
4. Query and download logs of interval data generated by the software and calculated by the meters.
5. Query and download logs of alarm and event data generated by the software and calculated by the meters.
6. Automatically re-arm the waveform recorders, on upload of information.
7. Provide a facility to archive, trim, and back up the database on demand, or on a schedule.
8. Provide a facility to view historical data from archived databases.
9. Support user changes to the database.

    a. Support on-line changes while the data storage/retrieval application is running.
    b. Suffer no interruption to its operation while changes are being made.
    c. Require no restart once the configuration has been performed.

B. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by the electrical power monitoring and control system.
2. Plan for each building floor, showing the following:

    a. Locations and identification of all monitored and controlled electrical equipment.

3. Control schematic for each device that is controlled by the meters of this Section, including a graphic system schematic representation, similar to that indicated on Drawings, with device identification.
4. Graphic display for each piece of equipment connected to the electrical monitoring and control system through a data link.
5. Electrical power monitoring and control system network riser diagram that shows schematic layout for entire system including meters, gateways and other network devices.

2.8 NETWORK CONFIGURATION SOFTWARE

A. Network Management Graphical Interface Features:

1. Add and remove devices in the power monitoring and control network.
2. Application for naming devices based on a user-defined naming scheme.
3. Add and remove I/O servers in the power monitoring and control network.
4. Edit communication properties for devices including timeouts and delays.

5. Display mandatory fields when adding a new device.
6. Allow to manually connect and disconnect serial, Ethernet, modem, and Ethernet gateway sites.
7. Enable and disable devices and sites in the power monitoring and control network without interruption to other devices or sites.
8. Pool modem resources so that the software uses any available modem.
9. Monitor the following diagnostics:

    a. Communication request/response and error rates, and timeouts.
    b. Log acquisition services.

B. Database Maintenance Features:

1. Backup, archive, and trim data, event, and waveform logs.

    a. Record start and end date for operation.
    b. Allow copying data to another database.
    c. Be capable of selecting any or all of the logs specified for the meters that are Work of this Section.

        1) Data logs.
        2) Event logs.
        3) Waveform logs.

C. Web Reporter: Allow viewing historical data in preformatted report templates via a web browser.

1. Features:

    a. User-configurable report generator to trigger on event, based on a schedule, or manual initiation.
    b. Format reports in HTML, PDF, TIF, Excel, XML, or user-selected printer, or network folder.
    c. Distribution of reports via email.

2. Report on power and demand profiles.
3. Power quality report with CBEMA evaluation.
4. EN 50160 compliance report.
5. 100-ms PQ report.
6. Energy over Period Report:

    a. User-defined rollup interval by day, week, month, or year.
    b. Compare daily energy to the following:

        1) Previous day.
        2) Same day, previous week.
        3) Same day, previous month.
        4) User-defined specific day.

c. Compare weekly energy to the following:

1) Previous week.
2) Same week from previous month.
3) Same week from previous year.
4) User-defined specific week.

d. Compare monthly energy to the following:

1) Previous month.
2) Same month from previous year.
3) User-defined specific month.

e. Compare annual energy to the following:

1) Previous year.
2) User-defined specific year.

7. Energy by daily period report for the user-defined periods. Aggregate consumption of the periods by the day, week, and year.
8. Tabular Report: Show values for multiple measurements and measurements from multiple devices in tabular format.
9. Trend Report:

a. Show values for multiple measurements and measurements from multiple devices in any of the following graphical formats:

1) Line chart.
2) Pie graph.
3) Bar chart.
4) Column chart.
5) Smooth line chart.
6) Stacked column chart.
7) Stacked bar chart.

10. Alarm and Event History: User formatted, based on the meters and priority; and with user-defined alarm and event reports.
11. System Configuration Report:

a. Device name.
b. Device type.
c. Device address.
d. Connection status.
e. Device protocol.
f. Device description.

12. Each default report shall include the following:

a. Summary aggregation of data from the selected devices.

b. Individual device information.
c. Raw data.

13. The reporting tool shall provide a graphical interface to create and manage multiple Time of Use schedules:

a. Tariffs including energy cost rates per kWh, kVARh, and kVAh, and demand charges per kW, kVAR, and kVA.
b. Off-peak and on-peak times.

2.9 MONITORING OF POWER DISTRIBUTION EQUIPMENT

A. Power Distribution Equipment: Web-enabled, direct connected to the LAN or intranet.

B. Instrument Transformers: Comply with IEEE C57.13.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA C12.11 accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

C. Ethernet Connectivity:

1. A multipoint, RS-485 Modbus serial communications network shall be included within the equipment to interconnect breaker trip units, protective relays, drives, and metering devices equipped with communications.
2. Serial communications network shall be wired to an Ethernet server in the incoming section of the equipment. Hardware and cabling required for the connection to the network shall be included within the power distribution equipment.
3. Serial communications devices within the equipment shall be factory addressed and tested to verify reliable communications to the equipment's Ethernet Server.

D. Ethernet Gateways:

1. User configurable; complying with UL 60950-1, and IEEE 802.3, Class 3 PoE.
2. Include provisions to set initial Ethernet parameters via a local operator interface, or standard (RJ-45) Ethernet port, that is accessible from the front of the equipment. Initial setup shall be limited to basic Ethernet addressing parameters, as assigned by Owner.
3. Common Gateway Features:

a. User configurable, with secure password-protected login process.
b. Include communications diagnostic information for serial and Ethernet ports as well as internal health status and memory management information through embedded HTML web pages for viewing using a standard web browser.
c. Include embedded HTML pages providing real-time information from devices connected to the Ethernet gateway's RS-485 port(s) through a standard web browser.
d. Allow firmware upgrades through the communications port.

4. Include a "Quick-Start" guide with the equipment to describe the commissioning process for setting the equipment's Ethernet network address and for ensuring trouble-free data access from any PC on the network, using a standard web browser.
5. Implement a common user interface ("look and feel") across all styles of power equipment.

E. Distribution Equipment Monitoring:

1. Main menu and summary pages, factory configured, to display data for each communicating device within the power equipment lineup.
2. Display Data:

a. Circuit summary page to display circuit name, three-phase average rms current, real power (kW), power factor, and breaker status (if applicable).
b. Load current summary page to display circuit name, and phase a, b, and c rms current values.
c. Demand current summary page to display circuit name, and phase a, b, and c average demand current values.
d. Power summary page to display circuit name, present demand power (kW), peak demand power (kW), and recorded time and date.
e. Energy summary page to display circuit name, real energy (kWh), reactive energy (kVARh), and time/date of last reset.
f. For unit substations equipped with dry-type transformer(s) and microbased temperature controller(s), the circuit summary web page listed above shall be augmented with transformer coil temperatures, phase a, b and c current values, and cooling fan status (on/off).
g. For motor-control centers, the circuit summary web page shall be tailored specifically for this application, to display circuit name, three-phase average rms current, thermal capacity (percentage), drive output frequency (in Hertz, where applicable), and contactor status.

2.10 SYSTEM OPERATOR INTERFACES

A. Operator means of system access shall be through the following:
1. Remote connection using outside of system PC, tablet, or phone using an internet portal.

2.11 RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.

B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for control wiring, RS-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.

2.12 WIRES AND CABLES

A. Electrical Power Wiring: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Copper conductors are Type THHN/THWN-2.

B. Control Wiring:

1. Optical-Fiber Cable: Multimode, 50/125-micrometer OM3, six-fiber, nonconductive, tight-buffer, optical-fiber cable, with aqua jacket.
2. Balanced Twisted Pair Cable: 100-ohm, four-pair Category 6.
3. RS-485 Cable: Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
4. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.

a. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
b. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
c. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

C. RS-232 Cable:

1. PVC-Jacketed, RS-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

a. Type CM.
b. Flame Resistance: UL 1581, vertical tray.

2. Plenum-Type, RS-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

a. Type CMP.
b. Flame Resistance: NFPA 262, flame test.

2.13 SURGE PROTECTION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Protection Technologies Inc. (APT).
2. PowerLogics, Inc./PQ Protection.
3. Schneider Electric USA, Inc.

4. Siemens Industry, Inc., Energy Management Division.

B. SPDs: Comply with UL 1449, Type 2.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual metal-oxide varistors in a given mode.

D. Comply with UL 1283.

E. Protection modes and UL 1449 SPD for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. L-N: 1200 V for 480Y/277 V/700 V for 208Y/120 V.
2. L-G: 1200 V for 480Y/277 V/700 V for 208Y/120 V.
3. N-G: 1200 V for 480Y/277 V/700 V for 208Y/120 V.
4. L-L: 2000 V for 480Y/277 V/1200 V for 208Y/120 V.

F. SCCR: Equal or exceed 100 kA.

G. Nominal Rating: 20 kA.

H. Indoor Enclosures: NEMA 250, Type 1.

I. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting performance of the Work.

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

3.2 POWER MONITORING AND CONTROL SYSTEM INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceways except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

C. 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.

D. Wiring and Cabling Installation:

1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.

E. Raceways Installation:

1. Comply with Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.
2. Comply with Section 270528 "Pathways for Communications Systems" for control wiring, RS-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.

F. Identification Installation:

1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
2. Comply with Section 271500 "Communications Horizontal Cabling" for identification products and cable management system requirements for twisted pair cable, RS-485 cable, low-voltage control cable, and RS-232 cable.

3.3 WORKSTATION INSTALLATION

A. Desktop Workstations Installation:
1. Install software on BMS workstation(s) and verify that software functions properly.
2. Develop Project-specific graphics, trends, reports, logs, and historical database.

B. Graphics Application:

1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Submit sketch of graphic layout with description of all text for each graphic for Owner's and Architect's review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing shall be done on-site with Owner's review and feedback.

7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy to include in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of the system operation and maintenance manual.

3.4 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

3.5 GROUNDING

A. For data communication wiring, comply with NECA/BICSI 568.

B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Visually inspect balanced twisted pair cabling and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test balanced twisted pair cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

5. Optical-Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to IEC 61280-4-1.
2) Attenuation test results for links shall be less than that calculated according to equation in TIA-568-C.0.

c. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

6. Power Monitoring and Control System Tests.

a. Test Analog Signals:

1) Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2) Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3) Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

b. Test Digital Signals:

1) Check digital signals using a jumper wire.
2) Check digital signals using an ohmmeter to test for contact making or breaking.

c. I/O Control Loop Tests:

1) Test every I/O point to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2) Test every I/O point throughout its full operating range.
3) Test every control loop to verify that operation is stable and accurate.
4) Adjust control loop proportional, integral, and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5) Test and adjust every control loop for proper operation according to sequence of operation.
6) Test software and hardware interlocks for proper operation.
7) Operate each analog point at the following:

a) Upper quarter of range.
b) Lower quarter of range.

c) At midpoint of range.

8) Exercise each binary point.
9) For every I/O point in the system, read and record each value at workstation, at controller, and at field instrument simultaneously. Value displayed at workstation and at field instrument shall match.
10) Prepare and submit a report documenting results for each I/O point in the system, and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

B. Wiring and cabling will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 FINAL REVIEW

A. Submit written request to Architect when the power monitoring and control system is ready for final review. Written request shall state the following:

1. The system has been thoroughly inspected for compliance with Contract Documents and found to be in full compliance.
2. The system has been calibrated, adjusted, and tested and found to comply with requirements of operational stability, accuracy, speed, and other performance requirements indicated.
3. The system monitoring and control of electrical distribution systems results in operation according to sequences of operation indicated.
4. The system is complete and ready for final review.

B. Review by Architect will be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Final review shall include a demonstration to parties participating in final review.

3.8 MAINTENANCE SERVICE

A. Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of defective components, cleaning, and adjusting as required for proper system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the power monitoring and control system.

B. Extent of Training:

1. Base extent of training on scope and complexity of power monitoring and control system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

a. Provide no fewer than two days of training total.
b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
c. Total days of training shall be broken into not more than four separate training classes.
d. Each training class shall be no fewer than two consecutive day(s).

C. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

D. Instructor Requirements:

1. One or multiple qualified instructors, as required, to provide training.
2. Instructors shall have no fewer than five years of providing instructional training on no fewer than five past projects with similar electrical monitoring and control system scope and complexity.

E. Training Outline: Submit training outline for Owner review at least [**10**] <**Insert number**> business days before scheduling training. Outline shall include a detailed agenda for each training day that is broken down into each training session that day, training objectives for each training session, and synopses for each lesson planned.

F. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power, and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector, and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration, and service requirements.
5. The workstation provided with the system shall be used in training. If workstation is not indicated, provide a temporary workstation to convey training content.

G. Off-Site Training:

1. Provide conditioned training rooms and workspace with ample tables, chairs, power, and data connectivity for each attendee.
2. Provide capability to remotely access to Project monitoring and control system for use in training.
3. Provide a workstation for use by each attendee.

3.11 At Completion of Training:

A. Staff familiar with the system installed are capable of demonstrating operation of the system during final review.

B. Demonstration shall include, but not be limited to, the following:

1. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
2. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and workstations.
3. Trends, summaries, logs, and reports set-up for Project.
4. Software's ability to communicate with controllers, workstations, and uploading and downloading of control programs.
5. Software's ability to edit control programs off-line.

6. Data entry to show Project-specific customizing capability including parameter changes.
7. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
8. Execution of digital and analog commands in graphic mode.
9. Spreadsheet and curve plot software and its integration with database.
10. Online user guide and help functions.
11. For Each Meter:

    a. Memory: Programmed data, parameters, trend, and alarm history collected during normal operation is not lost during power failure.
    b. Operator Interface: Ability to connect directly to each meter with a portable workstation.
    c. Wiring Labels: Match control drawings.
    d. Network Communication: Ability to locate a meter on the network. Communication architecture matches Shop Drawings.
    e. Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators, and devices.

12. For Each Workstation:

    a. I/O point lists agree with naming conventions.
    b. Graphics are complete.

END OF SECTION 260913

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

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 distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Electric Company.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.
4. **Eaton (ADDENDUM 01)**

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.

1. 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.

C. Transformers Rated 15 kVA and Larger:

1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

1. One leg per phase.
2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
3. Grounded to enclosure.

C. Coils: Continuous windings without splices except for taps.

1. Coil Material: Copper.
2. Internal Coil Connections: Brazed or pressure type.
3. Terminal Connections: Bolted.

D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

E. Enclosure: Ventilated.

1. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Wiring Compartment: Sized for conduit entry and wiring installation.
4. Finish: Comply with NEMA 250.

a. Finish Color: Gray weather-resistant enamel.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

H. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 80deg C rise above 40 deg C ambient temperature.

I. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding the indicated insulation class in a 40 deg C maximum ambient and a 24-hour average ambient of 30 deg C.
2. Indicate value of K-factor on transformer nameplate.
3. Unit shall comply with requirements of DOE 2016 efficiency levels when tested according to NEMA TP 2 with a K-factor equal to one.

K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.

L. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.

M. Wall/pendant Brackets: Manufacturer's standard wall brackets or wall/pendant brackets fabricated from design drawings signed and sealed by a licensed structural engineer.

N. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:

1. 9.00 kVA and Less: 40 dBA.
2. 9.01 to 30.00 kVA: 45 dBA.
3. 30.01 to 50.00 kVA: 45 dBA for K-factors of 1, 4, and 9; 48 dBA for K-factors of 13 and 20.
4. 50.01 to 150.00 kVA: 50 dBA for K-factors of 1, 4, and 9; 53 dBA for K-factors of 13 and 20.
5. 150.01 to 300.00 kVA: 55 dBA for K-factors of 1, 4, and 9; 58 dBA for K-factors of 13 and 20 .
6. 300.01 to 500.00 kVA: 60 dBA for K-factors of 1, 4, and 9; 63 dBA for K-factors of 13 and 20.

2.4 IDENTIFICATION

A. Nameplates: Engraved, labels for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
2. Ratio tests at rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located.

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

3.2 INSTALLATION

A. Install wall/pendant-mounted transformers level and plumb with wall/pendant brackets fabricated by transformer manufacturer or from design drawings signed and sealed by a licensed structural engineer.

1. Coordinate installation of wall-mounted and pendant/structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. 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.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, and grounding.
c. Verify that resilient mounts are free and that any shipping brackets have been removed.

d. Verify the unit is clean.
e. Perform specific inspections and mechanical tests recommended by manufacturer.
f. Verify that as-left tap connections are as specified.
g. Verify the presence of surge arresters and that their ratings are as specified.

2. Electrical Tests:

a. Measure resistance at each winding, tap, and bolted connection.
b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

B. Related Requirements

1. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.

5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
8. Include diagram and details of proposed mimic bus.
9. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

D. Delegated Design Submittal:

1. For arc-flash hazard analysis.
2. For arc-flash labels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Routine maintenance requirements for switchboards and all installed components.
b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.8 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

C. 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 and scheduling the outage at the convenience of the owner:

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.

1.9 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB (Electrification Products Division).
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.
4. **Eaton (ADDENDUM 01)**

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Nominal System Voltage: as indicated on drawings.

