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SPECIFICATION STAMP PAGE

DATE: May 10, 2018

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Coeur d'Alene, ID 83814

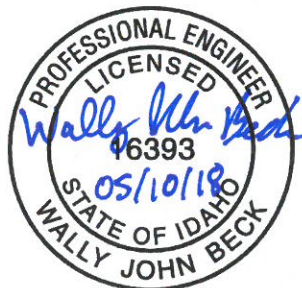
PROJECT: ITD
Generator Replacement

PROJECT#: 18180

ENGINEERS: Spencer A. Goodall, E.I.T.
Wally John Beck, P.E.

<u>Section</u>	<u>Specification Description</u>
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The technical specification sections listed above have been prepared under the direction of the Professional Engineer, registered in the State of Idaho, whose seal and signature appear below:



SECTION 26 00 00
ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Contract requirements
- B. Codes, permits and fees
- C. Quality assurance and standards
- D. Site visit and familiarization
- E. Submittals
- F. Coordination of electrical work
- G. Material and workmanship
- H. Space requirements
- I. Safety regulations
- J. Delivery, storage and handling of materials

1.2 RELATED SECTIONS

- A. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.

1.3 STANDARDS AND REFERENCES

- A. Refer to Division 1 for general administrative/procedural requirements related to compliance with applicable standards.
- B. This Work and all materials shall meet the standards set forth in the applicable portions of the following recognized standards:
 - 1. ANSI – American National Standards Institute.
 - 2. ASHRAE – American Society of Heating Refrigerating & Air-Conditioning Engineers.
 - 3. ASME – American Society of Mechanical Engineers.
 - 4. ASPE – American Society of Plumbing Engineers.
 - 5. ASTM – American Society for Testing and Materials.
 - 6. ETL – Electrical Testing Laboratory.
 - 7. FM – Factory Mutual Engineering Corporation.
 - 8. IEEE – Institute of Electrical and Electronics Engineers.
 - 9. NEC – National Electric Code (by NFPA).
 - 10. NEMA – National Electrical Manufacturers Association.
 - 11. NFPA – National Fire Protection Association.
 - 12. UL – Underwriters’ Laboratories Inc.

1.4 SUBMITTALS

- A. General: Submittals required for this project shall include, but are not be limited to:

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1. Shop Drawings and Product Brochure Submittals.
 2. Record (as-installed) Drawings.
 3. Certifications and Test Reports.
 4. Operating and Maintenance Manuals.
 5. Warranties (Guarantees).
 6. Refer to Division 1 for additional submittal requirements.
- B. Shop Drawings and Product Brochure Submittals:
1. The terms "Submittal" and "Shop Drawing" in this Specification are defined as either product literature, samples of equipment, or actual Shop Drawings.
 2. The Contractor shall submit a minimum of six (6) complete bound sets of Shop Drawings and complete data covering each item or equipment or material. The Owner and Engineer will each retain one (1) copy of all Shop Drawing submittals for their files. Where full size Drawings are involved, submit two (2) prints and one (1) reproducible in lieu of six (6) sets.
 3. Submittals shall be provided with a cover sheet with the names and addresses of the Project, Engineer, General Contractor, and the Subcontractor making the submittal. The cover sheet shall also contain the Specification section number applicable to the item or items submitted, the item nomenclature and description and a submittal number. Electrical submittals shall be numbered sequentially by Specification section with a sequence suffix (e.g. 26 05 19-1, 26 06 33-2, etc.). Re-submittals shall be numbered with the original submittal number plus an "R" in the sequence suffix (e.g. the re-submittals of submittal 26 05 19-1 would be 26 05 19-1R1, 26 05 19-1R2).
 4. Submittals shall be provided with an index page with a listing of all data included in the submittal.
 5. Submittals shall be provided with a list of variations, including unfurnished or additional items or features between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "No Variations". Where variations affect the work of other contractors, then the contractor shall certify on this page that these variations have been fully coordinated with the affected contractors and that the submitting contractor shall pay all additional costs to the affected contractors associated with the variations.
 6. Submittals shall provide equipment information including manufacturer's name and designation, size, performance and capacity data. All applicable listings, labels, approvals and standards shall be clearly indicated.
 7. Submittals shall provide dimensional data and actual sketches as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances.
 8. Submittals shall include an identification of each item of material or equipment matching that indicated on the Drawings.
 9. Submittals shall provide sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method. Any non-applicable information shall be crossed out.
 10. Submittals shall include additional information as required in other sections of this Division.
 11. Submittals shall include certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Contract Documents signed and dated.
 12. Reports or information requiring certification shall be certified by an authorized officer of the manufacturer or testing agency.

