

**SOUTH CAROLINA  
DEPARTMENT OF MENTAL HEALTH**

**CFSH GUARD HOUSE  
STANDBY GENERATOR INSTALL**

**PROJECT MANUAL**

**STATE PROJECT NO. J12-N088-JM  
A/E PROJECT NO. 21010**

**APRIL 6, 2021**

**CONSTRUCTION DOCUMENTS**

**PREPARED BY:**



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**TABLE OF CONTENTS**

**APRIL 6, 2021**

<b><u>SECTION</u></b>	<b><u>DESCRIPTION</u></b>
<b><u>DIVISION 01 – GENERAL WORK</u></b>	
01 1000	General Requirements
01 1015	Temporary Service
01 1040	General Cleaning
<b><u>DIVISION 26 – ELECTRICAL</u></b>	
26 0500	Electrical General Requirements
26 0501	Electrical Coordination
26 0503	Cutting, Patching, Repair and Firestopping
26 0519	Wire And Cable - Building Wire (600 Volts And Below)
26 0526	Grounding
26 0533	Metallic Conduits/Raceways And Fittings
26 0535	Electrical Boxes
26 0548	Seismic Support Of Electrical Equipment
26 2416	Panelboards
26 2726	Wiring Devices
26 2816	Safety and Disconnect Switches
26 3213	Engine Generators

## SECTION 01 1000 – GENERAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 MATERIALS AND WORKMANSHIP:

- A. Unless otherwise specified, all materials shall be new, of the best quality consistent with the type and grade specified and of a type and quality suitable for the purpose they are to serve. All employees shall be competent, experienced and skilled in their trades. Workmanship throughout shall be of the first quality equal to the best recognized practice in the field concerned.

#### 1.2 APPROVAL OF SUBSTITUTIONS:

- A. Specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality.
- B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified shall be submitted for approval in writing ten (10) calendar days prior to bid opening date to the Engineer. Requests shall be accompanied by samples, literature, and information as necessary to fully identify and allow appraisal of the material or equipment. Submittals shall be concise, clear, and brief as possible. Incomplete submittals or submittals requiring lengthy research to ascertain quality will not be considered. No substitutions will be considered within ten (10) days prior to approval.
- C. Approval of the Engineer to use materials or equipment, if granted, will be in the form of a written addendum.
- D. The judgment and decision of the Engineer to approve or reject a request for substitution is final.
- E. Submittals for bidding are not required on items specified by model number or when a manufacturer listed by name can provide equipment with no deviations from the specifications. Submit all other items for approval.
- F. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly indicated in the form of a letter that is enclosed with the submittals.
- G. Contractor shall be responsible for verifying all dimensions with available space. If, in the opinion of the engineer, the physical dimensions do not permit the substituted material or equipment to be properly operated, maintained, serviced, or otherwise accessed, or the physical dimension adversely impact other components, a system's ability to be operated, maintained, serviced or otherwise accessed, the material or equipment shall be replaced at the contractor's expense.

1.3 EXAMINATION OF CONDITIONS:

- A. The Contractor, subcontractors and material suppliers shall carefully examine the drawings and specifications and all job conditions and call to the attention of the Engineer any conditions that will interfere with or preclude a first-class and serviceable installation of the product they propose to furnish. The Contractor shall notify the Engineer, in writing, should any conditions exist that would in any way affect a manufacturer's guarantee, warranty or responsibility for proper performance and service of an item.

1.4 FITTING JOB CONDITIONS:

- A. The Contractor, subcontractors and material suppliers shall be responsible for inspecting all job conditions affecting the installation of an item and taking all field measurements required prior to fabrication of an item to insure that the item concerned will integrate properly with all adjacent materials and fit all other conditions as they exist or will exist in the finished building.
- B. Work in connection with the installation of an item shall be coordinated with all other affected work and trades.
- C. Sleeves, anchors and other items that must be embedded in or that otherwise affect other portions of work shall be located and set while such portions of the work are in progress.

1.5 TESTS, CERTIFICATIONS AND APPROVAL BY OTHER AUTHORITIES:

- A. Where tests, certificates or approvals by authorities other than the Engineer are required, the Contractor shall have such tests performed and procure such certification or approvals. The contractor shall forward a minimum of four copies of the results of the test, the certificates, or approvals to the Engineer prior to the proceeding with work involved. Such laboratories and/or authorities as are employed for this purpose shall be competent, with a generally recognized reputation in the field concerned, and shall be subject to approval of the Engineer.

1.6 INCLUSION OF ACCESSORIES:

- A. Unless otherwise specifically mentioned, all anchors, bolts, screws, fittings, fillers, hardware, accessories, trim and other parts required for or in connection with an item of material to make a complete, serviceable, finished and first quality installation shall be furnished and installed as part of the item whether called for by the specifications or not.

1.7 PROTECTION:

- A. All materials shall be shipped and stored and handled in a manner that will afford protection and insure their being in "like new" condition at the time they are incorporated in the work. After installation, they shall be properly protected against damage to insure their being in "like new" condition when the building as a whole is completed and accepted by the Owner.

1.8 INSTALLATION:

- A. All items shall be installed in a workmanlike manner in accordance with the best recognized practice in the field concerned. Manufactured items shall be installed in strict

accordance with the manufacturer's printed directions, specifications and recommendations for an installation of highest quality.

- B. All working parts shall be properly adjusted after installation and left in proper working order.
- C. Items shall in all cases be installed plumb and true and in proper relation to surrounding materials.

1.9 ANCHORING AND TYING:

- A. All materials, including but not limited to those mentioned below, shall be securely anchored and/or tied together in accordance with the best recognized practice in the field concerned whether shown, specified or not.
- B. Material shall be installed in a permanent manner that will permit expansion, contraction and other minor movements and normal use of the structure without structural features becoming impaired and without any of its parts becoming loose.
- C. Ties and anchors shall be best quality for the purpose.
- D. All wood, steel, concrete or other framing shall be securely anchored and tied together and to supporting or abutting masonry. All veneers, finished and applied items shall be securely anchored and tied to the backing material.

1.10 REFERENCE TO STANDARD SPECIFICATIONS:

- A. When standard specifications such as The American Society for Testing and Materials, Federal Specifications, Department of Commerce (Commercial Standards), American Institute of Steel Construction, or other well known public or trade associations are cited as a standard to govern materials and/or workmanship, such specifications or portions thereof as referred to shall be equally as binding and have the full force and effect as though it was copied into these specifications. Such standards as are mentioned are generally recognized by and available to the trades concerned. The Engineer will, upon request of a bidder or contractor, furnish for inspection a copy of any standard specifications mentioned or direct the bidder or contractor to any easily available copy. Unless otherwise specifically stated, the standard specifications referred to shall be considered as the latest edition and/or revision of such specifications that is in effect on the date of the Invitation for Bids. In case of any conflicts between standard specifications and the written portion of the specifications, the specifications as actually written herein will govern.

1.11 REFERENCES TO MANUFACTURER'S PUBLICATIONS:

- A. Unless otherwise specifically stated, all manufacturer's catalogs, specifications, instructions or other information or literature that are referred to in the specifications shall be considered as the latest edition and/or revision of such publication that is in effect on the date of the Invitation for Bids.

1.12 HAZARDOUS MATERIALS:

A. Existing Conditions:

1. In the event the contractor for the project encounters on the site material believed to be asbestos, polychlorinated biphenyl (PCB), lead paints, fuel contaminated soil, or any other material considered hazardous, the contractor shall immediately stop work in the area affected and report the condition to the Engineer in writing by the fastest practical method.
2. The contractor shall not resume work until the contractor is advised in writing that the material is not hazardous and/or does not pose a risk to the contractor.

B. New Materials:

1. Contractors are hereby advised that the use of the following materials or products containing these materials in any quantity or any form is strictly forbidden, even if the products can be purchased and/or legally installed.
  - a. Asbestos
  - b. PCB
  - c. Lead

1.13 WORK FORCE:

- A. The Contractor shall submit weekly Construction Reports to the Engineer. The report shall include the number of men by trade or craft, type and location of work.

1.14 EQUIPMENT DELIVERY:

- A. Any Contractor receiving equipment or materials that are to be installed under his Scope of Work shall provide personnel and equipment to unload these materials at the time they arrive on site or make provisions for receiving and unloading the shipment.
- B. Any shipments arriving on site without proper personnel present to receive and unload the shipment will be instructed to return to the shipping terminal. The Contractor shall be responsible for all additional shipping charges.

1.15 ACCIDENT PREVENTION:

- A. Each Contractor shall have an approved written Accident Prevention Program and shall produce it when required by the Engineer.
- B. The Contractor shall hold weekly meetings with all subcontractors to monitor compliance with all safety regulations. These regulations shall be provision of the current editions of the State and Federal laws, including but not limited to, the latest amendments of the following: Williams-Steagler Occupational Safety and Health Act of 1970, Public Law 91-956, Part 1910 - Occupational Safety & Health Standards, Chapter 17 of Title 29, Code of Federal Regulations, Part 1926 - Safety & Health Code and Federal and State of (South Carolina) Regulations.

1.16 BARRICADES:

- A. The Contractor shall provide all labor and materials necessary to conduct work and protect personnel in accordance with OSHA standards.
- B. The Contractor shall furnish, install, and maintain all necessary temporary barricades at the building floor perimeters and openings. All other protection and safety barricades, devices, covers, etc., including at all roof areas shall be provided by the Contractor until which time these barricades, devices, and covers are no longer required to maintain safe conditions.

1.17 PERSONAL PROPERTY:

- A. Contractor will be held liable for all damage to personal and real property as a result of their negligence to provide protective measures.

1.18 GUARANTEE OF WORK:

- A. The Contractor shall procure and furnish to the Owner all guarantees that are called for by the specifications or that are promised by a manufacturer of an item in his published catalog or literature.
- B. Except as otherwise specified, all work shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment or workmanship for one year from the date of substantial completion.
- C. If, within any guarantee period, repairs or changes are required in connection with guaranteed work which, in the opinion of the Engineer, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the terms of the Contract, the Contractor shall promptly:
  - 1. Correct all defects and place in satisfactory condition all guaranteed work.
  - 2. Repair all damage to the building, site, equipment, or other components which, in the opinion of the Engineer, is the result of the use of materials, equipment, or workmanship which are inferior, defective or not in accordance with the terms of the Contract.
- D. Should the contractor disturb any work guaranteed under another Contract, they shall restore such disturbed work to a condition satisfactory to the Engineer and guarantee such restored work to the same extent as it was guaranteed under such other contract.
- E. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the Owner may have the defects corrected and the Contractor and his surety shall be liable for all expense incurred.
- F. There will be one final inspection of project by the Engineer and Contractors between the 11th and 12th month following final acceptance of the building by the Owner. Inspection will be with Owner. Any and all items found will fall in the years' warranty.

1.19 TRANSMITTAL OF DOCUMENTS:

- A. Unless stated otherwise, all information shall flow from subcontractors to prime contractor to Engineer and conversely. Reference to a subcontractor submitting to the Engineer is not intended to bypass this routing.

1.20 WORK STATED IN OTHER DIVISIONS OF WORK:

- A. The specifications in each Division are intended to compliment one another. In case of conflict, the most stringent requirement shall apply.

END OF SECTION



SECTION 01 1015 - TEMPORARY SERVICE

PART 1 - GENERAL

1.1 WATER FOR USE IN CONSTRUCTION:

- A. The Owner shall provide a source of clean potable water for the Contractor. The Contractor shall provide means of distribution.

1.2 DRINKING WATER:

- A. Each Contractor shall provide their own drinking water.