J. Main-Bus Continuous: as indicated on drawings.

K. Indoor Enclosures: Steel, NEMA 250, Type 1.

L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

M. Barriers: Between adjacent switchboard sections.

N. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

O. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: Transformer, factory installed in switchboard.

P. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

Q. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

R. Bus Transition and Incoming Pull Sections as required: Matched and aligned with basic switchboard.

S. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

T. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

U. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

V. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Copper feeder circuit-breaker line connections.
4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
5. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors.
6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
7. Disconnect Links:

    a. Isolate neutral bus from incoming neutral conductors.
    b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

W. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

X. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

2.2 SURGE PROTECTION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by the switchboard manufacturer.

E. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.

F. Features and Accessories:

1. SPD shall be internal to switchboard and shall be connected to the main bus via a branch breaker.

2. Integral disconnect switch.
3. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
4. Indicator light display for protection status.
5. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
6. Surge counter.

G. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

H. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V; 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V; 1200 V for 208Y/120 V.
3. Line to Line: 2000 V for 480Y/277 V; 1000 V for 208Y/120 V.

I. SCCR: equal to protected equipment.

J. Nominal Rating: 20 kA.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current 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.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long and short time adjustments.
    d. Ground-fault pickup level, time delay, and I squared t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compressionstyle, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    f. Shunt Trip where indicated: 120-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.
    g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Time adjustments for long- and short-time pickup.
    c. Ground-fault pickup level, time delay, and I squared t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
5. Remote trip indication.
6. Communication Capability: Web enabled integral Ethernet communication module and embedded Web server with factory-configured Web pages (HTML file format). Provide functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
7. Control Voltage: 120-V ac.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Section 262813 "Fuses."

2.4 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, and the following:

1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, [**single**] [**tapped**] [**double**] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; [**wound**] [**bushing**] [**bar or window**] type; [**single**] [**double**] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
d. Megawatts: Plus or minus 1 percent.
e. Megavars: Plus or minus 1 percent.
f. Power Factor: Plus or minus 1 percent.
g. Frequency: Plus or minus 0.1 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Analog Meters:

1. Meters: 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with anti-parallax 250-degree scales and external zero adjustment.

D. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.

E. Instrument Switches: Rotary type with off position.

1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

F. Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.

G. Watt-Hour Meters and Wattmeters:

1. Comply with ANSI C12.1.
2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
3. Suitable for connection to three- and four-wire circuits.
4. Potential indicating lamps.
5. Adjustments for light and full load, phase balance, and power factor.
6. Four-dial clock register.
7. Integral demand indicator.
8. Contact devices to operate remote impulse-totalizing demand meter.
9. Ratchets to prevent reverse rotation.
10. Removable meter with drawout test plug.
11. Semiflush mounted case with matching cover.
12. Appropriate multiplier tag.

H. Impulse-Totalizing Demand Meter:

1. Comply with ANSI C12.1.
2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
3. Cyclometer.
4. Four-dial, totalizing kilowatt-hour register.
5. Positive chart drive mechanism.
6. Capillary pen holding a minimum of one month's ink supply.
7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording [**five**] [**15**] [**30**] <**Insert time period**>-minute integrated demand of totalized system.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control Circuits: 120-V ac, supplied from remote branch circuit.

C. Control Circuits: <**Insert control voltage**>-V dc.

D. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

E. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

F. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

F. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

2.7 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.

B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.

1. Nameplate: At least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.

C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

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

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches (50-mm) above concrete base after switchboard is anchored in place.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to switchboards.
6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount in same room on wall..

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, surge protection devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install spare-fuse cabinet.

H. Comply with NECA 1.

3.3 CONNECTIONS

A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

B. Support and secure conductors within the switchboard according to NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified on drawings and in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified on drawings and in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified on drawings and in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Acceptance Testing:

    a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Perform the following infrared scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Switchboard will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated. as specified in Section 260573.16 "Coordination Studies."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.
4. Fusible panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

B. 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 and scheduling outage at owner’s convenience:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. 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.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches (2.13 m) maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

   a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus where indicated: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus where indicated: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and

overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

L. Selective Coordination
1. Overcurrent protective devices shall be selectively coordinated with all supply side overcurrent protective devices.

2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company; GE Energy Management - Electrical Distribution.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.
4. **Eaton (ADDENDUM 01)**

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Fused switch.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

G. Branch Overcurrent Protective Devices: Fused switches.

H. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company; GE Energy Management - Electrical Distribution.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or fused switch as indicated on drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers or fused switches, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

G. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.4 ELECTRONIC-GRADE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company; GE Energy Management - Electrical Distribution.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. SPD.

1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
2. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

    a. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    b. Line to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    c. Neutral to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    d. Line to Line: 2000 V for 480Y/277 V 1200 V; for 208Y/120 V.

3. SCCR: Equal to the SCCR of the panelboard in which installed.
4. Inominal Rating: 20 kA.

G. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

2.5 FUSIBLE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Bussman
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Fusible branch circuit panelboards shall be listed to UL 67 and cULus to CSA Standard 22.2.

C. Equipment shall be shipped without branch circuit fuses installed. Branch circuit fuses shall be shipped separately with the chassis. Where greater than 100A main fuses are specified, equipment shall be shipped with main fuses installed. Where less than or equal to 100A main fuses are specified, fuses shall be shipped separately with the chassis.

D. Branch circuits must be interchangeable with fusible switches from 15A to 100A without additional required space.

E. Panelboard branch circuits shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component that prevents removal of the fuse while energized, provides open fuse indication, and fuse ampere rating rejection feature.

F. SPD.

1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
2. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

    a. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    b. Line to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    c. Neutral to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    d. Line to Line: 2000 V for 480Y/277 V 1200 V; for 208Y/120 V.

3. SCCR: Equal to the SCCR of the panelboard in which installed.
4. Inominal Rating: 20 kA.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:General Electric Company; GE Energy Management - Electrical Distribution.Siemens Industry, Inc., Energy Management Division.Square D; by Schneider Electric.MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
i. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
k. Multipole units enclosed in a single housing with a single handle.
l. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
m. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.

b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

c. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.7 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.

J. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

K. Install filler plates in unused spaces.

L. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

N. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads. Incorporate Owner's final room designations. Update directory after balancing panelboard loads. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified on drawings and in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Molded-case switches.
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

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

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB/General Electric.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.
4. **Eaton (ADDENDUM 01)**

B. Type HD, Heavy Duty:

1. Double throw.
2. Three or six pole as indicated.

3. 600-V ac.
4. Amperage as indicated on drawings.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. 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.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 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.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB (Electrification Products Division).
2. Siemens Industry, Inc., Energy Management Division.
3. 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. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

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

F. Lugs shall be suitable for 167 deg F (75 deg C) rated wire.

G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

H. 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.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

O. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
9. Electrical Operator: Provide remote control for on, off, and reset operations.
10. Accessory Control Power Voltage: Integrally mounted, self-powered;.

2.5 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

D. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs:

    a. Compression type, suitable for number, size, trip ratings, and conductor material.
    b. Lugs shall be suitable for 194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.

3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Accessory Control Power Voltage: Integrally mounted, self-powered;.

2.6 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 gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) or gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12).

C. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1) or directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.

3.4 INSTALLATION

A. 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.

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

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.5 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.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
   e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

   a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
   b. Inspect physical and mechanical condition.
   c. Inspect anchorage, alignment, grounding, and clearances.
   d. Verify that the unit is clean.
   e. Operate the circuit breaker to ensure smooth operation.
   f. Inspect bolted electrical connections for high resistance using one of the two following methods:

      1) Use a low-resistance ohmmeter.

         a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

      2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

         a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

   g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262816

SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

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. Manual motor controllers.
2. Enclosed full-voltage magnetic motor controllers.
3. Combination full-voltage magnetic motor controllers.
4. Enclosures.
5. Accessories.
6. Identification.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. NC: Normally closed.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SCPD: Short-circuit protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type of magnetic controller.

1. Include plans, elevations, sections, and mounting details.
2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.

    a. Listing document proving Type 2 coordination.

7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Routine maintenance requirements for magnetic controllers and installed components.
    b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
    c. Manufacturer's written instructions for setting field-adjustable overload relays.

d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W per controller.

1.10 FIELD CONDITIONS

A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than23 deg F (minus 5 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m) for electromagnetic and manual devices.
3. The effect of solar radiation is not significant.

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. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric Company.
   b. Siemens Industry, Inc., Energy Management Division.
   c. Square D; by Schneider Electric.
   d. **Eaton (ADDENDUM 01)**

2. Standard: Comply with NEMA ICS 2, general purpose, Class A.
3. Configuration: Nonreversing.
4. Flush or Surface mounting as indicated on drawings.
5. Red pilot light.

B. 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, provide products by one of the following:
   a. General Electric Company.
   b. Siemens Industry, Inc., Energy Management Division.
   c. Square D; by Schneider Electric.
2. Configuration: Nonreversing.
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.
4. Overload Relays: NEMA ICS 2, bimetallic class as schedule on Drawings.
5. Pilot Light: Red.

C. Integral Horsepower Manual Controllers (IHPMC): "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, provide products by one of the following:
   a. General Electric Company.
   b. Siemens Industry, Inc., Energy Management Division.
   c. Square D; by Schneider Electric.
2. Configuration: Nonreversing.
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.
4. Overload Relays: NEMA ICS 2, bimetallic class as scheduled on Drawings.

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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric Company.
   b. Siemens Industry, Inc., Energy Management Division.
   c. Square D; by Schneider Electric.

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

C. Configuration: Nonreversing.

D. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.

1. Operating Voltage: Manufacturer's standard, unless indicated.

E. 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.

   a. Spare CPT Capacity as Indicated on Drawings: 50 VA.

F. Overload Relays:

1. Solid-State Overload Relay:

   a. Switch or dial selectable for motor-running overload protection.
   b. Sensors in each phase.

c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
d. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

G. Digital communication module, using RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous rms current each phase, and 3-phase average.
2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
3. Active Energy (kWh): 3-phase total.
4. Power Factor: Each phase and 3-phase total.

2.4 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. General Electric Company.
   b. Siemens Industry, Inc., Energy Management Division.
   c. Square D; by Schneider Electric.

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

C. Configuration: Nonreversing.

D. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.

1. Operating Voltage: Manufacturer's standard, unless indicated.

E. 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.

   a. Spare CPT Capacity as Indicated on Drawings: 50 VA.

F. Overload Relays:

1. Solid-State Overload Relay:

a. Switch or dial selectable for motor-running overload protection.
b. Sensors in each phase.
c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

G. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.

H. Digital communication module, using RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous rms current each phase, and 3-phase average.
2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
3. Active Energy (kWh): 3-phase total.
4. Power Factor: Each phase and 3-phase total.

I. Fusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

J. Nonfusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

K. MCP Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

L. MCCB Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.5 ENCLOSURES

A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.

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

2.6 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. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. Motor protection relays shall be with solid-state sensing circuit and isolated output contacts for hardwired connections.

1. Phase-failure.
2. Phase-reversal, with bicolor LED to indicate normal and fault conditions. Automatic reset when phase reversal is corrected.
3. Under/overvoltage, operate when the circuit voltage reaches a preset value, and drop out when the operating voltage drops to a level below the preset value. Include adjustable time-delay setting.

C. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

D. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.7 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.

B. Arc-Flash Warning Labels:

1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.

    a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

        1) Location designation.
        2) Nominal voltage.
        3) Flash protection boundary.
        4) Hazard risk category.
        5) Incident energy.
        6) Working distance.
        7) Engineering report number, revision number, and issue date.

    b. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 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. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

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

E. 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.

F. 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.

3.3 IDENTIFICATION

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

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with drawings and specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.
    d. Verify the unit is clean.
    e. Inspect contactors:

        1) Verify mechanical operation.
        2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.

    f. Motor-Running Protection:

        1) Verify overload element rating is correct for its application.
        2) If motor-running protection is provided by fuses, verify correct fuse rating.

    g. Inspect bolted electrical connections for high resistance using one of the two following methods:

        1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or

NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:

a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
c. Test motor protection devices according to manufacturer's published data.
d. Test circuit breakers as follows:

1) Operate the circuit breaker to ensure smooth operation.
2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.

e. Perform operational tests by initiating control devices.

4. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove all necessary covers prior to the inspection.

a. Comply with the recommendations of NFPA 70B, "Testing and Test Methods" Chapter, "Infrared Inspection" Article.
b. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of each motor controller.
c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor controller 11 months after date of Substantial Completion.
d. Report of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used, and lists the following results:

1) Description of equipment to be tested.
2) Discrepancies.
3) Temperature difference between the area of concern and the reference area.
4) Probable cause of temperature difference.
5) Areas inspected. Identify inaccessible and unobservable areas and equipment.
6) Load conditions at time of inspection.
7) Photographs and thermograms of the deficient area.
8) Recommended action.

e. Equipment: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 deg C at 30 deg C. The equipment shall detect emitted radiation and convert detected radiation to a visual signal.

f. Act on inspection results and recommended action, and considering the recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.

C. Motor controller will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 SYSTEM FUNCTION TESTS

A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of sensing devices, alarms, and indicating devices.

B. Motor controller will be considered defective if it does not pass the system function tests and inspections.

C. Prepare test and inspection reports.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 262913.03

5SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

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 separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Product Certificates: For each VFC from manufacturer.

D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
b. Manufacturer's written instructions for setting field-adjustable overload relays.

c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and connect factory-installed space heaters to temporary electrical service.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Schneider Electric USA, Inc.
3. Siemens Industry, Inc., Building Technologies Division.
4. **Eaton (ADDENDUM 01)**

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Variable Frequency Controller standard and optional features shall be tested and shall Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: Constant torque and variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.

3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: equal to upstream, distribution equipment.
7. Ambient Temperature Rating: Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet (1000 m).
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
4. Under- and overvoltage trips.
5. Inverter overcurrent trips.
6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
7. Critical frequency rejection, with three selectable, adjustable deadbands.
8. Instantaneous line-to-line and line-to-ground overcurrent trips.

9. Loss-of-phase protection.
10. Reverse-phase protection.
11. Short-circuit protection.
12. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: UL 489, molded-case switch, with power fuse block and current-limiting fuses with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
3. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
4. NC alarm contact that operates only when circuit breaker has tripped.

2.3 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

    a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

    a. A minimum of two programmable analog inputs: 4- to 20-mA dc.
    b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:

    a. 0- to 10-V dc.
    b. 4- to 20-mA dc.
    c. Potentiometer using up/down digital inputs.
    d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of one programmable analog output signal(s) (4- to 20-mA dc), which can be configured for any of the following:

    a. Output frequency (Hz).
    b. Output current (load).
    c. DC-link voltage (V dc).

d. Motor torque (percent).
e. Motor speed (rpm).
f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.
b. Set point speed reached.
c. Fault and warning indication (overtemperature or overcurrent).
d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: One.

G. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

a. Monitoring: On-off status.
b. Control: On-off operation.

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.4 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.5 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.

C. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.

1. Bypass Contactor: Load-break, NEMA-rated contactor.
2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

D. Bypass Contactor Configuration: Full-voltage (across-the-line) type.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
    b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 50 VA.

6. Overload Relays: NEMA ICS 2.

    a. Solid-State Overload Relays:

        1) Switch or dial selectable for motor-running overload protection.
        2) Sensors in each phase.
        3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
        4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
        5) Analog communication module.

    b. NC isolated overload alarm contact.

c. External overload, reset push button.

2.6 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons: Covered.
2. Pilot Lights: Push to test.
3. Selector Switches: Rotary type.
4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

B. Reversible NC/NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

F. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

H. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

I. Spare control-wiring terminal blocks; wired.

2.8 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

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

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall.

For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch (100-mm) nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch VFC.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

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

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

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

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify [**Architect**] [**Construction Manager**] [**Owner**] before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923

274116 INTEGRATED AUDIOVISUAL SYSTEMS

PART I – GENERAL

1.1 GENERAL NOTES

A. Audiovisual System Designer herein shall be referred to as architect.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the contract including instructions to Bidders, General and Supplementary Conditions and Division 1 Specifications Sections apply to the work of this Section.

B. ANSI-Infocomm standards (10:2013) Audiovisual Systems Performance Verification

C. AVIXA S601.01:201X Energy Management for Audiovisual Systems (revises ANSI/INFOCOMM 4:2012)

D. AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015) Cable Labeling for Audiovisual Systems

E. AVIXA V20I.0I:20IX Projected Image System Contrast Ratio (replaces 3M: 2011)

F. AVIXA A102.01.2017 (Formerly A103.01:2017 Audio Coverage Uniformity in Listener Area

G. ANSI/AVIXA D401.01:20IX Standard Guide for Audiovisual Systems Design and Coordination Processes (replace 2M: 2010)

H. AVIXA F502.01:201X Rack Building for Audiovisual Systems

I. AVIXA V202.01:2016 Display Image Size for 2D Content in Audiovisual Systems

J. AES 67-2015

K. 2010 ADA Standards for Accessible Design

1.3 DEFINITIONS

A. AHJ: authorities having jurisdiction

B. AS DIRECTED means as directed by the Architect, or his representative.

C. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, or installed within hung ceilings.

D. ENGINEER: Where referenced in this Division, "Engineer" is the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Design Professional, in addition to involvement by, and obligations to, the "Architect."

E. EXISTING TO REMAIN: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

F. FURNISH: "To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."

G. FURNISHED BY OWNER (or OWNER-FURNISHED) or FURNISHED BY OTHERS: "An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.

H. INSTALL: "To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."

I. PROVIDE: "To furnish and install complete, and ready for the intended use."

J. PLENUM: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

K. SUBMIT means submit to Architect for review.

L. SUBSTITUTION means a product meeting all requirements and specifications and having been approved by the engineer to replace another product specifically identified herein.

M. SYSTEM BLOCK DIAGRAM: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

N. WHERE REQUIRED means where required by code or authorities having jurisdiction.

O. ZONE means a region or area set off as discreet, independent or distinct from surrounding or adjoining areas.

1.4 RELATED WORK SPECIFIED ELSEWHER

A. Power, and all conduits for both power and low voltage, shall be furnished and installed by Electrical Contractor. All back boxes to be furnished and installed by Electrical Contractor as indicated in the Schedule of Responsibility on drawing TA0.01 unless otherwise noted.

B. Coordination with the Electrical Contractor is required to assure correct audiovisual conduit routing, audiovisual back box locations, and technical power circuit locations as specified in Division 26 – Electrical.

C. Coordination with the Low Voltage Contractor is required to assure pathways for low voltage and fiber optic cabling for audiovisual signals meet or exceed those required for telecommunications, security, data, and other signal type cabling as provided by the Low Voltage contractor. Coordination between the Electrical Contractor, Low Voltage Contractor, and the Audiovisual Contractor shall also be required to provided technical grounding for all dedicated AV racks rooms. Grounding and pathways shall be as specified in Division 27 - Communications.

D. Requirements and materials that apply to the work of others related to audiovisual systems are listed here to define and establish audiovisual system requirements. Coordinate the work of this section with the work of other sections as required in order to maintain satisfactory progress of the work of other sections. Refer to schedule of responsibility on TA0.01, UON.

1.5 WORK OF THIS SECTION

A. This section covers all audiovisual (AV) systems as described for Garrett College CEPAC in Mchenry, Maryland. The objective is to provide professional systems, installed, acceptance tested, and ready to use.

B. This written specification and the large format TA series drawings shall be collectively referred to herein as the Contract Documents. These documents including the drawings, specifications, and equipment lists are for reference and are not to be viewed as complete or correct. The AV Contractor is ultimately responsible for completing the systems to the owner’s intent, and for bringing any design changes, errors, or modifications to the owner’s attention before purchasing any equipment or beginning any installation. System features that show up in one part may not be shown in others. In the case of conflict between written specifications and drawings, Contractor must seek written clarification from the Owner. In the event the

Contractor fails to obtain such written clarification, the interpretation of the Owner shall prevail. Where conflict exists with other specifications concerning such work or materials, this specification takes precedence unless otherwise approved in writing by the owner.

C. This section includes all labor, materials, equipment, and services necessary to furnish and install the Audiovisual Systems for Garrett College CEPAC in Mchenry, Maryland as show on the drawings, including but not limited to the following:
1. Projectors and Projector Screens
2. Computers for soft conferencing and wireless sharing applications
3. Control System Touch Panels
4. Custom Racks installed in Millwork
5. Ceiling Speakers
6. Ceiling Microphones
7. Table Microphones
8. Audio Digital Signal Processing
9. Video Conferencing Codecs and Cameras
10. PTZ Cameras for Performance Recording
11. Audio Amplification
12. IP Controlled Power Distribution
13. Network Switches for AV Networking and Control
14. Video Switching and Control System Processors and related transmitters/receivers
15. Custom Faceplates
16. Equipment Racks and Rack Accessories

D. Equipment purchased through this contract, whether stored on the job site in a construction manager designated space or in the AV contractors own storage facility, shall require the AV contractor to furnish a certificate of insurance that verifies that the contractor shall be responsible for replacement of equipment due to theft or damages from the time of purchase by the AV Contractor till official turn-over to the owner confirmed by owner sign-off.

1.6 PROJECT CONDITIONS

A. All dimensions and equipment locations shall be verified in the field prior to fabrication by the Audiovisual Contractor, who shall make at least one (1) visit to the job site prior to preparation of shop drawings.

B. Coordinate conduit placement, routing, and separation with the Electrical Contractor to ensure proper installation.

C. Room numbers as shown for all rooms and tags on drawings are for reference only, For the purpose of labeling equipment, plates, wiring runs, and all other equipment to be labeled by the AV integrator the integrator shall coordinate with the Architect and owner to verify the final room numbers.

D. When working in spaces where architectural finishes are complete including but not limited to: carpeting, finished wall surfaces, finished ceiling materials, finished millwork products, and any glass surfaces. The AV contractor is required to wear protective hand and foot coverings while working in finished spaces. Coordinate with the construction manager to confirm prior to the start of on-site work to verify where this caution and care for architectural surfaces is required. Any surface that is soiled or damaged as a result of the AV contractors work is the responsibility of the AV contractor to clean and/or repair per the Architects and Construction Managers specification at the AV Contractor's expense.

E. No claims for additional compensation shall be allowed due to the Audiovisual Contractor's misunderstanding of the work involved or lack of a thorough investigation of the job site.

1.7 CONTRACTOR RESPONSIBILITY

A. It shall be the responsibility of the Audiovisual Contractor to furnish and install equipment complete in all respects and to furnish and install any additional equipment required to fulfill the intent of the Contract Documents regardless of whether or not such items are herein specified or indicated without claim for additional payment or costs.

B. The work specified herein shall be accomplished by a single Audiovisual Contractor who has complete responsibility for the systems described. The Audiovisual Contractor is required to have five (5) years of experience with systems of similar size and scope in Higher Education and Theatrical Performance Venues.

C. The Audiovisual Contractor shall be responsible for coordinating with other trades a complete and suitable installation of electrical isolation equipment to meet the intent of this specification.

D. No electrical equipment (except approved equipment) shall be located within the Acoustically Sensitive Spaces or installed on walls common to Acoustically Sensitive Spaces (Refer to Part 1 Paragraph 11). The Audiovisual Contractor shall report all discrepancies between this requirement and the Contract Documents to the Architect, Owner, and Electrical Engineer prior to installation of such equipment.

E. Upon completion of installation, the AV Contractor shall be responsible for drafting and delivering As-built drawings to the owner.

F. . The Audiovisual Contractor shall be responsible for coordinating with other trades a complete and suitable installation of electrical isolation equipment to meet the intent of this specification.

G. F. General Contractor shall provide all necessary blocking and structural bracing and backing for audio and video display/monitor devices within the space.

H. G. Electrical Contractor shall provide all conduit, power receptacles, branch circuits and other

scope shown of the coordinated electrical drawings based on the approved final design.

I. H. It is the responsibility of the Electrical Contractor to coordinate a pre-install meeting with the Audiovisual Contractor and the architect to ensure that the proper installation of conduit including the required sizing and separation as shown on the audiovisual drawings is provided. Failed operation and/or signal performance of audiovisual cabling infrastructure to meet audiovisual equipment requirements due to signal interference shall result in removal and reinstallation of all conduit, backboxes, and related hardware in addition to the demolition and repair of any items needed to be removed to remove and reinstall the conduit at the Electrical Contractors expense.

J. Upon completion, AV contractor shall provide all documentation to allow owner to register for A+ partner points.

K. The Audiovisual Contractor shall have a non-working project manager on site from the beginning of installation through owner approved sign-off of system installation, programming, and configuration.

L. If the contractor installs any equipment specified in the contract documents without verifying that the performance of said equipment meets the functional requirements of this written specification or the design intent as indicated in the contract documents, the contractor shall be responsible for all labor, materials, and work of other trades to remove said equipment, restock it, and furnish installation of a compliant solution in addition to any other payments to other trades to complete their scope of work. The difference in cost between the specified materials and equipment and the materials and equipment required to meet design intent shall be furnished to the architect and owner prior to substitution and replacement of any equipment or materials and shall not be provided without written consent from the architect and owner.

1.8 DESIGN INTENT

A. The Audiovisual Contractor shall furnish and install turnkey infrastructure and equipment for a fully functional system including but not limited to wire, cable, equipment racks, wiring devices, and listed major equipment, and all equipment as shown on the design drawings.

B. The Audiovisual Contractor shall furnish line item pricing for Infrastructure and Major Equipment List written in this specification.

1.9 FUNCTIONAL REQUIREMENTS

A. PROSCENIUM THEATER, CONTROL ROOM, AND STAGE
1. SUMMARY
a. The proscenium theater is a space intended primarily for theatrical drama

productions. The space includes a stage house, gallery catwalk level in the stage house, and orchestra pit. The audience chamber is configured with audio mix position at the cross aisle with the ability to set up a tech table for rehearsal, a control booth, and catwalk for technical access above the audience chamber.

2. AUDIO
   a. The main audio reinforcement system of the space shall be Left Right line arrays and a Center Subwoofer array configured to optimize audio in the space for the proscenium configuration of the venue. Additional loudspeakers shall be provided when needed for monitoring and front fills designed to sit on the front lip of the stage. Amplifiers for all speakers shall live in the third floor AV rack room and be connected to the digital audio network for ease of routing and management.
   b. A total of (8) wireless microphones shall have their receivers installed in the control room for use in productions speech reinforcement for presentation. These receivers shall be connected to a remote antenna within the audience chamber to pick up signal from performers on the stage and in the house.
   c. For ADA compliance an FM transmitter with receivers to accommodate 4% of the occupancy of the venue capacity shall be provided for hearing assistance. The transmitter shall live in the control booth with its antenna remotely located in the audience chamber to broadcast to the portable receivers.
   d. Stage panels shall be located in the stage house as well as the pit for interface of wired microphones and audio sources to be interfaced with the digital audio network for routing to a digital mixing console or DSP device for audio management.
   e. Various intercom interfaces shall be located around the venue and in the stage production panels to allow for 2 channels of production intercom. A power supply will allow for intercom to work at all times, and a remote station in a portable rack shall be provided for the stage manager to interface with the two channels simultaneously.
   f. Speaker patch points shall be located around the audience chamber of the venue to accommodate both multi-channel sound design for theatrical productions as well as surround audio for video playback from 5.1 surround sources.
   g. A quantity of loose powered loudspeaker shall be procured for various applications such as sound effects, fills, and production monitoring
   h. Ethernet patch points and fiber optic patch points shall be located around the house and in production panels to allow for networked digital audio devices to be connected to expand input and output capabilities in key locations around the room.
   i. These patch points shall land on patch bays found in the control room and in the third floor AV Rack Room.
   j. A DSP unit shall be used to manage streams on the audio network so that output streams to the amplifiers can be selectable from the output of the console or from AVB devices directly via the DSP unit. The intent is to have a system that may run with an operator at the digital mixing console or to manage a few sources from the control system for less sophisticated events. Owner to verify requirements for simple presentation set up to be controlled by a control interface.
   k. A portable stage manager back of house paging system shall be furnished to allow for announcements between stage manager and production personnel. This system

shall override local volume control devices to allow for a distributed announcement to back of house spaces and front of house spaces. AV contractor shall provide DC power supply to meet specification required to control relays associated with overridable volume control devices. An integrated touch panel shall be furnished to allow for loudspeakers zones to specifically selected for paging. The layout of the touch panel shall be coordinated with the owner.

3. VIDEO
   a. A permanent ceiling mounted projector shall be provided in the control room. The projector shall project through a projector window onto a truss framed fast fold projection screen mounted to a line-set.
   b. A loose projector shall also be provided for video projection mapping on the stage. The loose projector shall be furnished with additional lenses and mounting hardware so that they may be used and installed by the end user in various locations on a per production basis
   c. A video matrix frame shall be installed in the space for routing of various video sources to video display devices in the system. Sources shall include a PTZ camera, IR Camera, PCs providing video content for productions, and patchable video transmitter devices found on the stage, the stage house and the catwalks. Outputs shall include the patchable video receiver devices throughout the space, lobby display, green room display, video receiver device for a local monitor in the booth, and to any of the ethernet patch points on the frame to interface a transmitter for distributing content to receivers with displays or projectors for monitoring or production purposes.
   d. Ethernet patch points, fiber optic patch points, and SDI patch points shall be located around the house and in production panels to allow for video sources and displays to be connected to expand input and output capabilities in key locations around the room. These patch points shall land on patch bays found in the control room and in the third floor AV Rack Room.
   e. A video presentation matrix switcher shall be used to route video sources to multiple video outputs. Video Inputs Shall Include:
      1) Inputs
         a) Input #1 From IR Camera
         b) Input #2 Spare SDI Input
         c) Video Transmitter #1 (PTZ Camera)
         d) Video Transmitter #2 (Media Player)
         e) Video Transmitter #3 (Stage Left)
         f) Video Transmitter #4 (Stage Right)
         g) Video Transmitter #5 (Downstage Right)
         h) Video Transmitter #6 (Control Room)
         i) DM Patch #19
         j) DM Patch #20
         k) DM Patch #21
         l) Fiber Video Transmitter #1 (Multipurpose Room)

      Outputs

a) Video Receiver #1 (Theater Projector)
b) Video Receiver #2 (Lobby Display)
c) Video Receiver #3 (Box Office Display)
d) Video Receiver #4 (Green Room Display)
e) Spare DM Output #1
f) Spare DM Output #2
g) DM Patch #22
h) DM Patch #23
i) DM Patch #24
j) Fiber Output to Multipurpose Room

4. CONTROL/NETWORK
   a. Control of all AV components in the system shall be from the AV system control processor. The control protocol for interfacing with devices shall be IP based, unless otherwise noted.
   b. This shall include the cameras, video matrix switcher, all displays permanently connected to the video switcher, and wireless microphones.
   c. A permanently installed control touch panel shall provide system control in the control booth. The programming and configuration of this panel shall be determined by the owner prior to deployment.
   d. Several patch bays shall be provided to allow manual patching and routing of audio and video signals for various production needs. The contractor shall be responsible for furnishing patch cabling of appropriate length and assembly to meet the production needs as determined by the client. Confirm the exact quantity of patch cabling to be provided with the system with end users during training.
   e. A managed network switch shall be provided for control, monitoring, digital audio routing, and providing PoE to devices as required for a complete and functional system. The switch shall have its uplink connected to the building's enterprise network and is to be coordinated with the Owner to confirm IT requirements and IP addressing of all devices. VLAN configuration should be enabled to provide a VLAN that segregates IP Control and AVB. Connection of the switch to the enterprise network shall also require integration with the clients existing Fusion reporting server.
   f. A rack mounted engineering PC shall be provided for programming all IP control able devices as required for this project.
   g. The AV contractor shall furnish a portable iOS touch screen tablet with the following list of programs at a minimum as well as any programs necessary to have control over a majority of systems necessary for a production. Coordinate with owner any additional owner furnished applications.
      1) Presonus - UC Surface
      2) Tascam SS250 Control
      3) Q-SYS Control

B. MULTIPURPOSE ROOM
   1. SUMMARY

a. The Multipurpose room consists of three partitioned spaces that is designated for meetings and large gatherings. The meeting room will also be used for performances and other events. The Meeting room will be outfitted with various network, audio, and video connections for flexible use of the space that will headend to a designated rack room.

2. AUDIO
   a. Each partitioned space will feature zoned audio which will consists of three zone defined by each partition. Each audio zone will feature (4) pipe mounted loudspeakers.
   b. A quantity of wireless microphones shall be provided to cover each partitioned space. The AV contractor shall provide omni directional remote antennas that must be located in the field and coordinated with architecture.
   c. For ADA compliance an IR transmitter with receivers to accommodate 4% of the occupancy of the venue capacity shall be provided for hearing assistance. The transmitter shall live in the equipment rack with its antenna remotely located in the space to broadcast to the portable receivers.
   d. Floor boxes shall be located throughout the space for interface of wired microphones and audio sources to be interfaced with the digital audio network for routing to a DSP device for audio management.
   e. A portable wireless intercom system shall be provided to allow for production communication for a per production basis.
   f. Ethernet patch points shall be located in floor boxes to allow for networked digital audio devices to be connected to expand input and output capabilities in key locations around the room.
   g. A DSP unit shall be used to manage streams on the audio network so that output streams can be managed for each partition space or used in an uncombined mode for larger presentations and productions. Owner to verify requirements for simple presentation set up to be controlled by a control interface.