1.3 POWER:

- A. The Owner shall provide a source of power to the extent it is available at the site. The Contractor shall provide means of distribution and connections.

1.4 TOILETS:

- A. Toilet facilities are not provided by the Owner for this project.

1.5 COST OF UTILITIES:

- A. The Owner shall make available electricity, water, etc. required for construction purposes at no cost to the Contractor. The Contractor shall take care not to use more electricity, water, or other utilities than is necessary in the performance of the work described under this contract. The Owner reserves the right to charge for any overuse of utilities furnished to the Contractor by the Owner in the performance of this work.

1.6 TELEPHONE:

- A. The Contractor shall provide their own phones.

END OF SECTION

SECTION 01 1040 - GENERAL CLEANING

PART 1 - GENERAL:

1.1 CLEANING

A. General:

1. The Prime contractor is responsible for all clean-up. The Prime Contractor is responsible for removal of trash and demolished materials from the jobsite each day for the duration of the project (dumpster not provided by the Owner).
2. The Prime Contractor will be completely responsible for the final clean up of the job. The Prime Contractor is also responsible for clean up and trash removal on a daily basis and shall make sure no trash is left on the job site upon work completion.
  - a. At the conclusion of each workday, all areas of the facility shall be left clean and free from all loose building materials, dirt, dust, or construction materials resulting from demolition or renovation work.
  - b. The Prime contractor shall assign the overall responsibility for overseeing clean-up to one individual.
  - c. The Prime contractor's designated person responsible for overseeing clean-up shall walk through all areas of work at the end of each work day with the Owner's designated representative to verify compliance with this specification.
  - d. If clean-up work is found not to be in compliance at any time during the project, the Prime contractor's clean-up crew and designated person responsible for overseeing clean-up shall remain on-site, as required, to complete the clean-up work and shall not leave the site until all areas are left clean.
3. If the Contractor fails to perform his work including clean up, Owner will, after written notification have the work performed by other forces, the cost of which will be charged to the Contractor.
4. All debris shall be disposed of properly. Burning of materials on site will not be permitted.

B. Demolition/Renovation:

1. Demolition materials shall not be left on the site at any time.
2. Immediately following demolition work and repair/patching work, the site and all work areas shall be swept clean.
3. All materials to be retained by the Owner shall be delivered to a storage location on-site designated by the Owner. Dumpster shall be emptied immediately

following demolition of each phase. Grounds shall be kept clean as required daily.

4. All materials to be removed shall be stored daily in the dumpster. The dumpster shall be emptied immediately following demolition of each phase. Grounds shall be kept clean as required daily.
5. Keep facility clean of all large debris.

C. Special Safety Precautions:

1. At the end of each workday, all new and existing electrical boxes shall be secured with coverplates.
2. At the end of each workday, all new and existing wiring that is exposed during the course of daily work shall be secured in raceways, enclosures, or electrical boxes with coverplates or raceway fittings.
3. Under no circumstances shall any exposed live circuits (with measurable voltage between conductors) be permitted at any time.
4. Exposed wiring (new or existing) shall not be left unattended at any time.

END OF SECTION

## SECTION 26 0500 - ELECTRICAL GENERAL REQUIREMENTS

### PART 1 - GENERAL CONDITIONS

#### 1.1 WORK INCLUDED:

- A. The work covered under these sections of the specifications consists of furnishing all labor, equipment, supplies and materials, and of performing all operations, including cutting, channeling, chasing, excavating and backfilling necessary for the installation of complete wiring systems, raceways, wiring, and electrical equipment in accordance with this section of the specifications and the accompanying drawings.
- B. The Electrical Work shall include, but not be limited to, the following:
  - 1. Electrical distribution system
  - 2. Wiring devices
  - 3. Raceway system
  - 4. Conductors and cables
  - 5. Panelboards and Disconnect Switches
  - 6. Generator and Automatic Transfer Switch

#### 1.2 RELATED WORK:

- A. Related work to Division 26:
  - 1. Division 1
  - 2. The provisions, conditions, and requirements preceding and including general and supplemental conditions apply to and are a part of Divisions 26, 27, and 28.

#### 1.3 DEFINITIONS:

- A. Provide: Furnish and install complete ready for use, including all accessories required for operation.
- B. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance, support and accessories required for operation.
- C. Install: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.

#### 1.4 DESCRIPTION OF SYSTEMS:

- A. Furnish and install all materials for systems, resulting upon completion, in functioning systems in compliance with performance requirements specified. The omission of express reference to any parts necessary for or reasonably incidental to a complete installation shall not be construed as a release from furnishing such parts.

- B. The wiring specified and shown on the drawings is for complete and workable systems. Any deviations from the wiring shown due to a particular manufacturer's requirements shall be made at no cost to either the contract or to the Owner. Changes in electrical service to equipment due to substitutions of equipment by any Divisions of this specification shall be at no additional cost to the Owner.

1.5 QUALITY ASSURANCE:

- A. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service.
- B. Equipment and material which are not covered by UL Standard will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe will be considered, if inspected or tested in accordance with national industrial standards, such as NEMA, ICEA or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- C. All equipment of one type (such as panelboards, breakers, etc.) shall be the products of one manufacturer.

1.6 REQUIREMENTS OF REGULATORY AGENCIES/CODE COMPLIANCE:

- A. Contractors shall submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.
- B. All work shall conform to the following Building Codes:
  - 1. National Electrical Code (NEC-2017)
  - 2. National Electrical Safety Code (ANSI-C2-2018)
  - 3. International Building Code (IBC 2018)
- C. All work shall conform to all federal, state and local ordinances.
- D. References to the National Electrical Code and National Fire Protection Association (NFPA) are a minimum installation requirement standard. Design drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the NEC and NFPA.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS:

- A. All products shall be new (except where noted) and unused and without blemish or defect.

2.2 SUBSTITUTIONS:

- A. All requests for substitutions should be submitted so as to be received by the Architect/Engineer at least 10 working days before bid date and must be approved before award of Contract.
- B. Submittals shall be concise, clear, and brief as possible. Requests shall be accompanied by samples, descriptive literature and engineering information, as necessary, to fully identify and appraise the product.
- C. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly indicated in the form of a table of compliance that is enclosed with the submittals. The table of compliance shall clearly identify all deviations from the specifications with clear proof of equality for each case of deviation. Each item in the table of compliance shall be marked to show specification reference including the section and paragraph numbers.
- D. Contractor shall be responsible for verifying all dimensions with available space conditions (with provisions for proper access, maintenance, part replacement, and for coordination with other trades--electrical, plumbing, structural, etc.) for proper services, and construction requirements. Contractor to bear any additional cost for required changes in associated items which are directly or indirectly related to a substituted unit.
- E. The Contractor shall furnish drawings showing all installation details, shop drawings, technical data and other pertinent information as required.
- F. Approval of the equipment does not relieve the contractor of the responsibility of furnishing and installing the equipment at no additional cost.
- G. Where Contractor substitutes equipment manufactured by an alternative vendor other than the Specification approved first named manufacturer, the Contractor shall become responsible for the operation of the product in the intended system, including all related costs required to make the design work, function, and fit in the allocated space.

PART 3 - EXECUTION

END OF SECTION 26 0500

## SECTION 26 0501 - ELECTRICAL COORDINATION

### PART 1 - GENERAL CONDITIONS

#### 1.1 INTERPRETATION OF CONTRACT DOCUMENTS:

- A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 26.
- B. Attention is directed to Instructions to Bidders and to Division 1, General Conditions, which are binding in their entirety on this portion of the work in particular to paragraphs concerning materials, workmanship and substitutions.
- C. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- D. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not eliminate the requirement for field coordination for the indicated work.
- E. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.

#### 1.2 EXISTING CONDITIONS:

- A. The Contractor shall visit the premises and thoroughly familiarize himself with the details of the work, working conditions, verify dimensions in the field, advise the Architect/Engineer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install equipment in a manner to avoid building interference.

#### 1.3 SHOP DRAWINGS:

- A. The Contractor shall not purchase any materials or equipment prior to receipt of approved shop drawings.
- B. Prior to assembling or installing the work, prepare and submit shop drawings for the following items of equipment:
  - 1. Generator and Automatic Transfer Switch
  - 2. Panelboards
  - 3. Wiring devices

4. Circuit breakers
  5. Disconnect switches
  6. Wiring
  7. Raceway systems
- C. Submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements.
- D. Shop drawing sets shall be suitably bound and indexed. Loose sheets are not acceptable.
- E. Catalog cuts submitted for approval shall be legible and shall clearly identify equipment being submitted. Items of the submittal that have been "faxed" are not acceptable.
- F. Before preparing drawings, Contractor shall consult contract drawings and specifications in detail, obtain manufacturer's recommended installation instructions, and have shop drawings prepared based on specific equipment and material intended for installation. A principal of the contracting firm shall sign shop drawings (indicating conformance with plans and specifications) before submission
- G. Approval on shop drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing (and in letter form) called attention to such deviations at the time of submission and secured written approval; nor shall it relieve him from responsibility for errors in shop drawings or schedules.
- H. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

#### 1.4 AS-BUILT DRAWINGS:

- A. The Contractor shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of items, material, and equipment on these job drawings.
- B. At the time of final inspection, two corrected sets of drawings shall be delivered to the Architect. Drawing costs to be by the Contractor.
- C. Corrected sets shall be made by obtaining a sepia of the applicable contract drawings. Sepia prints shall be corrected deleting incorrect locations and showing installed locations in accordance with information transferred from job drawings.
- D. Provide an additional set of corrected drawings in a moisture proof storage tube and mount the tube in the main electrical room.

#### 1.5 OWNER'S MANUAL:

- A. The Contractor shall submit to the Architect six identical manuals that contain manufacturer's brochures of items installed by the Electrical Contractor.



B. The cover of the manual shall state the following information:

1. Project Name
2. Location
3. Owner
4. Architect
5. Electrical Engineer
6. Electrical Contractor (name, address, phone number)
7. Project Supervisors
8. Date of Project Completion

1.6 OPERATING AND MAINTENANCE INSTRUCTIONS:

- A. After final tests and adjustments have been completed, a competent employee of the Contractor shall be provided to instruct the Owner's Representative in details of operation and maintenance for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time to assure that Owner's Representative is qualified to take over operation and maintenance procedures. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.

1.7 MAINTENANCE MATERIALS:

- A. All special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner's Representative and a receipt requested for same.
- B. Where specified, provide Owner's Representative with spare parts, equipment and materials and request a receipt for same.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION:

- A. In addition to the requirements of the National Electrical Code, install an identification sign which will clearly indicate information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchgear and motor control assemblies, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core and engraved lettering, a minimum of 1/4-inch high. Nameplates that are furnished by manufacturer, as a standard catalog item, or where other methods of identification is herein specified, are exceptions.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS:

- A. Inspection:
  - 1. Prior to any Work, the Contractor shall carefully inspect the installed Work of other Trades and verify that such Work is complete to the point where his installation may properly commence.
  - 2. Verify that equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the Architect Engineer.
  - 2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.
- C. Return to original (pre-construction) condition any paved areas, sidewalks, planting, etc., disturbed during electrical system installation.

3.2 INSTALLATION:

- A. Install equipment in strict accordance with the manufacturer's recommendations and the shop drawings approved by the Engineer.
- B. Secure equipment using fasteners suitable for the use, materials, and loads encountered. If requested, submit evidence proving suitability. Do not attach electrical materials to roof decking, removable or knockout panels, or temporary walls and partitions, unless indicated otherwise.
- C. Coordinated electrical systems, equipment and materials complete with auxiliaries and accessories shall be installed. Remove, modify, relocate and reinstall the existing electrical equipment and materials as shown.
- D. Equipment location: Shall be as close as practicable to locations shown on drawings.
- E. Working spaces shall be not less than specified in the National Electrical Code for voltages specified.
- F. Inaccessible Equipment:
  - 1. Where the Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
  - 2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and duct work.
- G. Equipment and Materials:
  - 1. New equipment and materials shall be installed unless otherwise specified.

2. Equipment and materials shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements shall apply to the installation in areas requiring special protection such as explosion-proof, vapor-proof, watertight and weatherproof construction.

### 3.3 COORDINATION WITH OTHER TRADES:

- A. Coordinate work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings, and shall make sure that proposed equipment can be accommodated. If interferences occur, Contractor shall bring them to the attention of Architect/Engineer, in writing, prior to signing of contract; or, Contractor shall, at his own expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.

### 3.4 SERVICE CONTINUITY:

- A. Electric service shall be maintained to the site during construction except with prior written approval of interruptions. Any required interruptions of electric service due to work being performed under this contract shall be scheduled in advance after consultation with the Architect and the Owner and shall generally occur between the hours of five o'clock p.m. and five o'clock a.m. The Contractor shall be responsible for any material and labor costs, including overtime pay, to meet these requirements as part of the Division 26 scope of work.
- B. At least 14 days prior to the requirement of any interruption of electrical service, the Contractor shall furnish to the Owner and Engineer for approval a written plan for the work associated with the outage including a description of the installation and removal of temporary wiring and facilities necessary to be installed.

### 3.5 WORK PERFORMANCE:

- A. Arrange, phase and perform work to assure electrical service is maintained for other buildings during construction. See General Methods of Procedure under Section GENERAL REQUIREMENTS.
- B. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior condition.
- C. Coordinate location of equipment and conduit with other trades to minimize interferences.
- D. Cutting of Holes:
  1. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed.
  2. Holes shall be located so as not to affect structural sections such as ribs or beams.
  3. Holes shall be laid out in advance. The Architect shall be advised prior to drilling through structural sections, for determination of proper layout.

- E. Where conduits, wireways, busduct, and other electrical raceways pass through fire partitions, fire walls or walls and floors, install a firestop that provides an effective barrier against the spread of fire, smoke and gases. Fire-stop material shall be packed tight, and completely fill clearances between raceways and openings. Installation of fire-stop material shall conform to Section 260503 Cutting, Patching and Repair, Firestopping.
- F. Hangers and other supports shall support only electrical equipment and materials. Provide not less than a safety factor of 5, which shall conform with any specific requirements as shown on the drawings or in the specifications.
- G. ***For exterior locations, exposed equipment and materials, including screws and other fasteners, shall be tamperproof. Cover plates shall have beveled edges.***

3.6 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT:

- A. Protect materials and equipment from damage during storage at the Site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering with securely fastened protective rigid or flexible waterproof coverings.
- C. Conduit shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.
- D. During construction cap the top of conduits and raceway installed vertically.
- E. During installation, equipment, controls, controllers, circuit protective devices, etc., shall be protected against entry of foreign matter on the inside; and be vacuum cleaned both inside and outside before testing, operating and painting.
- F. Damaged equipment shall be placed in first class operating condition or be returned to source of supply for repair or replacement.
- G. Painted surfaces shall be protected with removable heavy kraft paper, sheet vinyl or equal, installed at the factory, and removed prior to final inspection.
- H. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with same quality of paint and workmanship as used by manufacturer so repaired areas are not obvious.

3.7 DISPOSITION OF EXISTING MATERIAL AND EQUIPMENT:

- A. All material and equipment which is noted, specified, or required by the Owner to be salvaged and which is not scheduled to be reused or relocated shall be carefully removed and shall be delivered to the Owner and stored where directed on the site.
- B. Carefully remove and store on the site material and equipment noted or specified to be reused or relocated. Thoroughly clean this equipment prior to installation.
- C. Remove materials or debris resulting from demolition operations from the site.

3.8 EXCAVATING, TRENCHING, BACKFILLING AND RESURFACING:

- A. Perform work as required, indicated, and in compliance with site work. Excavation depths indicated are below finished grade unless noted otherwise.
- B. Do not excavate below required depth except as necessary for removal of unstable soil. Unless indicated otherwise, pitch electrical conduit runs downward away from buildings.
- C. Where backfill compaction is critical (e.g. under floor slabs, roadways, sidewalks, trenches deeper than four feet), test the degree of compaction each 75 linear feet of trench and each two feet of depth. Test as required by Division - "Sitework" and compact backfill until density is acceptable.
- D. Repair the excavated area to original pre-excavation condition. Repair and replace sidewalks, roadways, etc.
- E. Compact soil and condition soil fill for sod (soften/rake/till). Provide sod as required to provide 100% grass coverage (match existing grass type). Elevation of sod shall match adjacent existing grade level.
- F. *Burial depth for underground feeders shall be 12" minimum.***

3.9 IDENTIFICATION:

- A. Upper case letters of uniform height; centered on device, coverplate, or enclosure; engraved letters filled with a contrasting color; and characters made clearly and distinctly.
- B. Use abbreviations defined in the contract documents whenever possible. Use plan designations for labeling, unless indicated otherwise. Indicate loads served using designations from electrical schedules and designations from the trade furnishing the equipment served.
- C. Label the following with marking pen.
  - 1. Junction boxes or portions of junction boxes with 120 or 240 volt wiring; pull and junction boxes; and pull, junction boxes, and raceway installed above ceilings and for future use. Label inside covers in exterior locations and outside covers in unfinished areas.
- D. Label feeder conductors and control conductors with self adhesive, numbered labeling tapes; Brady Co. or equal. Indicate feeder numbers on feeders and terminal numbers for control conductors. Label conductors at origin and destination points and at junction boxes where two or more feeder or control circuits are present.

3.10 ACCESS TO EQUIPMENT:

- A. Equipment shall be installed in location and manner that will allow for convenient access for maintenance and inspection.

3.11 GENERAL COMPLETION AND DEMONSTRATION:

- A. Results expected:

1. Systems shall be complete and operational, and controls shall be set and calibrated.
  2. Testing, start-up and cleaning work shall be complete.
- B. Demonstration:
1. Upon notification by the Contractors, the Engineer will visit the project for a demonstration of the building system and an inspection of the completed work.
  2. Items which do not comply with the Contract Documents or which function incorrectly will be listed, and the list will be submitted by the Engineer to the Contractors for repairs.
  3. After corrections have been made the Contractors shall notify the Architect/Engineer who will recheck the systems for compliance of items listed.

3.12 CLEANING:

- A. Periodically clean during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of packing material and debris.
- B. Clear away debris and surplus material resulting from electrical work. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

END OF SECTION 26 0501

## SECTION 26 0503 - CUTTING, PATCHING AND REPAIR

### PART 1 - GENERAL REQUIREMENTS

#### 1.1 SCOPE OF WORK:

- A. Cutting: Furnish all labor, materials, tools and equipment and perform all operations in connection with the cutting of new and existing building structure, finishes and building assemblies as specified hereinafter.
- B. Patching: Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of watertight sealant as required to seal voids or gaps around Division 26000 equipment at penetrations through exterior floors, walls, and roof systems.
- C. Repair: Furnish all labor, materials, tools and equipment required to repair all existing or new building components and finishes, outside components, landscaping, utilities, or other appurtenances that are damaged as a result of the performance of this contract.
- D. All existing utilities, feeders, branch circuits, signal wiring, control wiring, etc. shall be reconnected to new or existing systems as required to maintain the same functions as existed prior to new work.

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include but not be limited to, the following:
  - 1. Division 1
  - 2. All other Division 26 sections

#### 1.3 QUALITY ASSURANCE:

- A. Sealants shall equal or exceed all requirements of ASTM E-814.
- B. All applicable codes as stated elsewhere in these specifications for the type of work performed.

### PART 2 - PRODUCTS

#### 2.1 WATERPROOFING:

- A. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.

- B. The following waterproofing sealant manufacturers are acceptable:
  - 1. TREMCO
  - 2. Sonneborn - Contech
  - 3. W. R. Meadows

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Patch and repair all building finishes, structural components, or other appurtenances that are damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
- B. Replace all building components, outside components, shrubbery, or other appurtenances which are damaged beyond repair. Replacement item(s) shall be of equal or higher quality than the original item(s).
- C. All penetrations thru exterior floors, walls, and roof systems shall be sealed watertight.
- D. All roof penetrations shall be patched in accordance with roofing manufacturers' recommendations.
- E. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

#### 3.2 INSTALLATION OF SEALANT MATERIALS:

- A. Install materials in accordance with manufacturer's recommendations for installation of these materials.
- B. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant. Use joint filler to achieve required joint depths. Apply primers as recommended by sealant manufacturer.
- C. Openings larger than required for proper installation of electrical raceways or conduits shall be patched or repaired.

END OF SECTION



SECTION 26 0519 - WIRE AND CABLE - BUILDING WIRE (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 SCOPE:

- A. This section includes the furnishing, installation, and connection of the building wire for power and lighting circuits.
- B. Unless otherwise specified in other sections of these specifications, control wiring shall be provided, installed, and connected to perform the functions specified in other sections of these specifications.
- C. Unless otherwise specified in other sections of these specifications, communication and signal wiring shall be provided, installed, and connected to perform the function specified in other sections of these specifications.

1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
  - 1. Division 1
  - 2. All other Division 26000 sections

1.3 WORK INCLUDED:

- A. The work under this section consists of furnishing materials and equipment, performing labor and services necessary for the installation of the electrical cable and wiring system shown on the drawings and hereinafter specified.

1.4 APPLICABLE PUBLICATIONS:

- A. The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.
  - 1. National Fire Protection Association (NFPA) Publications
    - No. 70 . . . . .National Electrical Code (NEC)
  - 2. Underwriters' Laboratories, Inc. (UL) Publications:
    - No. 44 . . . . .Rubber-Insulated Wire and Cables
    - No. 83 . . . . .Thermoplastic-Insulated Wires

No 493 . . . . .Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

No. 486. . . . .Wire Connectors and Soldering Lugs

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Building Wire (Power and Lighting):

1. Cable and wire shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.

2. Conductors:

a. Shall be annealed copper.

b. Shall be stranded for sizes No. 8 and larger. Sizes No. 10, and smaller shall be solid.

c. Size shall be not less than shown on the drawings. Minimum size shall be No. 12 AWG.

3. Insulation: Unless otherwise shown on the drawings, insulation shall be as follows:

a. THWN - Dry Locations.

b. THHN - Dry, Damp Locations.

c. XHHW - Dry, Damp, Wet Locations.

4. Color Code:

a. All secondary service, feeder, and branch circuit conductors shall be color coded as follows:

<u>240/120 Volt</u>	<u>Phase</u>
Black	A
Red	B
White	Neutral

b. All No. 12 and No. 10 branch circuit conductors shall have solid color compound or solid color coating.

c. No. 8 AWG and larger phase conductors shall have either:

1) Solid color compound or solid color coating.