3. VIDEO
   a. A pipe mounted projector shall be furnished for each partitioned space to project an image on a recessed motorized projection (184”) screen.
   b. A video matrix frame shall be installed in the space for routing of various video sources to the projectors in the system. Sources shall include auxiliary HDMI inputs, and patchable video transmitter devices in floor boxes. Outputs shall include the patchable video receiver devices throughout the space, (3) projectors, and to any of the ethernet patch points on the frame to interface a transmitter for distributing content to receivers with displays or projectors for monitoring or production purposes.
   f. A video presentation matrix switcher shall be used to route video sources to multiple video outputs. Video Inputs Shall Include:
      2) Inputs
         a) Video Transmitter #1 (Floorbox Room 802)
         b) Video Transmitter #2 (Floorbox Room 803)

c) Video Transmitter #3 (Floorbox Room 804)
d) DM Patch #19
e) DM Patch #20
f) DM Patch #21
g) Fiber Video Transmitter #1 (Proscenium Theater)

Outputs

k) Video Receiver #1 (Projector Room 802)
l) Video Receiver #2 (Projector Room 803)
m) Video Receiver #3 (Projector Room 804)
n) Video Receiver #4 (Green Room Display)
o) DM Patch #22
p) Fiber Output to Proscenium Theater

c.

d. These projectors shall be furnished to the owner with additional lenses and mounting hardware so that they may be used and installed by the end user in various locations on a per production basis.

e. Ethernet patch points shall be located around the space to allow for video sources and displays to be connected to expand input and output capabilities in key locations around the room. These patch points shall land on patch bays found in the AV Closet.

4. CONTROL/NETWORK

a. Control of all AV components in the system shall be from the AV system control processor. The control protocol for interfacing with devices shall be IP based, unless otherwise noted.

b. This shall include the projectors, video matrix switcher, projection screens, and any devices permanently connected to the video switcher, and wireless microphones.

c. 3 permanently installed control touch panels shall provide system control in each partitioned space. The programming and configuration of this panel shall be determined by the owner prior to deployment.

d. A larger touch panel shall be mounted in the equipment rack in the AV Closet for non-end user control of the space. The programming and configuration of this panel shall be determined by the owner prior to deployment.

e. A rack mounted engineering PC shall be provided for programming all IP control able devices as required for this project.

f. A network video patch bay shall be provided to allow manual patching and routing of video signals for various production needs. The contractor shall be responsible for furnishing patch cabling of appropriate length and assembly to meet the production needs as determined by the client. Confirm the exact quantity of patch cabling to be provided with the system with end users during training.

g. A managed network switch shall be provided for control, monitoring, digital audio routing, and providing PoE to devices as required for a complete and functional system. The switch shall have its uplink connected to the building's enterprise network and is to be coordinated with the Owner to confirm IT requirements and IP addressing of all devices. VLAN configuration should be enabled to provide a

VLAN that segregates IP Control and Dante.

h. AV contractor shall coordinate the integration of the automatic window shade's control into the AV control system. Presets and other controls for shades shall mimic what has been designed by the shade's vendor on all applicable AV touch panels.

i. The AV contractor shall furnish a portable iOS touch screen tablet with the following list of programs at a minimum as well as any programs necessary to have control over a majority of systems necessary for a production. Coordinate with owner any additional owner furnished applications.
   1) QSC - Q-SYS Control
   2) Crestron - X Panel

C. BACK OF HOUSE AND AUXILIARY SPACES

1. SUMMARY

The back of house and auxiliary spaces consists of the Lobby, Corridors, Dressing Rooms, Multipurpose Dressing Rooms, Green Room, Public Men's and Women's Restrooms, Box Office, and Coat Room.

a. LOBBY 800
   3) First Level Front of House Lobby space with access to Multipurpose Room and Proscenium Theater with audio for background and playback, and digital signage for video playback from Proscenium Theater.
   4) An audio network endpoint shall be provided for a wired or wireless microphone for presentations in the Lobby.

b. CORRIDOR 800B
   1) Front of House Corridor with access to Piano lab with audio background and playback.

c. CORRIDOR 800A
   1) First Level Front of House Corridor space with access to Multipurpose Room, Proscenium Theater, and Back of House Spaces with audio for background and playback.

d. CORRIDOR 850
   1) Back of House Corridor providing access between front of house to back of house, and between the back of house support spaces for Proscenium Theater with audio background and playback.

e. PRINCIPLE DRESSING/PRACTICE ROOM 858
   1) Back of House Dressing Space for performers with audio monitoring and intercom functionality.

f. PRINCIPLE DRESSING/PRACTICE ROOM 857

1) Back of House Dressing Space for performers with audio monitoring and intercom functionality.

g. DRESSING/ MULTIPURPOSE ROOM 852
1) Back of House Dressing Space for performers with audio monitoring and intercom functionality.

h. DRESSING/ MULTIPURPOSE ROOM 853
1) Back of House Dressing Space for performers with audio monitoring and intercom functionality.

i. GREEN ROOM 808
1) Back of house green room for performers with audio and video monitoring of the Proscenium Theater and intercom functionality.

j. PUBLIC WOMEN'S RESTROOM 814
1) Front of House space with audio background and playback audio.

k. PUBLIC MEN'S RESTROOM 812
1) Front of House space with audio background and playback audio.

l. COAT ROOM 811
1) Front of House space with audio background and playback audio.

m. BOX OFFICE 810
1) Front of House space with audio background and playback audio.
2) AV Contractor shall also provide a monitor for displaying digital signage and owner furnished content.

D. AV ALTERNATE (#4)
1. IN-EAR MONITORING SYSTEM ALTERNATE #4
a. In-ear monitoring system to include 8 channels of wireless transmitters, 8 receivers with earphones, a portable rack, power distribution, and a utility drawer for storage of receivers and earphones.

1.10 SCOPE OF WORK

A. Furnish shop drawings and receive approval, prior to fabrication and installation.

B. Furnish all materials and labor and any engineering services to supply a complete and professionally installed system in working order. Labor furnished shall be specialized and experienced in audiovisual system installation.

C. Furnish and install all wire and cable called out in the Contract Documents.

D. Coordinate all backbox locations with the Electrical Contractor and appropriate general trades.

E. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment.

F. Perform initial adjustments and verification tests. Submit verification test report to the Architect and Owner five days prior to commissioning.

G. Participate in acceptance testing and perform final adjustments utilizing Audiovisual contractor furnished test equipment and project engineers.

H. Furnish and participate in user training.

I. Furnish system documentation including copies of all relevant drawings and equipment manuals in compliance with the Contract Documents.

J. Furnish maintenance services for the specified period from the date of acceptance.

K. Guarantee all new equipment, software, hardware, components, and workmanship for the specified period from the date of acceptance.

L. Refer to drawing TA0.01 Audiovisual General Notes for the Schedule of Responsibility.
M. Attend daily production meetings on site to review

N. Contractor shall be responsible for exchanges and returns of all equipment shown or described in the contract documents whether they are provided by the vendor or owner furnished.

O. Furnish to owner spares, additional parts, optional parts, specialty tools, or any miscellaneous equipment included with purchase of equipment described herein.

P. The AV Contractor is responsible for furnishing all software, configuration, and programming files to the owner required for integration upon completion of system commissioning. These files shall become property of Garrett College.

1.11 SUBMITTALS

A. Pre-bid Submittals:
   1. Contractors must pre-qualify in order to bid on this project. Contractors must provide proof of the following qualifications and certifications and evidence of experience in similar audio and/or video installations. Submit listed qualifications to Architect for review ten (10) days prior to submission of a bid. Late submittal will result in exclusion from bid.
      a. Credential for project manager, project engineer, and lead installer which must include NICET, EST, and/or CTS-I certifications.
      b. Proof of the AV Contractor's membership in NSCA or AVIXA (Audiovisual and

Integrated Experience Association). Indicate current AVSP level.

c. Proof that the AV Contractor has been continuously engaged in the installation and service of AV equipment for at least five (5) years in systems of similar size, scope, and project type.
d. Proof that the AV Contractor holds current certifications necessary to perform Graphic User Interface Programming and Configuration.
e. AV contractor shall submit copies of shop drawings/as-builts to indicate the ability to create drafts and drawings in CAD/Revit.

B. Bid Submittals:
1. Contractors shall examine all drawings and read all divisions of this specification in order to avoid omissions and duplications and to ensure a complete job. No allowances shall be made for failure to read and understand the Contract Documents. Discrepancies between drawings and the specifications or obvious omissions shall be referred to the Architect and Owner prior to the bid date. Where discrepancies occur, and pre-bid instructions have not been obtained, the Contractor agrees to abide by the Owner's decisions.
2. Bid proposals shall include all work and all equipment as specified, as well as any additional equipment and materials not listed here, to be used in assembling the system to fulfill the design intent.
3. The bid submittal shall include the following:
   a. Infrastructure and Major Equipment List and installation bid.
   b. Major Equipment List line item pricing.
      1) Installation costs for General Equipment including hardware and labor shall be furnished.
      2) Pricing shall include in-bound freight, shipping, and all delivery charges.
      3) This project is Tax exempt, and this shall be reflected in the pricing for this project.
         i. The AV Contractor shall provide proof that they are a Crestron Electronics Inc. Commercial A+ Partner in good standing, and hold all relevant DMC certifications for proper installation, programming, and engineering of systems herein. A minimum of a Silver Certified Crestron Programmer with the proper credentials on staff is required to bid on this project.

C. Shop Drawings Submittals:
1. Within thirty (30) days of contract award, submit four (4) copies of detailed shop drawings to the Architect and Owner for approval. All shop drawings shall be marked with the related drawing number when submitted.
2. System installation and fabrication shall not begin without written approval from the Architect and Owner.
3. Review of shop drawings shall not constitute final approval of system function. Said review does not in any way relieve the Contractor from the responsibility of furnishing material or performing work as required by the Contract Documents.

4. Failure of the Contractor to submit shop drawings in ample time for the evaluation shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default shall be allowed.
5. At a minimum, shop drawings shall include:
   a. Table of Contents
   b. Itemized list of all equipment and materials to be used in assembling the system.
   c. Catalog cut sheet or data sheet for each listed item.
   d. One-line Signal Flow diagrams for all sound reinforcement systems, visual systems, and auxiliary systems showing point to point wiring interconnections of all equipment with wire run numbers and patch bay designations. Show all transformers, switches, relays, control circuits, and modifications to equipment. Show all equipment items which are required for realization of the functions described herein.
   e. Complete lists of all wire run numbers along with the termination location of each end of each wire run.
   f. Schematic diagrams for any custom circuitry and all typical connections between audio lines, patch bays, visual system lines and rack mounted equipment.
   g. Drawings of all items which are to be custom fabricated or modified. Drawing shall be in scale suitable for fabrication. They shall show materials, finishes, hardware, back boxes, connectors, and panel/control markings. Submit samples of lettering/label size and typeface to be employed on custom plates, panels, and other equipment.
   h. Submit samples of custom work, finishes, or other materials as required by the Architect and/or Owner to verify appearance and quality. All costs for shipping samples shall be the responsibility of the Contractor.
   i. Full size drawings illustrating the physical layout and labeling of patch bays.
   j. Mechanical drawings of all assemblies, major and sub-assemblies, racks, cabinets, and enclosures, indicating provisions for proper cable management, power management, and thermal management.
   k. Mechanical drawings showing all proposed mounting details of all major equipment (e.g. loudspeakers, cameras, projectors, video displays, projection screens), and associated rigging and interface with adjacent architecture.
   l. Vibration and noise control information shall be included and coordinated with the Electrical Contractor.
   m. Conduit Routing Plan, to be coordinated with electrical contractor prior to cable pull.

6. The above listed drawings shall be produced on AutoCAD 2004 min. or similar computer drafting program. Scans or photocopies of the Contract Documents are not acceptable.
7. The use of electronic files from other sources (e.g. Architect's backgrounds, Architect's drawings, vendor-supplied panel drawings) shall not absolve the Contractor of the responsibility for ensuring that the Shop Drawings represent a completely engineered coordinated system. The Contractor has final responsibility for providing systems that conform to all requirements in the Contract Documents.

8. The Contractor shall review Electrical Contractor shop drawings for all vibration and noise control equipment and systems information.
9. Proposed Touch panel Graphical User Interface (GUI) layouts shall be submitted for approval prior to the commencement of control system programming. AV Contractor must have written confirmation from the owner of approved GUI layouts prior to development of system control code.

D. Substitutions:
1. No substitutions shall be permitted as part of the submittal process. It is the responsibility of the AV Contractor to provide all equipment as specified herein, and immediately inform the owner in writing of any equipment that is inaccessible to the AV Contractor.
2. Any items which may incur excessive lead times and delay must be reported to the owner in writing immediately, and modification to the equipment provided as part of this specification to prevent delay as a result of excessive lead times must be approved by the owner in writing prior to AV Contractor purchase.
3. The Owner reserves the right to substitute new products which become available subsequent to the issuance of the Contract Documents, provided that:
   a. The contractor has not yet purchased the originally specified equipment.
   b. The substitute equipment shall not materially increase the Contractor's cost.

1.12 JOB CONDITIONS

A. Keep the job adequately staffed at all times. Unless illness, loss of personnel, or other circumstances beyond the control of the Contractor intervene, keep the same individual charge throughout.

B. Cooperate with all appropriate parties in order to achieve well-coordinated progress with overall construction completion schedule and satisfactory results.

C. Watch for conflicts with work of other contractors on the job and execute, without fair claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or to preserve acoustic or visual performance, symmetry, and pleasing appearance.

D. Immediately report to the Owner any design or installation irregularities, particularly architectural elements that interfere with the intended coverage angles of loudspeakers, camera, or projection equipment, so that appropriate action may be taken.

E. The AV Contractor is required to have prior approval from the Construction Manager before any and all cutting, patching, and painting for proper and finished installation of the system, and repair any damage done as a result of such installation.

F. Audiovisual System work areas are to be maintained in a clean and orderly condition. Clean up and dispose of trash from all audiovisual system work areas.

1.13 ACOUSTICALLY SENSITIVE SPACES

A. The following areas have been designated as "Acoustically Sensitive Space:
   1. Control Rooms
   2. Electrical Equipment Spaces
   3. Mechanical Equipment Spaces

B. An acoustically sensitive space is defined as a room or space, which requires special construction consideration to meet room acoustic, acoustic isolation, and noise control or vibration control requirements.

C. All conduit runs penetrating acoustically sensitive spaces shall have both ends sealed by means of removable closed cell neoprene foam after all cables have been run to prevent sound transmission from adjacent spaces.

D. All audiovisual wiring devices in acoustically sensitive spaces shall have a gasket sealing the faceplate to the back box to prevent sound transmission from adjacent spaces.

1.14 DELIVERY AND HANDLING

A. The Audiovisual Contractor shall coordinate delivery and installation of all equipment with the Construction Manager and/or Electrical Contractor.

B. Equipment purchased through this contract, whether stored on the job site in a construction manager designated space or in the AV contractors own storage facility, shall require the AV contractor to furnish a certificate of insurance that verifies that the contractor shall be responsible for replacement of equipment due to theft or damages from the time of purchase by the AV Contractor till official turn-over to the owner confirmed by owner sign-off.

C. If required by the Construction Manager or Electrical Contractor, audiovisual equipment shall be delivered in a minimum of three (3) separate shipments that shall include:
   1. Shipment #1: All items in which conduit is terminated which includes backboxes, wiring device faceplates with receptacles, projection screen cases, etc.
   2. Shipment #2: All items which require structural backing such as rigging components, monitor and projector mounts, etc.
   3. Shipment #3: All items that are not required until the building/area of work is secure and ready for electronic equipment. This shall include equipment racks, wiring device face plates, portable equipment, etc.

D. Audiovisual Contractor shall deliver all material to the job site suitably crated, packed, and protected and bearing the label and the nomenclature of the product(s) found in each carton or crate.

1.15 QUALITY ASSURANCE

A. Parts listed shall be complete and equipment furnished shall conform to manufacturer's specifications.

B. All materials shall be new and shall conform to the applicable provisions of Underwriter's Laboratories (ULEQ) and American Standards Association (ASA).

C. Procure and pay for all permits, licenses, and inspections, and observe any requirements stipulated therein. Conform in all trades with all local regulations and codes.

D. Comply with federal, state, and local labor regulations and applicable union regulations.

E. Installation shall conform to the latest federal, state, and local electrical safety codes of authorities having jurisdiction. Where conflict exists, the most stringent code or regulation shall apply.

1.16 GUARANTEE AND SERVICE

A. The Audiovisual system shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practice.

B. All new systems and components shall be guaranteed free of defects in materials and workmanship for a period of (18) eighteen months from the date of the AV contractor receiving written owner sign-off of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.

C. Installation of relocated existing equipment shall be guaranteed free of defects in materials and workmanship for a period of one (1) year from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.

D. All audiovisual system software and firmware updates shall be automatically issued to and deployed for the Owner free of charge during the warranty period.

E. The Contractor shall be available on call and on eight (8) hour notice during the first month following acceptance of the system, to assist the Owner's representatives in any problems which may arise during the initial period of operation.

F. The Contractor shall provide same day response to service requests, via 24/7 phone support.

G. If during guarantee period any component is out of service for more than seven (7) consecutive days due to unavailability of parts or service, the contractor shall furnish and install identical new component. If an identical component is not available, the contractor shall substitute equivalent equipment with written approval of the owner.