- 2) Stripes, bands, or hash marks of colors specified above.
  - 3) Colored pressure-sensitive plastic tape. Tape shall be applied in half overlapping turns for a minimum of three inches for all terminal points, and in all junction boxes, pull boxes, troughs, manholes, and handholes. Tape shall be 3/4-inch wide with colors as specified above. The last two laps of tape shall be applied with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
    - d. The neutral conductor shall have a colored strip matching the phase conductor color it is paired with where dedicated neutral conductors for single phase circuits are shown.
    - e. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
- B. Splices and Joints:
1. Shall be in accordance with UL and NEC.
  2. Branch circuits (No. 10 AWG and smaller):
    - a. Connectors shall be solderless, screw-on, pressure cable type, 600 volt, 105 degree C, with integral insulation. They shall be approved for copper conductors, and shall be reusable.
    - b. The integral insulator shall have a skirt to completely cover the stripped wires.
    - c. The number, size, and combination of conductors as listed on the manufacturers packaging shall be strictly complied with.
  3. Feeder Circuits:
    - a. Connectors shall be indent, hex screw, or bolt clamp-type. Material shall be high conductivity and corrosion-resistant.
    - b. Connectors for cable sizes 250 MCM and larger shall have not less than two compression indents.
    - c. Splices and joints shall be insulated with materials approved for the particular use, location, voltage, and temperature. Insulation shall be not less than that of the conductors being joined.
    - d. Plastic electrical insulating tape:
      - 1) Tape shall be flame retardant, cold and weather resistant.

- C. Control Wiring:
  - 1. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring.
  - 2. Wire size shall be large enough so that the voltage drop under inrush conditions will not adversely affect operation of the controls.
- D. Wire Lubricating Compound shall be suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and as hereinafter specified.
- B. All wiring shall be installed in raceway systems, except where direct burial is shown on the drawings.
- C. Cables and wires shall be spliced only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Cable supports shall be installed for all vertical feeders in accordance with the NEC. They shall be of the split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- E. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- F. Cable and wire entering a building from underground shall be sealed between the wire and conduit, where the cable exits the conduit, with a nonhardening approved compound.
- G. Wire Pulling:
  - 1. Suitable installation equipment shall be provided to prevent cutting or abrasion of conduits during pulling of feeders.
  - 2. Ropes used for pulling feeders shall be made of suitable nonmetallic material.
  - 3. Pulling lines for feeders shall be attached by means of either woven basket grips or pulling eyes attached directly to the conductors.
  - 4. All cables to be pulled in a single conduit shall be pulled in together.

#### 3.2 FIELD TESTING:

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Test shall be performed by megger and conductors shall test free from short-circuits, grounds, and opens.

South Carolina Department of Mental Health  
CFSH Guard House - Standby Generator Install

- C. Conductors shall be tested phase-to-phase and phase-to-ground.
- D. Record test results and include report within the OWNER'S MANUAL.

END OF SECTION 26 0519

## SECTION 26 0526 - GROUNDING

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK:

- A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounding systems.
- B. The term ground, as used in this specification, shall mean any of the grounding types specified.

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
  - 1. Division 1
  - 2. All other Division 26 sections

#### 1.3 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL listed and labeled.
- B. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical grounding and bonding.
- C. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

### PART 2 - PRODUCTION

#### 2.1 GENERAL:

- A. Provide electrical grounding systems with assembly of materials, including cables/wires, connectors, terminals, solderless lugs, grounding rod/electrodes, bonding jumper braid and additional accessories needed for complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards.

#### 2.2 GROUNDING CONDUCTORS:

- A. Shall be UL and NEC approved types, copper, with insulation color identified green, except where otherwise shown on the drawings, or specified.
- B. Wire size shall not be less than #12 AWG and not less than required by the NEC.

2.3 GROUND RODS:

- A. Ground rods shall be copperclad steel, 3/4 inch diameter by minimum ten feet long.

2.4 GROUNDING CLAMPS:

- A. Clamps for connection of grounding electrode conductors to metal piping 1" and less in diameter shall be cast brass/bronze and of the single screw type design.
- B. Clamps for bonding of metal piping for 1" through 6" in diameter shall be bronze or brass and of the U-bolt type.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL GROUNDING:

- A. General: Install electrical grounding systems in accordance with applicable portions of NEC, with NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
- B. Coordinate with other electrical work as necessary to interface installation of electrical grounding system with other work.
- C. Weld grounding conductors to underground grounding rods/electrodes.
- D. Connection to structural steel building components shall be made utilizing exothermic welding. Bolted connections for bonding to steel building components shall only be used in load bearing masonry construction when connecting to bar joist roofing systems.

3.2 FEEDERS AND BRANCH CIRCUITS:

- A. Install green insulated equipment grounding conductors with feeders and branch circuits. Conductors shall be sized in accordance with NEC Article 250.

3.3 EQUIPMENT GROUNDS:

- A. All equipment that has electrical connections (lights, receptacles, panels, and utilization equipment) shall have a ground wire connected that is directly tied to the ground bus of the panel which serves it.
- B. Fixed electrical appliances and equipment shall have a ground lug installed and provided by this contractor for termination of the green ground conductor.

3.4 CONDUCTIVE PIPING:

- A. Bond conductive piping systems in the building whether furnished and installed by this contractor or not to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.5 GROUND ROD INSTALLATION:

- A. Distance: Drive each rod vertically for not less than ten feet.

- B. Multiple Rods: Where required to obtain the specified ground resistance, install multiple rods spaced 10' apart in an equilateral triangle pattern.
- C. Make the connections by the exothermic process to form solid metal joints.
- D. Where rock prevents the driving of vertical ground rods, install grounding electrodes in trenches and of suitable length to achieve the specified resistance.

3.6 FIELD QUALITY CONTROL:

- A. Upon completion of installation of electrical grounding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground over 3 ohms, take appropriate action to reduce resistance to 3 ohms, or less, by driving additional ground rods and/or by chemically treating soil encircling ground rod; then retest to demonstrate compliance. Ground resistance tests shall be performed utilizing fall-of-potential test method for ground resistance measurements.
- B. Record results of ground resistance tests and corrective actions and include copies within the Operation and Maintenance Manual.

END OF SECTION 26 0526



## SECTION 26 0533 - METALLIC CONDUITS/RACEWAYS AND FITTINGS

### PART 1 - GENERAL

#### 1.1 SCOPE:

- A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems.
- B. Types of raceways in this section include the following:
  - 1. Rigid metal conduit (RMC or GRC)
  - 2. Intermediate metal conduit (IMC)
  - 3. Electrical metallic tubing (EMT)
  - 4. Flexible metal conduit (FMT)
  - 5. Liquidtight flexible metal conduit (LFMC)
- C. The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
  - 1. Division 1.
  - 2. All other Division 26000 sections.

#### 1.3 QUALITY ASSURANCE:

- A. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- B. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to raceways systems; and, provide products and components which have been UL listed and labeled.
- C. NEC Compliance: Comply with requirements as applicable to construction and installation of raceway systems.

### PART 2 - PRODUCTS

#### 2.1 RIGID METAL CONDUIT (RMC OR GRC):

- A. Rigid metal steel conduit shall conform to ANSI C80.1 and Underwriter's Laboratories UL-6 specification, ANSI C80.1.

- B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating.
- C. Fittings: Fittings shall be ANSI/NEMA FB 1 threaded type, hot dipped or electronic plated. Threaded conduit to be secured to boxes, cabinets, etc., by means of galvanized threaded bushings on the inside and bond-type locknuts on the inside and outside of such boxes and cabinets. Fittings shall be watertight and the same material as conduit installed with factory manufactured elbows.

2.2 RIGID INTERMEDIATE STEEL CONDUIT (IMC):

- A. Intermediate Metallic Conduit shall conform to ANSI C80.1 and proposed Underwriter's Laboratories UL 1242 specification.
- B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating. Intermediate Metallic Conduit (IMC) shall have galvanized/metallized thread protection, and pipe interior shall be protected by corrosion inhibiting coating.
- C. Fittings: Shall be similar to GRC.
- D. Maximum allowable size shall be (4) inches.

2.3 ELECTRICAL METALLIC TUBING (EMT):

- A. Electrical metallic tubing shall conform to ANSI C80.3 and Underwriter's Laboratories UL 797.
- B. EMT shall be hot-dipped galvanized steel with internal coating of silicone epoxy lubricant to assist in wire pulling.
- C. Fittings: Shall be compression type, steel or malleable iron. Set screw or indentation type of fittings are not acceptable.
- D. EMT Color Code shall be as follows:
  - 1. 480V, 277V, 208V, 120V wiring systems – no color code, silver

2.4 FLEXIBLE METAL CONDUIT (FMC):

- A. Flexible metal conduit shall conform to UL 1.
- B. Flexible conduit to be of hot-dipped galvanized interlocked spirally wound steel strip.
- C. Fittings shall be multiple point type, threading into the internal wall of the conduit convolutions, and shall have insulated throat. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

2.5 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC):

- A. Liquid-tight flexible metal conduit shall conform to UL 360.
- B. Liquid-tight flexible metal conduit shall consist of flexible galvanized steel tubing over which is extruded a liquid-tight jacket of polyvinyl chloride (PVC). Conduit shall be

provided with a continuous copper bonding conductor wound spirally between the convolutions.

- C. Fittings used shall be reusable type of malleable iron/steel construction, electro zinc plated inside and outside, furnished with nylon insulated throat and taper threaded hub. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

#### 2.6 EXPANSION AND DEFLECTION COUPLINGS:

- A. UL 467 and UL 514 shall apply.
- B. Shall accommodate, 1.9 cm (0.75 inch) deflection, expansion, or contraction in any direction, and shall allow 30 degree angular deflections.
- C. Shall include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
- D. Shall be watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.
- E. Jacket shall be flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

#### 2.7 CONDUIT SUPPORTS:

- A. All parts and hardware shall be zinc-coated or have equivalent corrosion protection.
- B. Pipe straps: Fed. Spec. FF-S-760, type 1, style A or B.
- C. Individual conduit hangers: Shall be designed for the purpose, and have pre-assembled closure bolt and nut, and provisions for receiving hanger rod.
- D. Multiple conduit (trapeze) hangers shall be not less than 1-1/2 x 1-1/2 inch, 12 gage steel, cold formed, lipped channels. Hanger rods shall be not less than 3/8 inch diameter steel.
- E. Solid masonry and concrete anchors: Fed. Spec. FF-S-325 shall apply. Anchors shall be GROUP III self-drilling expansion shields, or machine bolt expansion anchors GROUP II type 2 or 4, or GROUP VII.

### PART 3 - EXECUTION

#### 3.1 CONDUIT INSTALLATION SCHEDULE:

- A. Power distribution feeders such as feeders for switchboards, panelboard, transformers, etc.:
  - 1. Above Grade - RMC or IMC
  - 2. Underground - S40 (PVC) (with green insulated grounding conductor sized in accordance with NEC 250-102). Elbows shall be PVC coated GRC.

3. Conduits run within or rising through building or equipment slabs: RMC or IMC with factory applied external PVC coating.
- B. Feeders to motors: Same requirements as power distribution feeders.
- C. Branch circuit and HVAC equipment feeders 1-1/2" trade size and larger: Same requirements as power distribution feeders.
- D. Branch circuits from panelboards (not described above):
  1. Exposed to weather - RMC or IMC
  2. Concealed dry interior location - EMT.
  3. Exposed dry locations:
    - a. Mechanical, plumbing and fire protection equipment rooms – RMC or IMC within 8 ft. of finished floor, EMT above 8 ft.
    - b. Other locations – EMT unless noted otherwise on drawings.
  4. Underground - S40 (PVC). Elbows shall be PVC coated GRC.
  5. Conduits installed in cast-in-place concrete: RMC or IMC with factory applied external PVC coating.

### 3.2 CONDUIT INSTALLATION - GENERAL:

- A. Installation shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.
- B. Contractor shall lay out and install conduit runs to avoid proximity to hot pipes. In no case will a conduit be run within three inches of such pipes, except where crossings are unavoidable and then conduit shall be kept at least one inch from the covering on pipe crossed.
- C. Conduits shall be supported as required to comply with applicable paragraphs of the NEC.
- D. Conduit installation shall be as follows:
  1. Installed as complete runs before pulling in cables or wires.
  2. Flattened, dented, crushed or deformed conduit is not permitted and shall be removed and replaced at no cost to the Owner.
  3. Installed so they will not obstruct head room, walkways, doorways or work by other trades.
  4. Cut square with a hacksaw, reamed, burrs removed, and drawn up tight.
  5. Mechanically and electrically continuous.