H. During the course of the guarantee period, the Contractor shall provide a minimum of three (3) service visits to the site for inspection and adjustment of equipment and programming. Contractor shall submit proposed schedule for these visits and shall notify Owner and Architect in writing at least one (1) month in advance of each visit.

1.17 INSURANCE

A. All equipment and materials shall be fully insured against loss or damage up until acceptance of the system by the Owner or until the Owner relieves the Contractor in writing of this responsibility, whichever is earlier.

PART 2 – EQUIPMENT

2.1 GENERAL

A. AV contractor is to verify all equipment listed in this specification prior to purchase with owner to confirm if any items not listed as OFE have been purchased directly through the owner to expedite arrival on site due to the construction timeline. Any equipment purchased by the owner as a result of this shall be credited back to the owner from the bid, but shall still be required to be installed by the AV Contractor per the construction documents. Failure to coordinate with the owner prior to AV Contractor purchase of equipment to confirm any equipment purchased directly by the owner shall not incur additional costs to the owner for equipment purchase, shipping, restocking fees, or related expenses to equipment purchase.

B. All materials and equipment shall be new and of the latest design or model offered for sale by the manufacturer.

C. Equipment models furnished shall operate at the required AC line voltage (i.e. 120 Volts) and frequency (i.e. 60 Hz)

D. Contractor shall furnish at minimum, quantities as indicated in the Contract Documents as required for complete installation.

E. Coordinate all color options for equipment with owner prior to purchase of equipment.

F. Audiovisual Wire and Cable:
   1. Approved manufacturers:
      a. Belden – As Noted for specific cabling runs on drawings
      b. Berk-Tek - As Noted for specific cabling runs on drawings
      c. Crestron - As Noted for specific cabling runs on drawings
      d. Extron - As Noted for specific cabling runs on drawings
      e. Kramer - As Noted for specific cabling runs on drawings

2. All wire numbers listed in the Contract Documents are Belden unless otherwise noted.
3. Where required, install plenum rated cable listed and labeled for plenum installation.
4. Cabling jacket color shall adhere to owners cabling standards. Confirm cabling type and jacket color meet owner standards prior to pulling and termination. The following jacket colors are approved by the owner and should be verified prior to cable purchase and pull
   a. AV Category Cabling (Other than Crestron DM Cable) shall be Gray
   b. Speaker Wire shall be Gray
   c. DM Cabling shall be Blue
   d. SDI Cabling shall be purple
   e. Microphone and Line Level cable shall be Black. Where stereo audio cabling exists, the Left Chanel Shall be White and the Right Channel shall be Red.
   f. Any cabling related to the Simulation Center Equipment (Where applicable) shall be Black, coordinate with Sim Vendor where required to confirm this.
5. Where cabling is run under raised access floor, provide 2" ENT nonmetallic flexible raceway between cabling source and destination with pullstring. Coordinate color with other trades so that ENT for Audiovisual cable is unique from other ENT used for other services. Verify color as part of shop submittal process.

G. Electrical Wire and Cable (including ground conductors)
1. Where conflict exists with any codes or ordinances, such codes and ordinances shall take precedence.
2. Where conflict exists with Electrical Specifications, the higher standard or more stringent requirement shall apply.

H. Wiring Devices:
1. Specifications – Duplex Receptacles – AV Technical Power
   a. Grade: Specification, Hubbel IG5362 or equal
   b. Type: NEMA 5-20R
   c. Color: Orange
2. Specifications – Plug Mold
   a. Grade: Wiremold V/G 2000 Series or equal
   b. Size: As specified or required.
3. Specifications – Outlet Strips
   a. Grade: UL Listed, Wiremold or equal.
   b. Size: As specified or required.
4. Approved Manufacturers:
   a. Waber
   b. Wiremold
   c. Hubbell
   d. Bryant
   e. GE
   f. Leviton

I. Electrical Plates and Panels:
1. Specifications – Rack mount panels

a. Material: 11 gauge steel or 1/8" aluminum, minimum thickness.
b. Finish: Black or to match adjacent equipment.
c. Size: 19" wide, standard EIA mounting hole spacing, height as specified or required.

2. Specifications – Back Box Enclosures
   a. Material: Code grade steel.
   b. Finish: Black or Galvanized.
   c. Size: As specified or required.
3. Specifications – Plug Box and Termination Panels
   a. Material: 11 gauge steel or 1/8" aluminum, minimum thickness.
   b. Finish: Black (unless otherwise noted by the Owner).
4. Any and all recessed face plates shall have a minimum ¾" reveal beyond the back box to hide the intersection between the wall material and the back box excluding standard decora-style plates. The color of all visible plates shall be coordinated with the owner.
5. Approved Manufacturers:
   a. Hoffman
   b. Whirlwind
   c. Pro-Co
   d. Wireworks.

J. Any equipment to be located outdoors or in damp locations must carry a NEMA 3R rating and be labeled accordingly.

K. Control System Programming:
1. All control system programming, installation, testing, and debugging to be performed by a manufacturer certified programmer, supplied either directly by the AV Contractor staff or via a manufacturer authorized and certified independent programmer.
2. AV Contractor shall furnish complete control system programming, including all source code and on-site coordination, testing, and debugging. This includes delivery of uncompiled source code at project close out to the owner as well as an archived project filed. Confirm any additional requirements for the delivery of code for AV control systems with owner.
3. AV Contractor shall furnish all programming of control system equipment including:
   a. Nightly system shut down.
   b. Janitorial/Off-hour maintenance control.
   c. Emergency Life/Safety override.
   d. Audiovisual source equipment selection (e.g. Audio Source, Video Source, Display Selection)
   e. Audiovisual source equipment transport control (e.g. play, pause, stop, forward, reverse).
   f. Master Volume control
4. Touch Panel interfaces shall have two (2) modes of operation:
   a. User Mode:
      1) Basic controls of all system components
      2) Streamlined user interface.

3) Room modes available via single button presets
b. Tech Mode:
1) Advanced control and configuration of system components.
2) Setup of presets

5. Pushbutton interfaces shall have the following control options:
a. Presentation Mode:
1) Display of presenter's computer through an audiovisual wiring device to the display
2) Presenter's microphone through the system to the loudspeakers.
3) Audio from the presenter's computer through the system to the loudspeakers.
b. Video Mode:
1) Display of a video source through the audiovisual system to the display.
2) Audio from the same video source through the audiovisual system through the system to the loudspeakers.
c. Aux Mode:
1) Display of a video source through the system via an auxiliary input.
2) Audio from the same video source though the system via and auxiliary input to the loudspeakers.
d. Source Selection Control, which provides the ability to:
1) Select any source equipment to be displayed on any video display in the system and routing audio from that source through the system to the loudspeakers.
e. Source Transport Control, which at minimum provides the ability to:
1) Play, pause, stop, forward, reverse and source equipment in the system.
f. Master Volume Control of the system.

6. In rooms where a volume control system and digital signal processor (DSP) exist, the control system shall be programmed such that:
a. The appropriate preset on the DSP system and display system shall be selected based on that activity taking place.
7. Provisions for control from a computer via web interface shall be included.
8. Control system programming shall accommodate future addition of touch panels and mobile applications for Apple iPhone/iPad and Android devices.
9. AV Contractor to schedule meeting with Owner and Architect to review control system functionality and operational requirements prior to the commencement of work.
10. AV Contractor shall coordinate with owner for Icons required for GUI configuration prior to programming.
11. AV Contractor shall verify with owner the direction of GUI configuration to match existing GUI on their campus.
12. Owner Must approve all GUI design prior to integration.
13. GUI design for spaces included in this bid package must match all spaces in the building regardless of vendor.

L. Crestron Fusion Integration:
1. Coordinate with the owner regarding current Crestron Fusion Deployment in order to gather the appropriate protocols, addressing, and systems.

2. Crestron Fusion shall be utilized to monitor and report information from the following equipment:
   a. All Displays
   b. All Projectors
   c. All Projection Screens
   d. All Crestron Presentation Switchers and Video Switchers
   e. All Crestron Control Panels
   f. All QSC DSP Units
   g. All Hardware Video Codecs
   h. All Amplifiers
   i. All Loudspeakers

M. Audio DSP System:
   1. Audio Inputs
      a. All system audio inputs shall be programmed with limiters.
      b. It shall be possible to matrix any input to any output within the system.
   2. Audio Outputs:
      a. All audio outputs shall be programmed with high pass filters, parametric equalization, delay, and limiters.
      b. It shall be possible to matrix any input to any output within the system.

N. Equipment furnished shall be that specified herein.

O. Detailed performance specifications shall be those published by the manufacture effective on the date of this document for all equipment specified herein.

P. The AV Contractor shall verify the final location of all installed projection screens, projection lifts, and AV Contractor installed projectors in coordination with the Construction Manager, Architect, and Owner prior to the purchase of any projection equipment, and provide projector performance calculations based on this final location for throw ratio, image brightness, contrast ratio, as well as verification of image size vertically, horizontally, and diagonally to confirm proper installation. The AV contractor shall submit the information with the required shop drawings for approval by the architect and owner prior to ordering any materials or equipment for the projection systems. Failure to coordinate screen information shall not result in additional costs to the Owner.

Q. The AV Contractor shall verify all projector lenses for appropriate focal length and intended image size with the Contract Documents, based on field measurements of actual throw distance. Failure to coordinate lens information shall not result in additional costs to the Owner.

R. All miscellaneous materials including brackets, pole extensions, mounting hardware, electrical connectors, and other items to properly install the equipment specified shall be included as part of this project whether it is listed or not.

S. Existing structural mounting to be reused as conditions permit.

T. If required, Cost Reduction and/or Value Engineering shall be conducted by the Architect and Owner based on final bid amounts.

U. Programming of all managed switches shall be coordinated with owner

V. Wireless microphone frequencies to be coordinated with owner. AV contractor shall coordinate with owner before equipment purchase and verify operational frequency range of equipment to be installed with an AV contractor furnished list of proposed operational frequencies of all wireless equipment for owner review.

2.2 MAJOR EQUIPMENT

A. Equipment List Per Room Type:
1. The major equipment list itemizes system components and their quantities to provide the systems as shown in the contract documents. It is the responsibility of the contractor to provide any additional accessories, patch cabling, interfaces, and other miscellaneous equipment not described herein to provide a working system as called out in the functional requirements section of this specification (1.7), unless otherwise noted as owner furnished or future equipment. For items not given specific quantities in these documents, it is the responsibility of the contractor to verify those quantities with the owner and architect prior to system installation.
2. The Integrator is responsible for providing a complete inventory per room of all equipment being furnished as part of this bid package to the owner. The following equipment lists are for reference and are supplemental to information and system requirements included elsewhere in the contract documents to create a complete itemized inventory to the owner which shall include manufacturer, model, serial number, build number, current firmware, and MAC address as applicable.
3. Equipment List Per Room Type:

a. Proscenium Theater, Control Room, and Rack Room

Manufacturer	**Model/Part #**	**Description**	**Qty**	**Notes**
AKG	C414 XLS MATCHED PAIR	MATCHED PAIR STEREO SET	1	
AKG	DGN99	DYNAMIC GOOSENECK MICROPHONE	1	
AKG	C1000 S	HIGH-PERFORMANCE SMALL DIAPHRAGM CONDENSER MICROPHONE	2	

ALLOWANCE	MICROPHONE ACCESSORIES ALLOWANCE - $2000	MICROPHONE ACCESSORIES TO BE COORDINATED WITH OWNER TEAM	1	
ALLOWANCE	PROJECTOR LENS AND MOUNTING HARDWARE ALLOWANCE LOOSE PROJECTOR - $14,000	PROJECTOR LENS AND MOUNTING HARDWARE ALLOWANCE FOR PROJECTION MAPPING IN PROSCENIUM THEATER	1	
APPLE	IMAC PRO	SPECIFICATION FOR PC SHALL BE COORDIANTED WITH OWNER	1	
APPLE	IPAD	SPECIFICATION FOR IPAD SHALL BE COORDIANTED WITH OWNER, IPAD SHALL BE FURNISHED WITH RUGGED CASE	1	
BELDEN	AX103114	DM PATCH PANEL	1	
CHIEF	VCTU	XL UNIVERSAL TOOLESS PROJ MOUNT	1	
CHIEF	MONTOUR K1		1	
CHIEF	CMA700	CMA CEILING PLATE WITH ADJUSTABLE COLUMN	1	
CLEAR-COM	MS-702	"2 CH. HEADSET/SPEAKER MAIN STATION: ENCORE TWO-CHANNEL HEADSET/SPEAKER MAIN STATION. BUILT-IN 1-AMP (2-AMP PEAK) POWER SUPPLY, 1RU RACK MOUNT. THREE XLR-3 MALE CONNECTORS FOR EACH PARTYLINE A AND B, ONE XLR-3 FEMALE FOR PROGRAM AUDIO IN	1	

		AND ONE XLR-3 MALE FOR STAGE ANNOUNCE OUT ON THE REAR PANEL. JACK FOR HOT MIC OUT."		
CLEAR-COM	RM-701	2 CH. REMOTE STATION RACK MOUNT: ENCORE TWO-CHANNEL 1RU REMOTE STATION RACK MOUNT WITH INTERNAL SPEAKER AND PORTS FOR GOOSENECK MICROPHONE AND/OR HEADSET. MUST BE USED IN CONJUNCTION WITH A POWER SUPPLY SUCH AS A PS-702 OR MS-702.	1	
CLEAR-COM	CZ11513	4-UP DX210 SYSTEM W/ CC-15 HEADSETS: BS210 LICENSE-FREE BASE STATION W/2 ANTENNAS; 115-230 VAC POWER SUPPLY; 115 VAC POWER CORD, 4 BP210 BELTPACKS WITH; 8 BAT41 BATTERIES AND 4 POUCHES; 5 CC-15-MD4 SINGLE EAR NOISE CANCELING HEADSETS; AC40A BATTERY CHARGER; 115-230 VAC POWER SUPPLY, POWER CORD, MANUAL.	1	

CLEAR-COM	KB-702GM	"2 CH. FLUSH-MOUNT HEADSET/SPEAKER GM MIC: ENCORE TWO-CHANNEL SELECTABLE FLUSH-MOUNT HEADSET/SPEAKER STATION, GOOSENECK MICROPHONE JACK AND VOX. MOUNTS IN FOUR-GANG BOX, CONSOLE, OR V-BOX ACCESSORY ENCLOSURE 21.6CM/8.25"" X 11.4CM/4.5"". INCLUDES A FOUR-PIN MALE HEADSET CONNECTOR."	2	
CLEAR-COM	CZ11517	BP210 BELTPACK WITHOUT HEADSET: TWO-CHANNEL BELTPACK WITH 2 BAT41 BATTERIES, AND POUCH. FOR USE WITH THE DX210 BASE STATION.	2	
CLEAR-COM	CZ11450	CC-15-MD4 HEADSET: SINGLE EAR NOISE-CANCELING HEADSET, ELECTRET MIC, WITH MINI DIN CONNECTOR.	2	
CLEAR-COM	107G065	DX BELT PACK POUCH: RUBBER OUTER CASE FOR DX, BP200, BP210. BP300 BELT PACKS	2	
CLEAR-COM	CC-300	SINGLE-EAR STANDARD	5	
CLEAR-COM	CC-110	LW SINGLE-EAR STANDARD	5	

CLEAR-COM	RS-701	SINGLE-CHANNEL STANDARD BELTPACK: ENCORE SINGLE-CHANNEL STANDARD BELTPACK. FOUR-PIN MALE HEADSET CONNECTOR AND THREE-PIN FEMALE/MALE LOOP THROUGH INTERCOM LINE CONNECTORS.	10	
COMMUNITY	DS8-B	SURROUND SPEAKERS	6	
COMMUNITY	DS-WMPB	MOUNTING HARDWARE	6	
CRESTRON	DM-MD16X16650718 4	16X16 DIGITALMEDIA™ SWITCHER	1	
CRESTRON	DMC-S2	DIGITALMEDIA 8G™ SINGLE-MODE FIBER INPUT CARD FOR DM® SWITCHERS	1	
CRESTRON	DMC-S2O-HD	2-CHANNEL DIGITALMEDIA 8G™ SINGLE-MODE FIBER OUTPUT CARD FOR DM® SWITCHERS	1	
CRESTRON	AV3	CONTROL PROCESSOR	1	
CRESTRON	TS-1542-B-S 6507096	15.6" HD TOUCH SCREEN, WALL MOUNT OR VESA, BLACK SMOOTH	1	
CRESTRON	DMC-4KZ-HD6508070	HDMI® 4K60 4:4:4 HDR INPUT CARD FOR DM® SWITCHERS	2	
CRESTRON	DMC-SDI6502685	3G-SDI INPUT CARD FOR DM® SWITCHERS	2	
CRESTRON	DMC-4KZ-CO-HD6508074	2-CHANNEL DIGITALMEDIA 8G+® 4K60 4:4:4 HDR OUTPUT CARD FOR DM® SWITCHERS	3	