6. Supported within one foot of all changes of direction, and within one foot of each enclosure to which connected.
  7. Ends of empty conduit to be closed with plugs or caps at rough-in stage to prevent entry of debris until wires are pulled in.
  8. Conduits shall be secured to cabinets, junction boxes, pull boxes, and outlet boxes by bonding type locknuts.
  9. See architectural detail for conduit penetrations of roof membrane.
- E. Conduit Bends:
1. Shall be made with standard conduit bending machines.
  2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
  3. Conduits shall not be bent with a pipe tee or vice.
- F. Conduit shall be securely fastened in place at intervals as specified by the code using suitable straps, hangers and other supporting assemblies. All strap hangers and supporting assemblies:
1. Shall be of rugged construction capable of supporting weight with a reasonable factor of safety.
  2. Shall be adequately protected against corrosion.
- G. In wet locations or in locations where corrosive conditions are present, vertical and horizontal runs of conduit shall be firmly supported so that there is at least 1/4" air space between the conduit and the wall or supporting surface. Spacers and supporting straps shall be of malleable iron construction, hot dipped galvanized.
- H. EMT shall be securely fastened in place at intervals as specified by the code using straps, hangers and other supporting assemblies.
1. Spacers and supporting straps shall be of rugged malleable iron or steel construction hot dipped galvanized.
- I. Flexible conduit when installed shall have sufficient slack to avoid sharp flexing and straining due to vibration and thermal expansion/construction. Conduit shall be installed in such a manner that liquids will tend to run off the surface instead of draining towards the fittings.
- J. Concealed work installation:
1. In concrete:
    - a. Conduit shall be run in direct lines.
    - b. Conduit shall not be installed through concrete beams, except where shown on the structural drawings or as approved by the Engineer prior to

construction, and after submittal of drawing showing locations size, and position of each penetration.

- c. Conduit shall not be installed in concrete which is less than three inches thick.
  - d. Conduit outside diameter larger than 1/3 of the concrete thickness is not permitted.
  - e. Spacing between conduits in slab shall be approximately six conduit diameters apart except one conduit diameter at conduit crossings.
  - f. Conduits shall be installed approximately at the center of the slab.
  - g. Couplings and connections shall be water tight. Thread compounds shall be UL approved conductive type to ensure low resistance ground continuity through the conduits.
2. In CMU (Concrete Masonry Unit) Walls:
- a. Conduits shall run vertically within CMU walls except where noted on the drawings or as approved by the Engineer prior to construction.
3. Conduit shall be run parallel or perpendicular to the building lines.
4. Branch circuit conduits, and conduits feeding ceiling lighting shall not be supported by the suspended ceiling, lighting fixtures, or air conditioning ducts.
5. Recessed lighting fixtures shall be connected to conduit with not over six feet of flexible metal conduit.
- K. Exposed work installation:
- 1. Conduit shall be run parallel or perpendicular to the building lines.
  - 2. Horizontal runs shall be installed close to the ceiling or beams and secured with approved conduit straps.
  - 3. Horizontal or vertical runs shall be supported at not over eight foot intervals.
- L. Surface metal raceways:
- 1. Surface metal raceways shall be used only where shown on the drawings.

### 3.3 UNDERGROUND INSTALLATION:

- A. Tops of conduits shall be:
- 1. Not less than 24 inches and not less than shown on the drawings below finished grade.
  - 2. Not less than 30 inches and not less than shown on the drawings below road and other paved surfaces.

3. Shall not be installed above power company direct burial primary feeder.
- B. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
- C. For excavation and back-filling, see Section 260501 ELECTRICAL COORDINATION.
- D. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound to prevent the entrance of moisture and gases.
- E. **Underground conduits shall be encased in not less than 3" of red concrete (all around) where run outside of building slab.**
- F. **Furnish and install a six (6) inch wide polyethylene tape, permanently colored yellow, for electric underground work (outside the building) with wording indicating type of service and "caution". Install twelve (12) inches below finished grade and directly above underground equipment.**

#### 3.4 MOTORS AND VIBRATING EQUIPMENT:

- A. Flexible metal conduit shall be used for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Flexible metal conduit shall be liquid-tight when installed in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, and locations subject to seepage or dripping of oil, grease or water. Flexible metal conduit shall be installed with green ground wire.

#### 3.5 EXPANSION JOINTS:

- A. Conduits 3 inches and larger, rigidly secured to building construction on opposite sides of a building expansion joint, shall be provided with expansion and deflection couplings. The couplings shall be installed in accordance with the manufacturer's recommendations.
- B. Conduits smaller than 3 inches shall be provided with junction boxes on both sides of the expansion joint, and connected by 15 inches of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above may be installed.
- C. Expansion and deflection couplings shall also be installed where shown on the drawings.

#### 3.6 CONDUIT SUPPORTS, INSTALLATION:

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Pipe straps or individual conduit hangers shall be used for supporting individual conduits.
- C. Multiple conduit runs shall be supported by trapeze hangers. Trapeze hangers shall be designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 pounds. Each conduit shall be attached by U-bolt or other approved fastener.
- D. Conduit shall be supported independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, etc.

- E. Solid Masonry and Concrete: Fasteners shall be as follows:
  - 1. New construction: Generally, steel or malleable iron concrete inserts in concrete prior to pouring.
  - 2. Existing construction:
    - a. Steel expansion anchors not less than 1/4-inch bolt size and not less than 1-1/8 inch embedment.
    - b. Power set fasteners shall be approved, and not less than 1/4-inch diameter with depth of penetration not less than three inches.
    - c. Anchors or fasteners attached to concrete ceilings shall be vibration and shock resistant.
- F. Hollow masonry. Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.
- G. Metal structures. Fasteners shall be machine screw or devices specifically designed and approved for the application.
- H. Attachments by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking is not permitted.
- I. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- J. Vertical supports. Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown on the drawings. Supports for cable and wire shall have fittings which include internal wedges and retaining collars.

### 3.7 PREMISES WIRING SYSTEM CONDUIT:

- A. Install a complete conduit system for premises wiring systems.
- B. Minimum size conduit shall be 3/4", but not less than shown on the drawings.
- C. Conduit bends and elbows shall be long radius.

### 3.8 SOUND, FIRE ALARM, CLOCK, TV, AND SECURITY SYSTEM CONDUIT:

- A. All wiring shall be installed in conduit.
- B. Size all conduit as required per NEC and manufacturers' recommendations for number of wires or cables but minimum size shall be 3/4".
- C. Install junction boxes and pull boxes as required for each system.
- D. Conduit bends shall be long radius.



3.9 PULL WIRES:

- A. Install a # 14 gauge fish wire in all empty conduits, except telephone and communications. Install a nylon pull string in telephone and communication conduits.

3.10 PAINTING:

- A. Exposed conduit shall be painted; see Section 09 9100, PAINTING.

END OF SECTION 26 0533

## SECTION 26 0535 - ELECTRICAL BOXES

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK:

- A. This section includes the furnishing, installation and connection of all outlet boxes, junction boxes, and floor boxes as shown on the drawings or as required to house the intended wiring, devices or equipment.
- B. Types of electrical boxes and fittings specified in this section include the following:
  - 1. Outlet boxes
  - 2. Junction boxes
  - 3. Pull boxes
  - 4. Bushings
  - 5. Locknuts
  - 6. Knockout closures

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
  - 1. Division 1
  - 2. All other Division 26000 sections
- B. Other systems specified in Division 26000 may call for special boxes not covered in section 26 0535.

#### 1.3 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- B. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and labeled.
- C. NEMA Compliance: Comply with applicable requirements of NEMA Stds./Pub No.'s OS1, OS2, and Pub 250 pertaining to outlet and device boxes, covers, and box supports.

## PART 2 - PRODUCTS

### 2.1 FABRICATED MATERIALS:

- A. Outlet and Device Boxes (dry interior locations): Provide galvanized coated sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as required by particular application, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
- B. Outlet and Device Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations.
- C. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suite each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- D. Bushings, Knockout Closures, and Locknuts: Provide corrosion resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- D. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

### 3.2 GROUNDING:

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION

## SECTION 26 0548 - SEISMIC SUPPORT OF ELECTRICAL EQUIPMENT

### PART 1 - GENERAL REQUIREMENTS

#### 1.1 SCOPE OF WORK:

##### A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of seismic support of electrical equipment systems and appurtenances where shown on the drawings and specified hereinafter.

#### 1.2 RELATED WORK/SECTIONS:

##### A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:

1. Division 1
2. All other Division 26 sections

#### 1.3 QUALITY ASSURANCE:

##### A. Codes and Standards:

1. All seismic equipment and design shall comply with all local codes and ordinances and meet or exceed the standards and procedures (latest editions) of the following:

- a. IBC

##### B. Seismic control equipment shall be sized and provided by manufacturer. Seismic bracing shall be a factory manufactured item listed in the manufacturers catalog for the intended use.

##### C. Manufacturer:

1. The seismic control supports manufacturers shall be as manufactured by one of the following or approved equal:
  - a. Mason Industries
  - b. Amber Booth
  - c. Peabody

1.4 SUBMITTALS:

- A. The manufacturer shall submit drawings including floor plans, sections and elevations showing piping, duct, and equipment. Drawings shall indicate location and type of all components provided.
- B. A schedule shall show capacity and load of each component at each location.
- C. Design shall be based upon actual installation and not contract drawing schematics.
- D. Submittals shall include:
  - 1. Sketches showing seismic loading, location of bracing and types and sizes of bracing assemblies.
  - 2. Submit seismic protection ratings in three principle axes certified by an independent laboratory.
  - 3. Submit calculations for shear, pull-up, primary overturning, and secondary overturning.
  - 4. Submit drawings indicating auxiliary supports and method of attachment.
  - 5. Calculations shall be submitted and signed by a licensed professional engineer.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All equipment and applicable conduit shall be mounted on or suspended from approved foundations and supports as specified herein and as shown on the drawings.
- B. Steel components shall be phosphated and painted. All nuts, bolts, and washers shall be zinc-electroplated.

2.2 BRACING HANGERS:

- A. Seismic bracing shall be a factory manufactured item listed in the manufacturers catalog for the intended use.
- B. Equipment sway bracing shall be provided for all items supported by off-the-floor structures or structures suspended from floors or roof above.
  - 1. Braces shall consist of angles, rods, bars, or pipes run at 45% angles from the equipment frame to the building structure secured at both ends with bolts 1/2" or larger.
  - 2. Bracing shall be provided in two planes of direction, 90 degrees apart, for each item of equipment.

2.3 ANCHOR BOLTS AND NUTS FOR PAD MOUNTED EQUIPMENT:

- A. Pad mounted equipment shall be anchored with a minimum of four (4) bolts. Each bolt shall be a 6" in length or at least 10 times longer than the nominal diameter of the bolt with a 90 degree hook on the non-threaded end.
- B. Nuts shall be heavy duty hexagon nuts.
- C. Minimum bolt sizes are as follows:
  - 1. Equipment up to 500 pounds, 3/8" diameter.
  - 2. Equipment from 500 to 1000 pounds, 1/2" diameter.
  - 3. Equipment from 1000 to 5000 pounds, 5/8" diameter.
  - 4. Equipment from 5000 to 10000 pounds, 3/4" diameter.