CRESTRON	DMC-4K-HDO6507120	2-CHANNEL 4K SCALING HDMI® OUTPUT CARD FOR DM® SWITCHERS	4	
CRESTRON	DM-TX-4K-100-C-1G-B-T	WALL PLATE 4K DIGITALMEDIA 8G+® TRANSMITTER 100, BLACK TEXTURED	4	
CRESTRON	DM-TX-4KZ-202-C	DIGITALMEDIA 8G+® 4K60 4:4:4 HDR TRANSMITTER 202	4	
CRESTRON	DM-RMC-4KZ-SCALER-C	DIGITALMEDIA 8G+® 4K60 4:4:4 HDR RECEIVER AND ROOM CONTROLLER WITH SCALER	4	
CRESTRON	DM-RMC-4K-100-C-1G-B-T	WALL PLATE 4K DIGITALMEDIA 8G+® RECEIVER & ROOM CONTROLLER 100, BLACK TEXTURED	2	
CRESTRON	DMC-4K-C-DSP-HDCP26507322	HDBASET® CERTIFIED 4K DIGITALMEDIA 8G+® INPUT CARD W/DOWNMIXING FOR DM® SWITCHERS	9	
CRESTRON	DM-CONN-ULTRA-RECP-50	DIGITALMEDIA™ ULTRA KEYSTONE RJ45 JACK, 50-PACK W/TERMINATION TOOL	1	
CRESTRON	DM-PSU-16	DM POWER SUPPLY	1	
CRESTRON	HD-DA-2	1-TO-2 HDMI® DISTRIBUTION AMPLIFIER & AUDIO CONVERTER	1	
~~**CUSTOM**~~	~~**CUSTOM**~~	~~**8RU CUSTOM FOAMED ROAD CASE FOR 8CHANNELS WIRELESS AND ALL ACCESSORIES**~~	~~**1**~~	**REMOVED (ADDENDUM 01)**
CUSTOM	CUSTOM	32 WAY NL4 PATCHBAY	1	

CUSTOM	CUSTOM	20 WAY BNC SDI PATCHBAY	1	
CUSTOM	CUSTOM	12 WAY LC SM FIBER PATCHBAY	1	
CUSTOM	CUSTOM	48 WAY BANTAM PATCHBAY	2	
CUSTOM	CUSTOM	24 WAY RJ45 NETWORK PATCHBAY	2	
CUSTOM	CUSTOM	BODYPACK SOFT PACK FOR WARDROBE	8	
CUSTOM	CUSTOM	16RU CUSTOM FOAMED ROAD CASE FOR 8 CHANNELS OF WIRELESS MICROPHONES AND ALL ACCESSORIES	1	
DA-LITE	87319	FAST-FOLD TRUSS FRAME SCREEN 108"X192" - 208" DIAGONAL	1	
DA-LITE	87323	FAST-FOLD TRUSS FRAME SCREEN DUAL VISION	1	
DA-LITE	36635	FAST-FOLD TRUSS FRAME DRAPERY KIT	1	
DECIMATOR	MD-LX	HDMI / SDI BI-DIRECTIONAL CONVERTER	2	
DENON	DN-500BD MKII	BLU-RAY/ DVD./ CD/ SD/ USB PLAYER	1	
EPSON	ELPLL08	LONG-THROW LENS 7.22 TO 10.12/ 5.28 TO 7.42	1	
EPSON	V11H910120	PREMIUM LARGE-VENUE LASER PROJECTOR WITH 4K ENHANCEMENT	2	
~~**EXTREME**~~	~~**X460-G2-48T-10GE4**~~	~~**NETWORK SWITCH**~~	~~**2**~~	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR CISCO IN PLACE OF EXTREME SOLUTION. CONFIRMATION OF MODEL TO BE**~~

				~~**FURNISHED AND INSTALLED TO BE PROVIDED IN FUTURE DRAWING REVISION.**~~ **REMOVED (ADDENDUM 01)**
CISCO	**CATALYST 3650-12X48UQ**	**NETWORK SWITCH**	**2**	**(ADDENDUM 01)**
EXTRON	SSP 7.1	SURROUND SOUND PROCESSOR	1	
GATOR CASES	GR-3S	3U PORTABLE RACK CASE	1	
GATOR CASES	GR-4S	4U PORTABLE RACK CASE	1	
LISTENTECH	LT-800-072-P1	RF TRANSMITTER PACKAGE 1 (72MHZ); INLCUDES ANTENNA AND SIGNAGE	1	
LISTENTECH	LA-123	90 DEGREE HELICAL ANTENNA (72MHZ)	1	
LISTENTECH	LP-51-072-01	ADVANCED INTELLIGENT DSP RF RECIEVER 12-PACK (72MHZ)	2	
LISTENTECH	LA-380	12 UNIT CHARGING/CARRING CASE	2	
LISTENTECH	LA-382	CABLE MANAGEMENT UNIT FOR COLLECTING RECEIVERS.	2	
LISTENTECH	LA-167	REPLACEMENT CUSHIONS FOR STEREO HEADPHONES	2	
LISTENTECH	LA-166	NECK LOOPS	4	
LISTENTECH	LA-403	EAR PHONES	15	
MARSHALL	CV503	MINIATURE FULL-HD CAMERA (3G/HDSDI)	1	
MARSHALL	CV2812-3MP	2.8~12MM, F1.4 3MP VARIFOCAL M12 LENS; HORIZ AOV = 108~30°	1	

MARSHALL	CVM-15	WALL MOUNT PLATE WITH 1/4" CENTER SCREW HOLE	1	
MARSHALL	CVM-7	7" ARTICULATING LOCKING ARM	1	
MARSHALL ELECTRONICS	M-LYNX-702V.3	DUAL 7" 1280 X 800 RACKMOUNT LCD DISPLAYS	1	
MIDDLE ATLANTIC	VFD-45A	VENTED FRONT DOOR, 45 RU RACKS, CURVED	1	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	CBS-BGR	CASTER BASE, BGR SERIES	1	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**

MIDDLE ATLANTIC	LT-1R	RACKMOUNT LIGHT, 1 RU, POWDER COATED	1	
MIDDLE ATLANTIC	UTR1	RACK SHELF1 RU	4	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	BGR-4527	BGR-SA SERIES RACK, 45 RU, 27"D, W/O REAR DOOR	4	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
~~**APC**~~	~~**ACF505**~~	~~**ROOF FAN TRAY 120VAC 50/60HZ FOR NETSHELTER AV**~~	~~**4**~~	**REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	**BGR-552FT-FC**	**FAN TOP, 552 CFM, W/CONTROLLER, BGR SERIES**	**4**	**ADDENDUM 01**

MIDDLE ATLANTIC	BGR-RR45	RACKRAIL, 10-32, 45 RU, BGR SERIES	4	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
APC	AP8932	POWER STRIP, 24 OUTLET, 30A, TWISTLOCK PLUG	4	
APC	AP7900B	RACKMOUNT POWER, 9 OUTLET, 15A, BASIC SURGE	4	
APC	SMX1500RM2UNC	NETWORK - UPS BACKUP POWER, 2RU, 1500VA	1	
MIDDLE ATLANTIC	D3	DRAWER, 3 RU, ANODIZED, W/LOCK	4	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER**~~

				~~**ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~**REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	FI-3	FOAM INSERT, FITS 3 RU DRAWER	4	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
PRESONUS	STUDIOLIVE SERIES 3	32 CHANNEL MIXING DESK W/ AVB	1	
PRESONUS	NSB16.8 RACK KIT	STURDY METAL RACK EAR MOUNTING KIT FOR ONE (1) PRESONUS NSB 16.8	1	
PRESONUS	NSB16.8	16X8 AVB STAGE BOX	2	
QSC	AF218-SW-BK	ALUMINUM ARRAY FRAME FOR STACKING FOUR (4) OR FLYING EIGHT (8) WL218-SW SUBWOOFERS	1	

QSC	CORE 510I	Q-SYS CORE	1	
QSC	CAN32	Q-SYS AVB BRIDGE CARD, 16X16 / 0X32 / 32X0	1	
QSC	I/O-8 FLEX	Q-SYS CHANNEL EXPANDER	1	
QSC	CX108V	8 CHANNELS, 100 WATTS/CH AT 70V	1	
QSC	TSC-55W-G2-BK	Q-SYS 5.5” POE TOUCH SCREEN CONTROLLER	1	
QSC	AF2102-LA-BK	LARGE ALUMINUM ARRAY FRAME FOR THE WIRELINE 10 (WL2102) AVAILABLE IN BLACK.	2	
QSC	WL218-SW	18" SUBWOOFER	2	
QSC	CIML4	FOUR CHANNELS OF MICROPHONE / LINE-LEVEL ANALOG AUDIO INPUT WITH 48V PHANTOM POWER	4	
QSC	COL4	FOUR CHANNELS OF BALANCED, LINE-LEVEL ANALOG OUTPUT	4	
QSC	PLD4.5	4 CHANNEL AMPLIFIER @ 2000W	5	
QSC	K12.2	POWERED SPEAKER 12"	8	
QSC	WL2102	LINE ARRAY SPEAKERS	14	
RADIAL	JDI	PASSIVE DIRECT BOX	2	
RADIAL	J48	ACTIVE DIRECT BOX	2	
RADIAL	JDI DUPLEX	2 CHANNEL PASSIVE DIRECT BOX	2	
SENNHEISER	EW 100 G4 ME2-XX	WIRELESS LAVALIER SET. INCLUDES (1) SK 100 G4 BODYPACK, (1) ME 2-II LAVALIER MICROPHONE (OMNIDIRECTIONAL, CONDENSER), (1) EM 100 G4 RACKMOUNT	2	

		RECEIVER, (1) GA3 RACK KIT AND (1) RJ10 LINKING CABLE,		
SENNHEISER	A 2003-UHF	RECEIVING/TRANSMITTING ANTENNA, PASSIVE, DIRECTIONAL, BNC CONNECTOR, 3/8" MOUNTING THREAD	2	
SENNHEISER	ASA 214-UHF	ACTIVE ANTENNA SPLITTER WITH DC POWER DISTRIBUTION FOR EW G3 AND EW G4 RECEIVERS. INCLUDES (1) NT 1-1 POWER SUPPLY AND (8) BNC CABLES	5	
SENNHEISER	EW 100 G4 ME2/835-S-XX	WIRELESS LAVALIER/VOCAL COMBO SET. INCLUDES (1) SKM 100 G4-S HANDHELD WITH MUTE SWITCH, (1) E 835 MIC CAPSULE (CARDIOID, DYNAMIC), (1) SK 100 G4 BODYPACK, (1) ME 2-II LAVALIER MICROPHONE (OMNIDIRECTIONAL, CONDENSER), (1) EM 100 G4 RACKMOUNT RECEIVER, (1) GA3 RACK KIT, (1) RJ10 LINKING CABLE AND (1) MIC CLIP,	6	
SENNHEISER	EW 100 G4 ME3-XX	WIRELESS HEADMIC SET. INCLUDES (1) SK 100 G4 BODYPACK, (1) ME 3-II HEADMIC (CARDIOID, CONDENSER), (1) EM 100 G4 RACKMOUNT RECEIVER, (1) GA3	8	

		RACK KIT AND (1) RJ10 LINKING CABLE,		
SHURE	BETA52A	KICK DRUM MICROPHONE	1	
SHURE	MX202	HANGING MICROPHONE	6	
SHURE	SM58	CARDIOID DYNAMIC VOCAL MICROPHONE	10	
SUPERLOGICS	SL-RMKB-W119B	1U RACKMOUNT 19" WIDE SCREEN (1440X900) LCD DRAWER (SHORT DEPTH: 18.1") WITH INTEGRATED KEYBOARD AND TRACKBALL (DVI-D AND VGA INPUTS), INCLUDES CABLES FOR USB CONNECTIONS	1	
SUPERLOGICS	SL-1U-LLQ370M-LA	1U RACK MOUNT INDUSTRIAL PC	1	
TASCAM	SS-CDR250N	2-CHANNEL NETWORKING CD/MEDIA RECORDER	1	
TRIPP LITE	U360-007	7-PORT USB 3.0 HUB	1	
VADDIO	999-99630-100	ROBOSHOT 30 ONELINK BRIDGE SYSTEM N/A	1	
VADDIO	535-2000-240	THIN PROFILE WALL MOUNT ROBOSHOT BLACK	1	

b. Multipurpose Room

Manufacturer	**Model/Part #**	**Description**	**Qty**	**Notes**
BELDEN	AX103114	DM PATCH PANEL	1	
CHIEF	MONTOUR K1		1	
CHIEF	CMA365	TRUSS CEILING ADAPTER	3	

CHIEF	CMA348	HARDWARELARGE VENUE VIBRATION ISOLATING COUPLER, BLACK	3	
CHIEF	CMS0305	3-5' ADJUSTABLE EXTENSION COLUMN	3	
CLEAR-COM	CZ11433	4-UP DX100 SYSTEM W/ CC-15 HEADSETS: MB100 SINGLE-CHANNEL STAND-ALONE LICENSE-FREE MOBILE BASE STATION W/2 ANTENNAS; 115-230 VAC POWER SUPPLY, 115VAC POWER CORD, AA BATTERY SLED FOR BASE; 4 BP200 BELTPACKS WITH; 8 BAT41 BATTERIES AND 4 POUCHES; 4 CC-15-MD4 SINGLE EAR NOISE CANCELING HEADSETS, AC40A BATTERY CHARGER,115-230 VAC POWER SUPPLY, POWER CORD, MANUAL	1	
COMMUNITY	DS8-B	COMPACT, TWO-WAY, FULL-RANGE COAXIAL SURFACE MOUNT LOUDSPEAKER; LF 1 X 8", HF 1 X 1.25" COMPRESSION DRIVER, 70 HZ - 20 KHZ, 115° CONICAL COVERAGE, 95 DB SPL 1W/1M, 150W RMS, 8 OHM OR 70V/100V OPERATION WITH MULTI-TAP SETTINGS. H X W X D: 18.5" X 9" X 10.1"	12	

COMMUNITY	DS-WMP	MOUNTING HARDWARE	12	
COMMUNITY	ALC-404D	4 CHANNELS X 400W + DSP AND DANTE	3	
CRESTRON	DM-MD8X8-CP3U	8X8 DIGITALMEDIA™ SWITCHER	1	
CRESTRON	DMC-4K-C-DSP-HDCP26507322	HDBASET® CERTIFIED 4K DIGITALMEDIA 8G+® INPUT CARD W/DOWNMIXING FOR DM® SWITCHERS	6	
CRESTRON	DMC-4KZ-HD6508070	HDMI® 4K60 4:4:4 HDR INPUT CARD FOR DM® SWITCHERS	1	
CRESTRON	DMC-S2	DIGITALMEDIA 8G™ SINGLE-MODE FIBER INPUT CARD FOR DM® SWITCHERS	1	
CRESTRON	DMC-4KZ-CO-HD6508074	2-CHANNEL DIGITALMEDIA 8G+® 4K60 4:4:4 HDR OUTPUT CARD FOR DM® SWITCHERS	2	
CRESTRON	DMC-4K-HDO6507120	2-CHANNEL 4K SCALING HDMI® OUTPUT CARD FOR DM® SWITCHERS	2	
CRESTRON	AV3	CONTROL PROCESSOR	1	
CRESTRON	TS-1542-B-S 6507096	15.6" HD TOUCH SCREEN, WALL MOUNT OR VESA, BLACK SMOOTH	1	
CRESTRON	TSW-1060-B-S	10.1" TOUCH SCREEN, BLACK SMOOTH	3	
CRESTRON	DMC-RMC-4K-SCALER-C	4K DM TO HDMI SCALER	4	
CRESTRON	DM-TX-201-C	HDMI OVER DM TX	5	
CRESTRON	DM-TX-4K-100-C-1G-B-T	HDMI OVER DM TX, BLACK WALL PLATE	3	
CRESTRON	DM-PSU-8	8 PORT DM POWER SUPPLY	1	

CRESTRON	DM-TX-201-S2	DIGITALMEDIA 8G™ SINGLE-MODE FIBER TRANSMITTER 201	1	*ON RACK SHELF
DA-LITE	35179	INSTALLED SMALL SCREENS	3	*MATTE WHITE 6’ 6” OF TOP BLACK DROP
EPSON	V11H739120	PRO L1405U LASER WUXGA 3LCD PROJECTOR W/ 4K ENHANCEMENT & STANDARD LENS	3	
~~**EXTREME**~~	~~**X460-G2-48T-10GE4**~~	~~**NETWORK SWITCH**~~	~~**1**~~	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR CISCO IN PLACE OF EXTREME SOLUTION. CONFIRMATION OF MODEL TO BE FURNISHED AND INSTALLED TO BE PROVIDED IN FUTURE DRAWING REVISION.~~~~ **REMOVED (ADDENDUM 01)**
CISCO	**CATALYST 3650-12X48UQ**	**NETWORK SWITCH**	**1**	**(ADDENDUM 01)**
LISTEN TECHNOLOGIES	LS-100-01-GY	LISTENIR IDSP STANDARD SYSTEM	3	
LISTEN TECHNOLOGIES	LA-347-GY	WALL MOUNTING PLATE	3	