2.4 ELECTRICAL EQUIPMENT:

- A. Systems include but are not limited to the following:
  - 1. Electrical switchgear
  - 2. Electrical conduit 2-1/2" inside trade diameter or greater
  - 3. Panelboards
  - 4. Dry Type Transformers
  - 5. Emergency Lighting Systems
  - 6. Lighting fixtures:
    - a. Lighting fixtures installed in suspended ceiling systems shall conform to the guidelines of CISCA.
    - b. Recessed lighting fixtures shall be independently supported from the structure. The suspended ceiling system shall not be used to support the fixtures.
    - c. Surface mounted fixtures shall be attached to the ceiling system with positive clamping devices that completely surround the ceiling members. Safety devices shall be attached between the clamping device and the adjacent ceiling hanger or to the structure above.
    - d. Pendant hung lighting fixtures shall be supported directly from the structure above using No. 9 gauge wire without using the ceiling suspension system for direct support.
- B. Electrical conduit of any size suspended by individual hangers of less than 12 inches from top of conduit to the supporting structure, do not have to be seismically braced.

- C. Slab or floor mounted equipment not subject to movement or vibration.
  - 1. Equipment shall be direct anchored.

2.5 SEISMIC ACCESSORIES:

- A. Provide all necessary brackets, bolts, fasteners, predrilled bases, oversized bases, accessory components and materials to install systems in accordance with manufacturer's requirements.

PART 3 - EXECUTION

3.1 GENERAL:

- A. If the equipment to be mounted is not furnished with integral structural frames and external mounting lugs (both of suitable strength and rigidity), approved structural subbase shall be installed in the field which shall support the equipment to be hung and to which shall be attached the hangers.

3.2 SUPERVISION:

- A. The manufacturer, or his qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Upon completion of the installation and after the system is put into operation, the manufacturer, or his representative, shall make a final inspection and submit his report to the Architects and Engineers in writing certifying the correctness of installation and compliance with approved submittal data.

END OF SECTION 26 0548

## SECTION 26 2416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK:

- A. This section includes the furnishing and installation, at locations shown on the drawings, of approved panelboards of a type indicated and specified herein.

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
  - 1. Division 1
  - 2. All other Division 26000 sections

#### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. 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.
- C. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in the NEC, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NEC.
- F. Panelboards shall comply with UL 67.
- G. Cabinet and boxes shall comply with UL 50.

#### 1.4 SUBMITTALS:

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 260500, ELECTRICAL GENERAL REQUIREMENTS.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB1.



C. 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. Service Conditions: NEMA PB1.

1.6 COORDINATION

- 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. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 LABELING:

- A. All panels shall be UL labeled.
- B. All panels used as a service entrance, shall be labeled as such.
- C. A nameplate shall be provided listing panel type and ratings.

2.2 GENERAL PANELBOARD CONSTRUCTION:

- A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated.
- B. Distribution, Lighting, and Appliance Panelboards: Provide dead-front safety constructed factory assembled circuit breaker type panelboards in sizes and ratings as indicated. Construct with rectangular shaped copper or tin plated aluminum bus bars which are securely mounted and braced, and with lugs bolted to main bus bars.

South Carolina Department of Mental Health  
CFSH Guard House - Standby Generator Install

1. Provide anti-turn solderless pressure type lug connectors approved for copper conductors, and construct unit for connecting feeders at top of panel.
  2. Equip with full-sized neutral bus bar with suitable lugs for circuits requiring neutral connection. Provide suitable lugs on neutral bus for each outgoing feeder required.
  3. Provide main and branch circuit breakers. Breakers shall be molded case bolt-in type, heavy-duty, quick-make, quick-break, with toggle handles that indicate when tripped. Where multipole breakers are indicated, provide with common trip so that overload on one pole will trip all poles simultaneously.
  4. Provide bare uninsulated grounding bars suitable for bolting to enclosures.
  5. Load center type panelboards are not acceptable, unless specifically called for in drawings.
- C. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide door-in-door front, with locks and keys for both inner and outer doors. All panelboard locks shall be keyed alike. Door hinges shall be piano hinges. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.
- D. Panelboard Accessories: Provide panelboard accessories and devices including, but not limited to circuit breakers as recommended by panelboard manufacturer for ratings and applications indicated.
- E. Panelboards shall be shown in the following schedule, or approved equal, and shall be completely factory assembled. Do not purchase panelboards or cabinets until shop drawings have been approved.
1. Branch Circuit Panelboards (120/208 or 120/240 V Operation). Minimum cabinet width shall be 20".

Square D	NQ
General Electric	AQ
Siemens	P1
  2. Branch Circuit Panelboards (277/480 V Operation). Minimum cabinet width shall be 20".

Square D	NF
General Electric	AD
Siemens	P2/P3
  3. Distribution Panelboards (over 400 Amp bus).

Square D	I-Line
General Electric	Spectra Series
Siemens	P4/P5

- F. Where a specific interrupting rating is shown on the drawings, panelboards and associated circuit breakers shall be rated for that value as a minimum. Series ratings of equipment is not acceptable.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF PANELBOARDS:

- A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.
- D. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.
- E. Provide properly wired electrical connections within enclosures.
- F. Fill out panelboard's circuit directory card upon completion of installation work. Type text, handwriting is not acceptable. Directory shall reflect actual installation configuration and shall incorporate final room numbers. Room numbers shown on architectural plans shall not be used for the directory.
- G. Installation shall comply with the NEC.
- H. Anchor to walls per manufacturer's recommendation.
- I. Lace all feeder cables with tie wraps in panel housing. All wiring shall be run square inside housing.
- J. Vacuum panel housing to remove all dust and dirt from housing prior to final inspection.
- K. Cover panel housing prior to room painting. Clean all paint from panel.
- L. Provide engraved plastic identification label black face with white lettering, indicating panelboard name, voltage system, and upstream distribution including room name and number. Attach identification labels to panel with rivets or sheet metal screws.
  - 1. Labels for panels fed from the emergency power system shall have red faces with white lettering.

3.2 GROUNDING:

- A. Provide equipment grounding connections for panelboards as indicated. Tighten connections to comply with tightening torques specified in UL Stds. 486A to assure permanent and effective grounds.

3.3 FIELD QUALITY CONTROL:

- A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Prior to energization, check panelboards for electrical continuity of circuits, and for short circuits.
- D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

END OF SECTION 26 2416

## SECTION 26 2726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SCOPE:

- A. This section includes the furnishing, installation, and connection of wiring devices as shown on the plans.
- B. Types of electrical wiring devices in this section include the following:
  - 1. Receptacles
  - 2. Switches
  - 3. Faceplates

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
  - 1. Division 1.
  - 2. Other Division 26000 sections.
- B. See section on Substitutions.

#### 1.3 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.

#### 1.4 SUBMITTALS:

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 26 0500, ELECTRICAL GENERAL REQUIREMENTS.
- B. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
- C. The specific item proposed and its area of application shall be marked on the catalog cuts.

### PART 2 - PRODUCTS

#### 2.1 FABRICATED WIRING DEVICES:

- A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and which comply with NEMA Stds. Pub. No. WD 1 and meet UL/Federal Spec WC-596. Unless noted otherwise device color shall be ivory.

- B. Wiring Devices: Wiring devices shall be as listed in the following table, or approved equal:

<u>Description</u>	<u>Cooper WD</u>	<u>Hubbell</u>	<u>Leviton</u>	<u>P &amp; S</u>
Single Pole Toggle Switch	2221V	HBL1221I	1221-2I	PS20AC1-I
20A 125V 2P 3W Grounded Duplex Receptacle (NEMA 5-20R)	5362V	HBL5362I	5362-I	5362-AI
20A 125V 2P 3W Grounded Duplex Ground Fault Interrupter (NEMA 5-20R)	VGf20V	GFR5362ITR	7899-I	2091-I

2.2 WET AND DAMP LOCATION RECEPTACLES:

- A. Type "DL" - Damp Locations: Damp location receptacles shall be duplex GFI receptacles similar to those under 262726 WIRING DEVICES, Part 2.1.B, mounted in cast metal outlet box fitted with a gasketed metal cover with spring door. Damp location receptacles shall be flush mounted unless noted otherwise. Wiring device utilized shall be listed weather resistant per NEC.
- B. Type "WP" - Wet Locations: Weatherproof receptacles shall be duplex GFI receptacles as specified under 262726 WIRING DEVICES, Part 2.1.B, mounted in cast metal outlet box fitted with a gasketed "while-in-use" metal cover, Hubbell WP26E or Pass & Seymour WIUC10-CAGV or approved equal. Weatherproof receptacles shall be flush mounted in exterior walls. Wiring device utilized shall be listed weather resistant per NEC.

2.3 DEVICE PLATES:

- A. Outlet boxes shall have a coverplate.
- B. Faceplates: Provide faceplates for single and combination wiring devices, of types, sizes, and with ganging cutouts as indicated. Select plates which mate and match wiring devices to which attached. Metal screws shall be used for securing plates to devices; screw heads colored to match finish of plates.
- C. Faceplates shall be uniform in design and finish for switches, receptacles, and other outlets. Plates shall be one-piece of the required number of gangs; sectional plates shall not be used.
- D. Plates shall be jumbo oversize satin finished stainless steel.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF WIRING DEVICES:

- A. Install wiring devices as indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.
- C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
- D. The devices shall be installed in such a manor as to allow the faceplates to be installed without distortion of the faceplate or gaps between the faceplate and wall.
- E. Install faceplates after painting work is completed.
- F. Unless otherwise specified, install faceplates on all device and outlet boxes including telephone outlet boxes. As a minimum, blank plates shall be included for 25% of telephone/data outlets shown on the drawings.
- G. Tighten connector and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A. Use properly scaled torque indicating hand tool.

### 3.2 PROTECTION OF FACEPLATES AND RECEPTACLES:

- A. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

### 3.3 GROUNDING:

- A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

### 3.4 TESTING:

- A. Prior to energizing circuitry, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 26 2726

## SECTION 26 2816 - SAFETY/DISCONNECT SWITCHES

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK:

- A. This section includes the furnishing, installation, connection, and wiring of safety switches.

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:

- 1. Division 1
- 2. All other Division 26000 sections

- B. See section on Substitutions.

#### 1.3 QUALITY ASSURANCE:

- A. Safety/Disconnect switches shall conform to Underwriter's Laboratories UL 98, "Enclosed and Dead-Front Switches."

#### 1.4 SUBMITTALS:

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 260500, ELECTRICAL GENERAL REQUIREMENTS.

### PART 2 - PRODUCTS

#### 2.1 GENERAL SAFETY/DISCONNECT SWITCH FEATURES:

- A. Furnish and install safety/disconnect switches as indicated on the plans and specifications.
- B. Switches shall be NEMA type HD (Heavy Duty) and UL listed.
- C. All switches shall have switch blades which are fully visible in the "OFF" position when the switch door is open. All current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall have removable arc suppressors where necessary to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60 degrees C and 75 degrees C, aluminum or copper wires.
- D. Switches shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started. The operating handle shall be an integral part of the box, not the cover. Provisions for padlocking the switch in the "OFF" position with at least three locks shall be provided. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch



door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. The handle position shall indicate whether the switch is "ON" or "OFF".

- E. Switches shall be horsepower rated for AC and/or DC as indicated by the plans.
- F. Disconnect switches shall be equipped with ground lug.

2.2 NEMA 1 AND 3R HEAVY DUTY SAFETY/DISCONNECT SWITCHES:

- A. Switches shall be furnished in NEMA 1 general purpose enclosures unless exposed to weather which shall be NEMA 3R. Covers on NEMA 1 enclosures shall be attached with pin type hinges. NEMA 3R covers shall be securable in the open position. NEMA 3R enclosures for switches thru 200 amperes shall have provisions for interchangeable bolt-on hubs. Hubs shall be as indicated on the plans. NEMA 3R enclosures shall be manufactured from galvanized steel. Enclosures shall have a gray baked enamel finish, electrodeposited on cleaned, phosphatized steel.
- B. Switches shall comply with paragraph 2.01 of this section.

2.3 SPECIFIED MANUFACTURERS:

- A. Specified manufacturers shall be as follows, or approved equal:
  - 1. General Electric
  - 2. Square D
  - 3. Eaton

PART 3 - EXECUTION

3.1 INSTALLATION LOCATION:

- A. As a general rule, install switches on the equipment it serves, if shown that way on the drawings.
- B. Do not install switch on equipment removable panel.
- C. All switches shall be accessible.

3.2 GROUNDING:

- A. Connect ground wires to ground lug.
- B. See section "GROUNDING".

3.3 CONDUIT BUSHINGS:

- A. Use plastic bushings where conduit enters switch.

END OF SECTION 26 2816

## SECTION 26 3213 - ENGINE GENERATOR & AUTOMATIC TRANSFER SWITCH

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK:

- A. Provide factory assembled engine generator set(s) (heretofore referred to as the "set") and associated equipment as shown on the contract documents and specified herein to provide an NEC 702 Optional Standby power supply system.
- B. Types of equipment and work required include the following:
  - 1. Diesel fuel set and support accessories
  - 2. Sub-base fuel tank and associated piping
  - 3. Weatherproof Sound Attenuating Enclosure
  - 4. Set Foundations
  - 5. Control/Annunciator panel
  - 6. Transfer Switch
  - 7. Installation
  - 8. Testing and configuration
  - 9. Startup
  - 10. Demonstration and training

#### 1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
  - 1. Division 1 including general provisions of the Contract and Supplementary Conditions.
  - 2. All other Division 26000 sections.

#### 1.3 QUALITY ASSURANCE:

- A. NEC Compliance: Comply with applicable requirements of NEC Articles 445, 700, and 702 pertaining to generators and standby systems.
- B. NFPA Compliance: NFPA 30, "Flammable and Combustible Liquids", NFPA 37, and "Installation and Use of Stationary Combustion Engines and Gas Turbines".

- C. UL Compliance: Provide standby power generator system components, including transfer switch, which are UL listed and labeled to the following standards: UL508 – Industrial Control Equipment, UL508A - Industrial Control Panels, UL142 – Sub-base Tanks, UL1236 – Battery Chargers. The set shall be UL 2200 listed. All transfer switches shall be UL listed per Standard 1008, CSA Approved.
- D. NEMA Compliance: Comply with applicable requirements of NEMA MG 1-1998, "Motors and Generators", and MG 2, "Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators",
- E. ANSI Compliance: ANSI S1.13-1971 "Measurement of Sound Pressure Levels in Air."
- F. ISO References:
  - 1. ISO 8528 - Reciprocating Internal Combustion Engine Driven Alternating Current Generator Sets - Part 5 - Generator Sets, latest edition: The set shall perform within the performance class operating limit values for performance class G1.
  - 2. ISO 9001: The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service, in accordance with ISO 9001.
- G. IEEE Compliance: Standard 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- H. FCC Compliance: Part 15, Subpart B.
- I. The manufacturer of the set(s) shall have produced similar equipment for a minimum period of 15 years.

#### 1.4 SUBMITTALS:

- A. Shop Drawings: Submit manufacturer's data on the set, associated components and transfer switch. Submittal shall include the following:
  - 1. Documentation of compliance with codes and standards listed under section QUALITY ASSURANCE of this specification.
  - 2. Performance information for the set, including load starting capabilities, set reactive power capability curves and regenerative power ratings.
  - 3. Emissions certifications.
  - 4. Seismic certifications. See division 26 specification SEISMIC SUPPORT OF ELECTRICAL EQUIPMENT.
  - 5. Layout drawings for major system components and assemblies. Indicate necessary clearance space for removal of engine generator elements for maintenance purposes.

6. Wiring diagrams for system showing interconnection of components. Clearly differentiate between portions of wiring that are manufacturer-installed and portions to be field-wired.
  7. Documentation of component tests and performance data noted within other sections of this specification.
- B. Equipment Operation and Maintenance Manuals: Prior to EPSS demonstration, submit one (1) copy of the equipment manual containing all shop drawings, wiring diagrams, and layout drawings. Include copies of startup/test reports, equipment warrantee and maintenance instructions.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Equipment delivery shall be scheduled just prior to installation date to minimize on-site storage time and possible damage from adverse conditions. During time equipment is stored on site, equipment shall be located in a dry, covered space completely protected from weather and physical damage prior to installation. Storage conditions shall meet additional requirements of equipment manufacturer.
1. Equipment shall be considered in storage until such time startup of the standby power system has occurred.

1.6 WARRANTY:

- A. All the standby power supply system components specified herein shall be warranted for a period of five years or fifteen hundred engine generator set operating hours, whichever occurs first, from the date of initial startup.
- B. There shall be one source of responsibility for the warranty; parts and service through the set manufacturer representative. Multiple warranties for individual components (engine, alternator, controls, transfer switches, etc.) from individual suppliers or representatives is not be acceptable.
- C. The warrantor shall maintain qualified factory trained service personnel with experience on specified equipment and shall be located within 2 hour travel time of the project location.

PART 2 - PRODUCTS

2.1 SET:

- A. Set performance and capacity ratings are specified as installed on site unless noted otherwise.
- B. The set(s) shall be Cummins Power Generation, Caterpillar, or Kohler engine generator(s), minimum rating of 25kW, 32kVA at 0.8 PF, 60 Hz, 1 phase, 3 wire, 120/240 volts on a standby power rating at 1800 RPM, 104 degree F ambient temperature at minimum 500ft above sea level.
- C. The set components shall be mounted on a structural steel base frame to maintain proper alignment between components, and shall incorporate vibration isolators.

- D. The set shall be equipped with a weatherproof, level 2 attenuation sound attenuation housing. Housing shall be rated for minimum 130 MPH wind speed.
- E. The set shall meet current federal, state and local emissions regulations for optional standby application engine-generator sets.

2.2 ENGINE:

- A. The engine shall be a stationary, liquid-cooled, four stroke diesel cycle engine suitable for use with number 2 diesel fuel. Engine shall be arranged for direct connection to the alternator.
  - 1. Turbocharging with air charge cooling is acceptable where required by engine manufacturer to meet specified unit rating.
- B. Engine shall include the following features:
  - 1. Remote two-wire starting, solenoid shift, electric starter with two independent systems to disconnect the starting circuit upon engine starting. The starter shall be capable of a single cranking limiter cycle without overheating or sustaining damage.
    - a. A single cranking limiter cycle which shall be a minimum of 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods
  - 2. Positive displacement, engine driven, full pressure lubricating oil pump, oil cooler, full flow oil filter with replaceable elements, dipstick oil level indicator, and oil drain. Oil drain shall be piped to unit housing exterior and provided with a removable plug.
  - 3. Primary and secondary fuel filters with replaceable elements, and an engine driven, mechanical, positive displacement fuel pump, with automatic fuel shutoff all mounted on the engine.
  - 4. High pressure electronic fuel injection.
  - 5. Replaceable dry element air cleaner.
  - 6. Engine protective devices shall have sensing elements located on the engine to initiate alarms and engine shutdowns. These shall interface with the ENGINE GENERATOR CONTROL on the generator set. Type and quantities as required to provide minimum functionality listed for the ENGINE GENERATOR CONTROL.
  - 7. Engine gauges, including hour meter, water temperature and oil pressure gauges and battery charging alternator ammeter.
  - 8. Engine mounted, belt driven battery charging alternator.
  - 9. Engine mounted, belt driven cooling pump(s), size and quantity as required by engine manufacturer.

2.3 ENGINE COOLING SYSTEM:

- A. Engine shall be liquid cooled by a thermostatically controlled radiator system with expansion tank and pusher fan belt driven by engine. System shall be mounted to engine-generator frame. Provide engine manufacturer's recommend coolant solution.
- B. An air-to-air intercooler system for turbo-charged units shall be provided where required by the manufacturer to meet required engine HP at 100% KVA rating of the set.
- C. All cooling components shall be installed within the weatherproof housing. Pipe system drain lines to unit housing exterior. Drain line shall have removable cap to prevent plugging from debris and insects.

2.4 ENGINE EXHAUST SYSTEM:

- A. Exhaust silencer shall be provided. It shall be chambered construction of the critical type.
- B. Stainless steel seamless flexible exhaust connections shall be provided as required for connection between the engine exhaust manifold and the exhaust silencer piping.
- C. **Mount and install all exhaust components inside the weatherproof housing.** All components shall be sized to assure proper operation without excessive backpressure.

2.5 ENGINE FUEL SYSTEM:

- A. Provide a steel, UL listed, dual-wall sub-base diesel fuel oil storage tank. Tank shall be complete with necessary pipe connections for connection to the engine-generator and approved fill and vent fittings. The sub-base tank shall be located in base of engine-generator set within, or part of, the weatherproof enclosure.
- B. Connections between the sub-base tank and engine fuel connections shall be flexible. All fuel hose and fittings shall be rated for minimum 300 degrees F at 100 psi.
  - 1. Connections shall be factory installed.
- C. Furnish and install a low fuel supply sensing device in fuel tank. Device shall signal the alarm annunciator panel specified herein. Sensing device shall be adjusted to signal low fuel level when the tank contains less than one third of its capacity.
- D. The sub-base fuel tank shall be sized by engine-generator manufacturer to provide adequate fuel storage to operate the generator for the following *minimum* run-time: 62 hours at 100% load rating.

2.6 ENGINE STARTER BATTERY SYSTEM:

- A. An engine starter battery and battery charger system shall be provided. Components shall be factory mounted within engine generator set housing.
- B. Battery - Provide heavy duty diesel starting flooded cell lead acid batteries, quantity and rating as required for two complete cranking limiter cycles. Batteries shall be installed on a rack within the set housing. All necessary intercell connection and battery cables shall be provided.

1. Provide battery calculations showing batteries are capable of supporting specified cranking cycles at minimum ambient starting temperature.
  2. Batteries shall not be installed until after battery charger is capable of operation.
  3. Required battery capacity shall be permanently mark at the battery charger location.
- C. Battery Charger – Provide a constant voltage, current limited, battery charger. Charger shall have float, taper, and equalize charge functions and shall be rated for 120 VAC normal power supply. The Battery charger shall:
1. Be suitable for installation within the unit housing.
  2. Have fused AC input and fused DC output.
  3. Include LED fault displays for AC Fail, High Battery, and Low Battery. Each fault shall also operate a Form C contact.
  4. Be capable of fully charging the engine starter batteries within 24 hours from a complete discharge state without sustaining damage to batteries or charger.
  5. Include an ammeter and voltmeter functions for monitoring battery status and charging. Meters shall have an accuracy of 5% or better.
  6. Be permanently marked with maximum supported battery capacity, nominal output current and voltage.

#### 2.7 ALTERNATOR:

- A. The Alternator shall be a self-aligning, four pole of the synchronous type with revolving field. The winding pitch shall be 2/3. The design shall utilize amortisseur windings and shall be furnished with a direct drive centrifugal blower for proper cooling and minimum noise.
- B. The alternator shall be directly connected to the engine flywheel housing and driven through a flexible coupling to insure permanent alignment. Coupling shall be designed to prevent shaft current from flowing.
- C. The alternator windings shall utilize class H insulation. The alternator shall be sized such that the temperature rise at 100% of set rating shall not exceed 105 degrees C at 40 degree C ambient temperature.
- D. The alternator exciter shall be a 1-phase, full-wave rectified exciter utilizing heavy duty silicon diodes mounted on the common rotor shaft.
- E. Voltage regulator supply shall be obtained from a permanent magnet generator (PMG) on common shaft with alternator field and exciter windings. The PMG/exciter shall be sized to provide sufficient excitation to supply 300% of the generator's rated output current for 10 seconds.