MIDDLE ATLANTIC	BGR-4527	BGR-SA SERIES RACK, 45 RU, 27"D, W/O REAR DOOR	1	~~*AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. A PC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.~~ **REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	VFD-45A	VENTED FRONT DOOR, 45 RU RACKS, CURVED	1	~~*AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. A PC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE~~

				~~**TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
~~**APC**~~	~~**ACF505**~~	~~**ROOF FAN TRAY 120VAC 50/60HZ FOR NETSHELTER AV**~~	~~**1**~~	**REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	**BGR-552FT-FC**	**FAN TOP, 552 CFM, W/CONTROLLER, BGR SERIES**	**1**	**ADDENDUM 01**
MIDDLE ATLANTIC	BGR-RR45	RACKRAIL, 10-32, 45 RU, BGR SERIES	1	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED**

				(ADDENDUM 01)
APC	AP8932	POWER STRIP, 24 OUTLET, 30A, TWISTLOCK PLUG	1	
APC	AP7900B	RACKMOUNT POWER, 9 OUTLET, 15A, BASIC SURGE	1	
APC	SMX1500RM2 UNC	NETWORK - UPS BACKUP POWER, 2RU, 1500VA	1	
MIDDLE ATLANTIC	D3	DRAWER, 3 RU, ANODIZED, W/LOCK	1	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. APC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	FI-3	FOAM INSERT, FITS 3 RU DRAWER	1	~~***AV CONTRACTOR TO PRICE EQUIVALENT**~~

				~~**SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. A PC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	CBS-BGR	CASTER BASE, BGR SERIES	1	~~***AV CONTRACTOR TO PRICE EQUIVALENT SOLUTION FOR APC IN PLACE OF MIDDLE ATLANTIC SOLUTION. A PC NETSHELTER SX ASSEMBLE-TO-ORDER ENCLOSURE TO BE FURNISHED AND INSTALLED**~~

				~~**BASED UPON MIDDLE ATLANTIC SPECIFICATION.**~~ **REMOVED (ADDENDUM 01)**
MIDDLE ATLANTIC	LT-1R	RACKMOUNT LIGHT, 1 RU, POWDER COATED	1	
QSC	CORE 510I	Q-SYS CORE	1	
QSC	CIML4	FOUR CHANNELS OF MICROPHONE / LINE-LEVEL ANALOG AUDIO INPUT WITH 48V PHANTOM POWER	5	
QSC	COL4	FOUR CHANNELS OF BALANCED, LINE-LEVEL ANALOG OUTPUT	2	
QSC	CDN64	Q-SYS DANTE BRIDGE CARD, 64X64	1	
QSC	I/O-8 FLEX	Q-SYS CHANNEL EXPANDER	1	
RADIAL	JPC	ACTIVE HYBRID DI, STEREO INPUTS FOR COMPUTERS & CD PLAYERS, 48V PHANTOM	4	
RADIAL	DINET DAN-TX	2-CHANNEL DANTE™ TRANSMITTER FOR ADDING INSTRUMENT OR LINE LEVEL INPUTS TO ANY DANTE SYSTEM	4	
SENNHEISER	SL DI 4 XLR	ANALOG/DIGITAL AUDIO CONVERTER, 4X MIC/LINE-IN, P48, 2 NETWORK PORTS (DANTE DAISY CHAIN), 12 VDC,	4	

		OR POE		
SENNHEISER	EW 100 G4 ME2/835-S-XX	WIRELESS LAVALIER/VOCAL COMBO SET. INCLUDES (1) SKM 100 G4-S HANDHELD WITH MUTE SWITCH, (1) E 835 MIC CAPSULE (CARDIOID, DYNAMIC), (1) SK 100 G4 BODYPACK, (1) ME 2-II LAVALIER MICROPHONE (OMNIDIRECTIONAL, CONDENSER), (1) EM 100 G4 RACKMOUNT RECEIVER, (1) GA3 RACK KIT, (1) RJ10 LINKING CABLE AND (1) MIC CLIP,	6	
SENNHEISER	ASA 214-UHF	ACTIVE ANTENNA SPLITTER WITH DC POWER DISTRIBUTION FOR EW G3 AND EW G4 RECEIVERS. INCLUDES (1) NT 1-1 POWER SUPPLY AND (8) BNC CABLES	2	
SENNHEISER	A 1031-U	RECEIVING/TRANSMITTI NGANTENNA, PASSIVE, OMNIDIRECTIONAL, BNC CONNECTOR, 3/8” MOUNTING THREAD	2	
SUPERLOGICS	SL-RMKB-W119B	1U RACKMOUNT 19" WIDE SCREEN (1440X900) LCD DRAWER (SHORT DEPTH: 18.1") WITH INTEGRATED KEYBOARD AND TRACKBALL (DVI-D AND VGA INPUTS), INCLUDES CABLES FOR USB CONNECTIONS	1	
SUPERLOGICS	SL-1U-LLQ370M-LA	1U RACK MOUNT INDUSTRIAL PC	1	
CUSTOM	CUSTOM	12 WAY XLR AUDIO PATCHBAY	1	
APPLE	IPAD	SPECIFICATION FOR IPAD SHALL BE	1	

		COORDIANTED WITH OWNER, IPAD SHALL BE FURNISHED WITH RUGGED CASE		

c. Back of House and Auxiliary Spaces

Manufacturer	Model/Part #	Description	Qty	Notes
JBL	26CT	6.5" CEILING LOUDSPEAKER TRANSDUCER ASSEMBLY	25	
ATLAS IED	SHS-6T2	STRATEGICALLY HIDDEN SPEAKER WITH 32-WATT 70/100V TRANSFORMER AND ENCLOSURE	15	
QSC	MP-A80V	POWER AMPLIFIER, 8 CHANNEL @ 200W	2	
ATTEROTECH	AXON C1-W	NETWORK VOLUME CONTROL DEVICE	1	
ATLAS IED	AT100-PA	WALL CONTROL PLATE WITH ROTARY POTENTIOMETER, PRIORITY RELAY	6	
NEC	C551	55" HD PROFESSIONAL DISPLAY	4	
CHIEF	LSTU	LARGE THINSTALL™ FIXED WALL DISPLAY MOUNT	3	
CHIEF	RMT2	MEDIUM FIT™ TILT WALL MOUNT	1	
CRESTRON	DM-RMC-4KZ-SCALER-C	DIGITALMEDIA 8G+® 4K60 4:4:4 HDR RECEIVER AND ROOM CONTROLLER WITH SCALER	3	
CRESTRON	C2N-CBF-P-W-T	CAMEO® KEYPAD, FLUSH MOUNT, WHITE TEXTURED	1	*PROVIDE AN 8 BUTTON PANEL

d. In-Ear Monitoring System (**Alternate #4**)

Manufacturer	Model/Part #	Description	Qty	Notes
SHURE	P3TRA215CL	WIRELESS IN EAR	8	
SHURE	PA411	ANTENNA COMBINER	2	
FURMAN	M-8DX	POWER CONDITIONER	1	

SKB	1SKB-R8UW	ROLLING ROTO RACK CASE	1	
MIDDLE ATLANTIC	UD2	RACK DRAWER	1	

PART 3 – EXECUTION

3.1 INSTALLATION OF SYSTEMS

A. Locate all apparatus requiring adjustments, cleaning, or similar attention so that it shall be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.

B. Furnish and install brackets, braces, and supports. Minimum fastening or support safety factor shall be at least five (5). Design shall be approved by the Architect and Owner.

C. All supporting structures supplied by the Contractor not having standard factory paint finish shall be painted. Paint specifications shall be supplied by the architect and owner or indicated herein.

D. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Architect and Owner. This does not exclude equipment or materials where standard colors or finishes may be specified herein.

E. Finish of blank panels and custom assembly panels shall match adjacent equipment panels.

F. Switches, connectors, jacks, receptacles, outlets, cables, and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched, or screened. Markings for these items are detailed in the contract documents to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Architect and Owner prior to marking.

G. The equipment specified herein is designed to operate in environments of normal humidity, dust, and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.

H. Coordinate with millwork fabricator for installation of audiovisual equipment into credenzas, lecterns, etc.

I. Review and coordinate Graphic User Interface Control System appearance and functionality:
   1. Crestron DigitalMedia© System: The DigitalMedia© systems shall be installed, configured, and tested by a DMC-E certified technician and/or engineer, in accordance with the guidelines set forth in the Crestron HD-DTDS Specification.

J. The contractor shall not install any custom plates with the integrators name or contact information in any rack or written on any blank panel.

K. All speakers shall be furnished and installed without logos or badges.

L. Should any hardware/equipment required for functional systems be missing to meet design intent, the owner must be notified in writing to provide direction for installation of a completed system.

M. The integrator is responsible for all programming associated with hardware installed as part of this specification. The integrator is responsible for coordination with owner to ensure equipment programming meets design intent.

N. Displays and display mounts shall be installed by the AV contractor, and shall be coordinated with the General Contractor prior to installation to verify any special requirement for installation on specific wall types.

3.2 CONDUIT

A. Review and coordinate audio installation with the Electrical Contractor to ensure proper operation of the audio system.

B. All wiring shall be in conduit unless authorized by the Architect and Owner, approved by the Architect and Owner in writing, and permitted by code. Exceptions are short runs at equipment terminations where there are no means of connecting conduit to the equipment.

C. Where installed exposed, conduits shall be parallel with or at right angles to walls or ceiling and /or follow surface contours and shall be supported from walls or ceilings by means of approved clamps or hangers. Conduit connections to equipment racks shall be insulated.

D. Minimum size conduit shall be trade size ¾". All conduits shall be sized for maximum 40% fill or less if required by code.

E. Conduits carrying high voltage or high amperage wiring serving equipment subject to abrupt start-up and possible slapping of wiring within conduit shall not pass through Acoustically Sensitive Spaces.

F. Conduits connected to dimmer racks or to transformers shall not pass directly into Acoustically Sensitive Spaces. Conduits connected to dimmer racks or transformers shall not penetrate walls, floors, or slabs of Acoustically Sensitive Spaces within thirty (30) feet of those equipment room walls or slabs. All penetrations in the path of conduits within thirty (30) feet of electrical rooms containing dimmer racks or transformers shall be resilient penetrations.

G. Large numbers of conduits penetrating walls of Acoustically Sensitive Spaces shall be

individually sleeved and shall pass through walls, floors, slabs, and ceilings perpendicularly.

H. Conduits shall not be installed to connect or contact rigidly other non-electrical equipment or building systems which are vibration isolated.

I. Coordinate all conduit sizes, locations, and quantities with the Electrical Contractor to provide proper routing, signal separation, and wire group type. Failure to do so shall not allow for additional compensation. Provide a conduit routing plan for approval by the Architect and Owner prior to installation. Routing plan shall include intended sizes, separation, and cable fill chart.

3.3 RESILIENT PENETRATIONS OF WALLS AND SLAB

A. All penetrations for conduit, innerduct, cabling, or any additional pathways for installation of equipment as part of this specification must be coordinated with the construction manager, architect, and owner prior to start of work.

B. All conduit and cable penetrations shall be sleeved, packed, and caulked airtight to form a resilient penetration at the following locations:
1. Mechanical Equipment Rooms
2. Electrical and Dimmer Equipment Rooms
3. Acoustically Sensitive Spaces
4. Rooms with Acoustically Isolated Construction.

C. Openings shall be oversized and sleeved to provide an inner diameter of one (1) to two (2) inches greater than the outside diameter of the duct or pipe. The conduit shall be centered in the opening and shall not rigidly contact the wall, floor, or ceiling. The resulting gap shall be packed with glass fiber packing material and foam rod. The gap shall be caulked to an airtight seal using permanently flexile acoustical sealant.

D. Acoustical sleeves may be used in lieu of resilient penetrations described above. Multiple conduit penetrations may be constructed following the detail for multiple penetrations identified in the Contract Documents.

3.4 ELECTRICAL POWER

A. Review and coordinate electrical power system installation including grounding with the Electrical Contractor to ensure proper operation of the audiovisual system.

B. Verify that All AC power circuits designated for audio equipment are wired with the correct polarity and ground. Report in writing any discrepancies found to the Architect and Owner for corrective action.
1. Provide distribution of electrical power within the equipment racks with a minimum of one space AC receptacle for each four (4) in use per branch circuit.

2. The Electrical Contractor shall ensure that all audio grounding does not intersect with any building ground except at earth.

3.5 STEEL SUPPORTS

A. Fabricate and install any supports so that the installation does not weaken or overload the building structure. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems. No drilling or cutting of concrete beams, joists, or structural steel, nor welding to structural steel, shall be permitted except as authorized in writing by the Architect and Owner.

3.6 SEISMIC RESTRAINTS

A. All hanging or free-standing equipment and cabinets furnished, including but not limited to racks, loudspeakers, projection screens, and mounts shall be secured to substantial building structures. The equipment described herein shall resist seismic acceleration in any direction up to a limit of the greater of 1.0G or the limit prescribed by the local governing codes.

B. Loudspeaker hanging details, rack bracing, and other seismic restraints may not be shown on the Contract Documents. The Contractor is responsible for development of these drawings to be submitted and approved by the Structural Engineer.

3.7 BOXES

A. With the exception of portable equipment, all boxes, conduits, cabinets, equipment, and wiring shall be held in place and the mounting shall be plumb and square.

B. All boxes shall be securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.

C. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes are not permitted except as authorized in writing by the Architect and Owner.

D. Clean all box interiors prior to installing plates, panels, or covers.

3.8 WIRING METHOD AND PRACTICES

A. Furnish and install all audiovisual wire and cable ensuring proper pulling tension, bend radius, quantities, types, lengths, routing, wire group separation, and identification.

B. Spare wire runs of each group and type shall be pulled to each termination location. The number of spares shall be ten (10) percent of those in actual use or one, whichever is greater

C. Splicing of cables is not permitted between terminations of specified equipment.

D. Do not pull wire or cable through any box fitting or enclosures where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, and rollers to protect cables from excess tension, abrasion, or damaging bending during installation.

E. Use wire pulling tensions in accordance with the wire and cable manufacturer's recommendations.

F. All wires shall be permanently identified at each wire end by marking with adhesive on crimp-on markers and a chart kept of each wire's function. This applies to wire within a rack assembly as well as wire running in conduit.

G. Wire ends shall be wrapped with appropriate heat shrink tubing. Each shield or drain wire shall be covered with heat shrink to avoid unintentional connections.

H. Use ring or tongue lugs on all barrier strip terminals. Do not exceed two (2) lugs per terminal. Use crimping tools that are designed for the application or solder. Do not cut strands from conductors to fit lug terminals. Spare terminal blocks, equivalent to ten percent (10%) of those in actual use shall be furnished.

I. Form in an orderly manner all conductors in enclosures and boxes, wire ways, and wiring troughs, furnishing circuit and conductor identification. Tie using tie wraps of appropriate size and type. Limit spacing between ties to twelve (12) inches and furnish and install circuit and conductor identification at least once in each enclosure.

J. When the audiovisual cables are pulled, leave a five foot (5') tail at each end to all field locations and a fifteen foot (15') tail at all equipment rack locations UON. Temporary labels shall be applied at both ends of each cable. Permanent labels shall be applied when the cables are cut back and terminated.

K. All labeling of audiovisual cables shall comply with Infocomm standard F501.01:2015. The numbering system used in compliance with this standard shall be verified with the owner prior to implementation. A schedule of all cabling and its labels shall be provided to the owner and Architect for review prior to pulling and termination of cables.

3.9 GROUNDING

A. Audiovisual system wiring shall conform to the following procedures:
   1. Audio equipment AC ground pins shall connect to AC ground.
   2. Audio equipment chassis shall connect to rack frames.
   3. Audio rack frames shall connect to AC ground bus in panel board by means of #2 gauge (minimum) conductor

4. Audio shields between AC powered pieces of equipment shall be connected to ground at one end only. Terminate capacitance as required.
5. Audio signal paths between AC powered pieces of equipment shall be connected using balanced lines and/or transformer isolation as required.
6. No unbalanced signal paths may be connected to patch bays.
7. Isolate all audiovisual system wiring from racks, back boxes, and conduit.
8. Isolate all audiovisual system racks from conduit and other conductive surfaces. Use insulated bushings for conduit connections and a dielectric plinth between racks and conductive flooring.
9. AC isolated ground system shall be isolated from all other facility grounds.

B. All metallic conduit, boxes, and enclosures shall be grounded in accordance with the current National Electric Code (NEC).

C. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provisions of grounding conductors separate from AC ground.

3.10 EQUIPMENT RACKS

A. The equipment racks shall be considered as custom assemblies and shall be assembled, wired, and tested in the Contractor's shop. Final assembly of racks shall take place on site after transportation but shall conform to the same test results achieved in the shop.