#### 2.8 ENGINE GENERATOR CONTROL:

- A. The unit shall be furnished with a microprocessor based integrated control and monitoring system that is factory wired, tested and shock mounted by the unit manufacturer. The control system shall be in a rigid metal enclosure, side mounted on the alternator end of the unit.
- B. The control shall include an operator display panel providing the following functionality:
1. Run-Stop-Remote selector switch.
  2. Individual status lamps indicating:  
  
Generator Running – Green  
Not-in-auto mode – Red flashing  
Low oil pressure – Yellow  
High engine temperature – Yellow  
Low oil pressure shutdown – Yellow  
Over speed shutdown – Yellow  
Fail to start - Yellow
  3. Alphanumeric display panel allowing configuration of operating parameters including cranking cycles, alternator voltage, alternator frequency, time delay start and time delay stop. Display shall also allow the viewing of engine operational parameters such as engine speed, coolant temperature, coolant level, starting battery voltage, battery charger status and oil pressure as well as event logs, hour meter and fault history.
  4. Provide an emergency stop pushbutton switch. Switch shall be a Red "mushroom head" push button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
    - a. The switch shall include a lockout provision for use in safely disabling the generator set for necessary service.
    - b. Depressing the emergency stop switch shall be annunciated as "Not-in-auto" at the set and at the remote annunciator(s).
- C. Engine Control Functions:
1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
  2. The control system shall include an engine governor control, which functions to provide steady state frequency regulation. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
  3. The control system shall include time delay start, adjustable 0 to 300 seconds (set at 15 seconds) and time delay stop, adjustable 0 to 600 seconds (set at 300 seconds).



4. The control system shall include sender failure monitoring logic for oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

D. Alternator Control Functions:

1. Engine generator control shall include a digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided for control of the alternator. It shall be immune from malfunction due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with single phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot.
2. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set for more than 60 seconds.
3. Controls shall be provided to individually monitor the output current for 1-phase short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown).
4. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
5. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

- E. A 120 volt space heater with thermostat shall be provided within generator set control panel to eliminate condensation.

2.9 SET AUXILIARY EQUIPMENT AND ACCESSORIES:

- A. Each set shall be furnished with a dry contact for remote indication of alarm conditions. Contact shall be normally closed and shall open when an alarm or pre-alarm is present on the remote annunciator or the EPSS is placed in a non-automatic operation mode.
- B. Each set shall be furnished with a thermal-magnetic main circuit breaker rated as follows: 80% rated, 3-Pole, 250A, 480V, 10,000AIC.

2.10 DELAYED TRANSITION AUTOMATIC TRANSFER SWITCHES:

- A. General:

1. Transfer switches shall be UL listed per Standard 1008 and shall be suitable for use on emergency and legally required standby systems in accordance with NFPA 70, 99 and 110.
  2. Transfer switches shall be listed and labeled for Service Entrance use.
  3. Transfer switches shall be a standard product of the engine generator unit manufacturer.
  4. Transfer switches shall be delayed transition switches rated 100A, 2-pole, 240V AC, minimum 35KAIC.
  5. Transfer switches shall have a utility-side fused service disconnect switch rated as shown on the drawings.
  6. NEMA 4 enclosure.
- B. Transfer switches shall utilize contactor type (NEMA Type A, IEC Type PC) double-throw construction, electrically operated and mechanically held in both normal and emergency positions. Transfer mechanism shall utilize direct acting linear operators.
1. Transfer switches utilizing circuit breakers or molded case switches do not meet the requirements of this specification.
- C. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure with ambient temperatures of -40 degrees C (-40 degrees F) to +50 degrees C (+122 degrees F), relative humidity of up to 95% (non-condensing), and altitudes of up to 10,000 feet.
- D. Transfer switches shall have minimum withstand and closing ratings (RMS symmetrical amperes) as required for the specified available fault currents. These ratings shall be obtained without contact welding. These fault current ratings shall be verified by UL witnessed test on representative test samples and shall be the ratings listed in the UL listing or component recognition procedures for the transfer switches supplied.
- E. Transfer switches shall have full rated lugs for all current carrying power source and load conductors inside cabinet.
- F. Manual operating handles shall be accessible to authorized personnel only by opening the key locking cabinet door.
- G. All switches shall have covers which allow visual determination of main contact position.
- H. Main switch contacts shall be high-pressure silver alloy contacts to resist burning and pitting for long life operation. All switches shall have arc chutes of heat absorbing material and metal leaves for positive extinguishing of arcs. Arc chutes shall have insulating covers to prevent interphase flashover.
- I. Transfer switches shall have one Form C, 10 Amp 250 Volt AC auxiliary switch on both normal and standby sides, operated by the transfer switch. These switches shall be factory wired to an easy access terminal block and shall be used to monitor transfer switch position for controlling indicator lights or other peripheral equipment.

- J. Complete AL-CU lugs, UL listed and CSA approved, shall be provided for normal, standby, and load positions. For 150 ampere and larger switches, top of bottom feed for load connections shall be provided for slim design requiring less wall space. Load connections shall be designed for field relocation, either from top to bottom or vice-versa.
- K. Provide auxiliary relays, each with 2 normally open and 2 normally closed contacts rated at 6 amps at 600V AC, as required to provide future remote indication and controls.

2.11 TRANSFER SWITCH CONTROL SYSTEM:

- A. The transfer switch shall be equipped with a microprocessor-based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have a real time clock with rechargeable battery back-up. The CPU shall be equipped with self-diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit.
- B. The controller shall use industry standard open architecture communication protocol for high speed serial communications via RS422/485 network. The serial communication port shall allow interface to either the manufacturer's or the Owner's furnished remote supervisory control.
- C. The controller shall include an LCD display, with keypad, which allows access to the system. The controller shall have password protection to limit access to qualified and authorized personnel.
- D. The controller shall allow testing of the transfer switch. The test mode shall allow manual start of the generator from the transfer switch controller and shall initiate an automatic transfer from normal to standby and then back to normal after a programmable time delay.
- E. The controller shall have a programmable generator exerciser feature which shall allow for weekly testing at a field settable arbitrary time, with or without transfer of load.
- F. The controller shall be capable of storing the following records in memory for access either locally or remotely:
  - 1. Number of hours transfer switch is in the standby position (total since record reset).
  - 2. Number of hours standby power is available (total since record reset).
  - 3. Total transfer in either direction (total since record reset).
  - 4. Date, time and description of the last four source failures.
- G. Voltage and frequency on both the normal and standby sources shall be continuously monitored by the transfer switch control system with the following pickup, dropout and trip setting capabilities:
  - 1. Under-voltage on all ungrounded conductors for both normal and standby sources: Dropout/trip setting shall be adjustable between 75 to 98% of nominal and the pickup/reset setting shall be adjustable between 85 to 100% of nominal.

- Dropout function shall have a time delay adjustable between 0-4 seconds. Accuracy shall be within 0 to -2%.
2. Over-voltage on all ungrounded conductors for both normal and standby sources: Dropout/trip setting shall be adjustable between 105 to 135% of nominal, pickup/reset shall be set to occur 2% below dropout/trip setting. Dropout function shall have a time delay adjustable between 0-120 seconds. Accuracy shall be within 0 to -2%.
  3. Over and Under-frequency for both normal and standby sources: Pickup/reset setting shall be adjustable between +/-5 to +/-20% of nominal frequency. Dropout/trip setting shall be 1 to 5% beyond Pickup/reset setting with a time delay of 0.1 to 15.0 seconds. Accuracy shall be within +/-0.05 Hz.
  4. Voltage and frequency settings shall be field adjustable in 1% increments.
- H. The controller shall allow programming of time delays for control of system upon loss or restoration of normal power and system testing. All time delays shall be adjustable through the user interface in 1 second increments:
1. Engine start delay shall be adjustable from 0 to 120 seconds.
  2. A time delay shall be provided on transfer to standby, adjustable from 0 to 60 seconds, for controlled timing of transfer of loads to standby.
  3. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. Time delay shall be automatically bypassed if the standby source fails and the normal source is acceptable.
    - a. Time delay for power failure shall be adjustable from 0 to 120 seconds.
    - b. Time delay for test mode shall be adjustable from 0 to 30 minutes.
  4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 30 minutes.
  5. Time delay for delayed transition feature shall be from 0 to 60 seconds.
- I. Each transfer switch shall be provided with factory installed power meter functions. Provide current and potential transformers necessary for measurement. Current and potential transformers shall be attached to the enclosure utilizing brackets and screw fasteners. The power meter functions provided shall include:
1. Voltage, phase-to-phase and phase-to-neutral (both normal and standny sources)
  2. Load current, per phase RMS
  3. Frequency
- J. ATS-PH ratings and enclosure:

1. Transfer switch ATS-PH shall be delayed transition switches rated 400A, 3-pole, 480V AC, minimum 35KAIC.
2. Transfer switch ATS-PH shall have a utility-side thermal-magnetic main circuit breaker rated 250A, 3-pole, 480V AC, minimum 22KAIC.
3. Transfer switch ATS-PH shall have a NEMA 4 enclosure.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. EPSS with all control wiring, engine/generator set(s), transfer switch(es), all other system components shall be installed as indicated on the drawings, as specified herein, and in accordance with approved shop drawings, manufacturer's instructions, and manufacturer's standard specification and dimension sheets.
- B. Conduits at the set shall be connected utilizing liquid tight metallic flexible conduit, field coordinate conduit stub-up locations with shop drawings prior to generator pad pour.
- C. Label all set output circuit breakers indicating transfer switch or load served.

#### 3.2 STARTUP, CONFIGURATION AND TESTING:

- A. Engage manufacturer's factory trained technician to check out the complete installation and to perform startup of the EPSS. This shall include:
  1. Commissioning and startup of the set. This shall include configuration of set parameters and testing of all engine generator shutdowns and alarms.
  2. Configuration of transfer switch parameters, i.e. time delays, pickup and dropout settings.
  3. Reactive load bank testing for each engine generator set at 100% of set KVA/PF for 4 contiguous hours.
    - a. Engine oil pressure, engine temperature and alternator output current and alternator output voltage shall be logged during testing on 15 minute intervals and shall be included in operation and maintenance manuals for records.
  4. Testing of transfer switch functions by simulation of power failures and manual operation of controls.

#### 3.3 DEMONSTRATION:

- A. Upon completion of startup, testing and calibration, the EPSS shall be demonstrated to the Engineer. Any deficiencies noted during demonstration shall be corrected and the EPSS re-demonstrated at the discretion of the Engineer.

#### 3.4 OWNER TRAINING:

- A. After demonstration and acceptance, Owner training shall be performed by a factory trained employee of the set manufacturer. Training shall include instruction of the correct operation of the EPSS as well as basic testing, trouble shooting and maintenance of the system. The training session shall be scheduled at a time of the Owner's choosing.
  - 1. Video recordings of the training session shall be provided.
  - 2. The session shall not be scheduled upon the same day as system startup-configuration-testing or Engineer demonstrations.
- B. Three copies of the equipment operation and maintenance manuals described under section 1.3 SUBMITTALS shall be supplied to owner prior to final acceptance for use during the training session.

3.5 FUEL:

- A. Furnish all fuel required for check-out, start-up, and testing. After testing and Owner training has been complete the fuel tank shall be filled with #2 diesel fuel.

END OF SECTION 26 3213