B. Placement of equipment in equipment racks, as shown in the drawings, is for maximum operator convenience. The insertion of additional equipment not indicated herein or any changes of placement of the equipment must be indicated in writing to the architect and owner before assembly.

C. Racks shall be installed plumb and square without twists in the frame or variations in level between adjacent racks.

D. All wire, cable, terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system. Labeling on manufactured equipment shall be by engraved plastic laminate or by thermal printer on adhesive tape, with white lettering on black background or dark background that is similar to panel finish.

E. Provide stiffeners to custom panels to prevent panel deformation during normal plugging or switching operations.

F. All field termination shall enter the rack via a bulkhead panel(s) mounted to the rear-rails of the equipment rack.

G. All wires and cable used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice which shall include but is not limited to hook and loops cable ties, cable wrap, lacing bars, D-ring panels, etc. Locking cable ties are not an acceptable form of cable management and shall not be permitted as a substitution for hook and loop cable ties.

H. Harnessed cables shall be combed straight, tie wrapped every eight (8) to twelve (12) inches and attached to the structure as necessary. Each cable that breaks out from the harness for a termination shall be provided with ample service loop to permit equipment removal from the racks without disconnecting.

I. Harnessed cables shall be formed in either a vertical or horizontal relationship to equipment, controls components, or terminations.

J. Cables shields shall be connected to the isolated ground system with due regard for the ground loops.

K. All system components and related wiring shall be located with due regard from the minimization of induced electromagnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience of the operator.

L. All rack mounted equipment with front panel controls, shall be furnished with security covers to avoid tampering with preset levels.

M. All rack mounted equipment shall be installed with Middle Atlantic HTX 10-32 Star Post Screws, UON.

N. Every device shall be installed with regard for proper polarity. Absolute polarity shall be maintained through the entire audio chain.

O. All equipment racks shall be installed with a service loop of sufficient length for adjustment of the rack to a serviceable position for complete serviceability. Service loops shall be sheathed in woven cable wrap for ease of service loop management.

P. Rack Shelves, Drawers, and other rack mounted equipment for housing and storing equipment within racks shall be provided as indicated on the drawings and installed with security screws.

3.11 INITIAL ADJUSTMENT

A. Verify all circuits and extensions for correct connection, continuity, and polarity. Absolute polarity shall be maintained between all points in the system.

B. Connector polarity shall be maintained except for terminations at equipment manufactured to other standards. Verify that polarity connections are consistent throughout the system.

C. Verify that the audio system is operational, and the system gain structure is within the recommendations of major component manufacturers.

D. Verify that the video system is operational and the video signal from all camera locations and projectors output to the correct locations including all control equipment.

3.12 VERIFICATION TESTS

A. Confirm that each individual wire and cable run (whether in rack or in a conduit) is identified with a unique number. These numbers are affixed to both ends of each cable and are clearly visible. Furnish a complete list of these numbers along with the termination location of each end of the wire run.

B. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. Contractor shall furnish a wide band oscilloscope in order to verify this condition.

C. Confirm that the system is free of audible clicks, pops, hums, and other noises when any operating control is activated, with or without an input signal

D. For all audio and video lines, confirm:
1. Proper circuits appear at each termination location.
2. Proper circuits appear at each jack bay location.
3. Continuity of all conductors.
4. Proper polarity is maintained.
5. Absence of shorts between conductors within each circuit.
6. Absence of shorts between circuit conductors and conduit.

E. Confirm that the loudspeakers and mountings are free of buzzes and rattles when the speaker is swept with sine wave tones over its rated bandwidth at one-half (1/2) its maximum rated power.

F. For all permanently mounted loudspeaker terminations, furnish impedance measurement of each pair of loudspeaker lines with all loudspeakers connected and all amplifiers disconnected. These measurements shall be documented in a table listing impedance for each third octave from 20 Hz to 20 kHz and shall be accurate to the nearest 0.1Ω.

G. For each installed data network cable or fiber optic cable, verify that performance conforms to the relevant TIA/EIA specifications.

H. For all electronic devices mounted in racks and connected to patch bays confirm:
1. Every audio input and output is balanced.
2. Proper polarity is maintained throughout the entire audio signal path.

I. Confirm that there are no short circuits between the neutral and isolated ground conductors for

each clean power circuit.

J. Confirm every input and output for video system including:
1. Proper signal to displays.
2. Proper sync to playback and recording equipment.

3.13 VERIFICATION TEST REPORT

A. Submit five (5) copies of a written report detailing the results of Initial Adjustments and Verification Test including all relevant drawings, charts, test instrument data and photographs. This report shall be completed and submitted to the Architect and Owner for review a minimum of five (5) days prior to Acceptance Testing and final tuning. With this report, submit written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection, testing, and tuning.

3.14 ACCEPTANCE TESTING

A. Acceptance Testing shall be performed by the Architect and Owner during a period designated by the Architect and Owner. Contractor shall furnish a minimum of two (2) technicians for the acceptance testing period.

B. All systems shall be compliant with Infocomm standard 1M:2009 Uniform Distributed Audio Standard as applicable.

C. The minimum time required for Acceptance Testing is two (2) working days of dedicated quiet. Coordinate this time period so that free access, work lighting, and electrical power are available on site.

D. The AV Contractor shall bear any costs incurred for additional Architect's time and expenses due to failure to have the system functioning in accordance with specification requirements at the time scheduled for Architect's Acceptance Testing and Tuning.

E. Ensure that audiovisual areas are in a clean and orderly condition ready for Acceptance Testing.

F. At the time of Acceptance Testing, submit one (1) copy each of the operation and maintenance manual to the Architect and Owner (refer to Paragraph 3.15).

G. Furnish test equipment meeting the following minimum specifications on site, at all times during the Acceptance Testing. Prior to Acceptance Testing, provide the Architect with a listing of the equipment model numbers and their software versions (if applicable) to be made available.
1. Oscilloscope: 1GHz bandwidth sensitivity – 1mV/cm
2. Digital Multi-meter: 1% accuracy
3. Function Generator: 1GHz bandwidth, distortion <1%

4. Real Time Analyzer: 1/3 octave with microphone.
5. Pink Noise Source: 20 Hz – 20 kHz
6. Impedance Sweep Meter: 20 Hz – 1 kHz range, 1Ω - 50Ω.
7. Polarity Checker: Microphone level, Line Level, and Loudspeaker Level.
8. NTSC bar graphs and other test patterns for video verification.
9. Ultra High definition (4K60) Video test generator with VGA, DVI, HDMI 2.0, SDI, and 3G-HDSDI outputs

H. Be prepared to verify the performance of any portion of the system by demonstrations, listening, and viewing tests, and instrumented measurements.

I. Make additional mechanical and electrical adjustments within the scope of the work which may be deemed necessary by the Architect and/or Owner as a result of the Acceptance Test. This may include realigning and re-aiming of video or audio systems, changes in system gain structures, grounding, filtering, or interfaces.

J. Final acceptance shall be contingent upon issuance by the Owner of a letter of acceptance stating that the work has been completed and is in accordance with the Contract Documents. The warranty period shall begin upon issuance of said letter.

3.15 SYSTEM DOCUMENTATION

A. Within fifteen (15) days of the Acceptance Testing, prepare and submit five (5) neatly bound copies of the operations and maintenance manuals to the Owner. Manuals shall be placed in an orderly fashion into a three-ring binder with spine labels indicating contents. These copies are in addition to the one (1) copy each furnished to the Architect and Owner during Acceptance Testing.

B. Manual shall include but not be limited to the following:
1. Table of contents
2. Written Guarantee and Service Policy
3. Basic power on/off and operational procedures.
4. All Available manufacturer’s operation and service literature for each major system component
5. A one-line signal flow diagram with all cable runs and patch points identified by alphanumeric characters
6. A copy of the Verification Test Report
7. Two (2) copies of as-built conduit riser diagram obtained from the Electrical Contractor
8. A copy of the final tuning settings as furnished by the Architect
9. Electronic versions of all documents included in the manual and electronic back up of all software, firmware, and files to restore initial install presets for all applicable devices copied on to (2) USB storage devices.

C. Furnish a framed copy of the as-built signal flow diagrams to be mounted in AV Room 891 and

804B. This diagram shall have all cable runs and patch points identified by alphanumeric characters. This print shall be at minimum ARCH D sheet size (24" x 36").

3.16 TRAINING

A. The AV Contractor shall provide up to forty-eight (48) hours instruction in the safe and proper operation of the equipment, in particular the presentation systems, control systems, and use of interactive displays systems to the owner's designated representatives.
   1. AV Contractor shall schedule instruction with the Owner's designated representatives.
   2. Instruction shall not necessarily follow immediately after the system commissioning.
   3. Instruction shall be independent of the system check-out and activation. Duration of system commissioning shall not affect the length of instruction time.
   4. Instruction, at Owners discretion, may occur in multiple time blocks of less than eight (8) hours each.
   5. AV Contractor shall be responsible for making and furnishing video documentation of instruction for future viewing to the Owner
   6. AV Contractor shall provide a minimum of (4) physical storage drives to be given full ownership to the Garret College.
   7. AV Contract shall include line item pricing for providing the service listed above.

END OF SECTION 27 41 16

SECTION 282000 - VIDEO SURVEILLANCE

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 a video surveillance system consisting of cameras, digital video recorder, data transmission wiring, and a control station with its associated equipment.

B. Related Requirements:

1. Section 281300 "Access Control System Software and Database Management" to integrate access control system interface and control.

1.3 DEFINITIONS

A. AGC: Automatic gain control.

B. BNC: Bayonet Neill-Concelman - type of connector.

C. B/W: Black and white.

D. CCD: Charge-coupled device.

E. FTP: File transfer protocol.

F. IP: Internet protocol.

G. LAN: Local area network.

H. MPEG: Moving picture experts group.

I. NTSC: National Television System Committee.

J. PC: Personal computer.

K. PTZ: Pan-tilt-zoom.

L. RAID: Redundant array of independent disks.

M. TCP: Transmission control protocol - connects hosts on the Internet.

N. UPS: Uninterruptible power supply.

O. WAN: Wide area network.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
4. UPS: Sizing calculations.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Design Data: Include an equipment list consisting of every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for cameras, camera-supporting equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Product Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.
2. Interior, Controlled Environment: System components, except central-station control unit, installed in air-conditioned interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
3. Interior, Uncontrolled Environment: System components installed in non-air-conditioned temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick. Use NEMA 250, Type 4X enclosures.
5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
6. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X enclosures.
7. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: ~~Three~~ **Five** years from date of Substantial Completion. **(ADDENDUM 01)**

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. 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.

C. Comply with NECA 1.

D. Comply with NFPA 70.

E. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

2.3 STANDARD CAMERAS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Axis Communications.

B. Color Camera:

1. Comply with UL 639.
2. Pickup Device: CCD interline transfer, 2 mega) pixels.
3. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
4. With AGC, manually selectable on or off.
5. Manually selectable modes for backlight compensation or normal lighting.
6. Scanning Synchronization: Determined by internally generated synchronization signal.
7. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
8. Motion Detector: Built-in digital.

C. Automatic Color Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.

1. Comply with UL 639.
2. Pickup Device: CCD interline transfer, 2 mega pixels.
3. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.
4. With AGC, manually selectable on or off.
5. Manually selectable modes for backlight compensation or normal lighting.
6. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:

    a. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.
    b. Motion detection shall be available at each camera position.
    c. Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.

7. Scanning Synchronization: Determined by internally generated synchronization signal.
8. White Balance: Auto-tracing white balance, with manually settable fixed balance option.
9. Motion Detector: Built-in digital.

2.4 LENSES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Axis Communications.

B. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.
2. Fixed Lens: With calibrated focus ring.
3. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:

a. Electrical Leads: Filtered to minimize video signal interference.
b. Motor Speed: Variable.
c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

2.5 POWER SUPPLIES

A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera, infrared illuminator, and lens.

1. Enclosure: NEMA 250, Type 1.

2.6 INFRARED ILLUMINATORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Axis Communications.

B. Description: Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.

1. Field-Selectable Beam Patterns: Narrow, medium, and wide.
2. Rated Lamp Life: More than 8000 hours.
3. Power Supply: PoE.

C. Area Coverage: Illumination to 150 feet (50 m) in a narrow beam pattern.

D. Exterior housings shall be suitable for same environmental conditions as the associated camera.

2.7 CAMERA-SUPPORTING EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Axis Communications.

B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

C. Pan Units: Motorized automatic-scanning units arranged to provide remote-controlled manual and automatic camera panning action, and equipped with matching mounting brackets.

1. Scanning Operation: Silent, smooth, and positive.
2. Stops: Adjustable without disassembly, to limit the scanning arc.

D. Pan-and-Tilt Units: Motorized units arranged to provide remote-controlled aiming of cameras with smooth and silent operation, and equipped with matching mounting brackets.

1. Panning Rotation: 0 to 355 degrees, with adjustable stops.
2. Tilt Movement: 90 degrees, plus or minus 5 degrees, with adjustable stops.
3. Speed: 12 degrees per second in both horizontal and vertical planes.
4. Wiring: Factory prewired for camera and zoom lens functions and pan-and-tilt power and control.
5. Built-in encoders or potentiometers for position feedback, and thermostat-controlled heater.
6. Pan-and-tilt unit shall be available with preset positioning capability to recall the position of a specific scene.

E. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

F. Protective Housings for Fixed and Movable Cameras: Steel or 6061 T6 aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.

1. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display. Tamper switches and central-control unit are specified in Section 283100 "Intrusion Detection."
2. Camera Viewing Window: Lexan window, aligned with camera lens.
3. Duplex Receptacle: Internally mounted.
4. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.
5. Built-in, thermostat-activated heater units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.
6. Sun shield shall not interfere with normal airflow around the housing.

7. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.
8. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.
9. Enclosure Rating: IP 67.

2.8 MONITORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panasonic Corporation of North America.
2. Samsung Opto-Electronics.
3. SANYO North America Corporation.
4. Toshiba Corporation.

B. Color:

1. Provide 2 Video Surveuillance monitotr in Building 750, location as directed by College.
2. Screen Size (Diagonal Dimension): minimum of 48” diagonal, 9:12 ratio.
3. Resolution: 3840 x 2160 pixels.
4. Electrical: 120-V ac, 60 Hz.

2.9 NETWORK VIDEO RECORDERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following running Milestone video management software:

1. Dell.

B. Internal 8 TB of hard disk drive.

1. Video and audio recording over TCP/IP network.
2. Video recording of MPEG-2 and MPEG-4 streams.
3. Video recording up to 48 Mbps for internal storage and up to 100 Mbps for external storage.
4. Duplex Operation: Simultaneous recording and playback.
5. Continuous and alarm-based recording.
6. Full-Featured Search Capabilities: Search based on camera, time, or date.
7. Automatic data replenishment to ensure recording even if network is down.
8. Digital certification by watermarking.
9. Internal RAID storage.

10. Full integration with LAN, Intranet, or Internet through standard Web browser or video management software.
11. Integrated Web server FTP server functionality.
12. Supports all new devices plus 20% future devices.
13. Include all software licenses, and assign same to College.

2.10 IP VIDEO SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products compatible with cameras by the following:

1. Axis Communications.

B. Description:

1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
2. System shall have seamless integration of all video surveillance and control functions.
3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.
4. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video. Unit shall provide connections for all video cameras, camera PTZ control data, bidirectional audio, discreet sensor inputs, and control system outputs.
5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.
6. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.
7. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.
8. All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

2.11 SIGNAL TRANSMISSION COMPONENTS

A. Cable: Category cable, IP network, PoE with RJ-45 jacks and plugs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

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

3.2 WIRING

A. Comply with requirements in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Install cables in raceways unless otherwise indicated.

1. Except raceways are not required in accessible indoor ceiling spaces and attics.
2. Except raceways are not required in hollow gypsum board partitions.
3. Conceal raceways and wiring except in unfinished spaces.

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

D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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.

E. For communication wiring, comply with the following:
1. Division 27.

F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras and infrared illuminators level and plumb.

B. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

E. Identify system components, wiring, cabling, and terminals according to Division 27.

F. Assign all software licenses to the College.

G. Set passwords as directed by the College.

H. Delete all factory set passwords.

3.4 DISPLAY AND STORAGE EQUIPEMENT

~~**A. Install displays and storage server in existing security control area in building 750, in location directed by the College. Adjust location of existing displays and storage as required to suit new installation.**~~ **(ADDENDUM 01)**

B. Program all new cameras and software.

C. Set passwords as directed by college.

D. Delete factory set passwords.

E. Assign all software licenses to the College.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

    a. Prepare equipment list described in "Informational Submittals" Article.
    b. Verify operation of auto-iris lenses.
    c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
    d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet (17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
    e. Set and name all preset positions; consult Owner's personnel.
    f. Set sensitivity of motion detection.
    g. Connect and verify responses to alarms.
    h. Verify operation of control-station equipment.

3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Video surveillance system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
3. Adjust all preset positions; consult Owner's personnel.
4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.7 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

END OF SECTION 282000