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13. Submittals shall include Certified Shop Drawings showing dimensions, loading details, anchor bolt locations, and inserts required for each piece of equipment set on concrete in sufficient time to cause no delay in the Work.
 14. Equipment and material submittals shall show sufficient data including all performance data, recommended installation details, and sufficient data to indicate complete compliance with the Contract Documents, including proper sizes, clearances, capacities, materials, and finishes.
- C. Required Shop Drawing Submittals:
1. Submittal Shop Drawings, including, but not limited to the following items:
 - a) All section 26 divisions.
 - b) Coordination Drawings as required by this Section.
 - c) As-Built Drawings.
- D. Shop Drawing Submittal Review:
1. Shop Drawings will be reviewed for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown in review comments is subject to the requirements of the Contract Documents. The submitting Contractor is responsible for: dimensions that shall be confirmed at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.
- E. Certifications and Test Reports:
1. The Engineer may, at their discretion, witness any or all on and off site acceptance and operational testing. Submit a detailed listing of certification and testing for each system indicating estimated dates for completion of system installation.
 2. Test procedures and test result reporting forms shall be submitted for review no later than the date of the certification and testing listing submittal.
 3. Submit four copies (coordinate with commissioning requirements) of all certifications and test reports to the Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.
 4. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section 26 01 26 - Electrical Testing.
 5. Notify the Engineer in writing one week prior to all scheduled testing to allow time for Engineer to schedule witnessing of testing, where elected by the Engineer.

1.5 OPERATING AND MAINTENANCE MANUALS

- A. Submit two copies of Operating and Maintenance Manuals to the Engineer for approval prior to the beginning of operator training. Provide four approved Operating and Maintenance Manuals for use in operator training. Manuals shall be bound in rigid cover, 3-ring binders with spine and cover labels and shall provide operating and maintenance information for every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied shall be clearly and legibly set forth in memoranda which shall, likewise, be bound with bulletins. As a minimum, the following information shall be provided as applicable:
1. Complete description of each system, item of equipment, and apparatus provided under this Division, including ratings, capacities, performances, data and curves, characteristics identifying name and number, locations, and wiring diagrams, including sources for all parts.

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2. Fully detailed parts lists, including all numbered parts and recommended spare parts, of each item of equipment and apparatus provided under this Division.
 3. Manufacturer's printed instructions describing operation, service, maintenance, and repair of each item of equipment and apparatus.
 4. Typewritten record of tests made of materials, equipment, and systems included under this Division. Such records shall state the dates the tests were conducted, name(s) of person(s) making and witnessing the tests, and citing any unusual conditions relevant to the tests.
 5. Identifying names, name tags designations and locations for all equipment.
 6. Fuse and motor heater information including location and use.
 7. Equipment and motor nameplate data.
 8. Copies of all approved Shop Drawing submittals.
 9. Fabrication drawings.
 10. Equipment and device bulletins and cut sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable.
 11. Maintenance instructions clearly highlighted to show all required periodic maintenance and lubrication.
 12. Wiring diagrams.
 13. Operating instructions clearly highlighted to show proper operating procedures for all equipment.
 14. Exploded parts views and parts list for all equipment and devices.
 15. Color-coding charts for all painted equipment and conduit.
 16. Location and listing of all spare parts and special keys and tools furnished to the Owner.
- B. Tools: Provide and deliver to the Owner's authorized representative any special tools required for maintenance of systems, equipment, and apparatus installed under this Division prior to requesting final acceptance of the installation.
- C. Commissioning requirements are part of this contract.

1.6 CODES, PERMITS AND FEES

- A. General:
1. Comply with the most recently revised versions of applicable laws, rules, regulations, and ordinances of federal, state, and local utilities and authorities. Where alterations to and deviations from the Contract Documents are required by said authority, report the requirements and secure approval before starting work. Obtain all applicable permits, licenses and inspections and pay all fees charged by above authorities.
- B. Code Design Basis:
1. The following codes and ordinances were used in the design of the project and shall be complied with during construction of the project.
 - a) Electrical Code – NEC, most recent edition enforced.
- C. Precedence:
1. Where Contract Document requirements are in excess of Code requirements and are permitted under the Code, the Contract Documents shall govern. None of the terms or provisions of the drawings or specification shall be construed as waiving any of the rules, regulations or requirements of these authorities. In the event of conflict between the Contract Documents and the local enforcing authority, the latter shall rule. Any modifications resulting there from shall be made without additional cost to the Owner or Engineer. This Contractor shall report any such modifications to the Engineer and secure his approval before proceeding.

1.7 QUALITY ASSURANCE

A. Materials/Methods:

1. Manufacturers, materials and methods described in the various sections of the Specifications and indicated on the Drawings are intended to establish a standard of quality only. It is not the intention of the Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturer's standard product would meet the requirements of the project design, Specifications and space constraints.

B. Alternative Products/Materials/Methods:

1. Products by other reliable manufacturers, other materials, and other methods may be accepted provided they have equivalent capacity, construction, and performance. Under no circumstances shall any substitution be made without the prior written approval of the Engineer.
2. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Engineer that the specified product, material or method is the only one that shall be used without prior approval.

C. Alternative Equipment:

1. Where substituted or alternative equipment is used on the project, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available, including all required Code and maintenance clearances, and to coordinate all equipment requirements and provisions with the Electrical Design and all other Contractors.

D. Compatibility:

1. Provide products that are compatible with other products of the electrical work, and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with other work. Determine in advance of purchase that equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearance as required by applicable codes and for adjustment, repair, and replacement.

1.8 SITE VISIT AND FAMILIARIZATION

A. General:

1. Become familiar with the Drawings and Specifications, examine the premises, and understand the conditions under which the Contract shall be performed, prior to submitting a bid.

B. Site:

1. Be informed of the site conditions, verify locations of new and existing equipment and determine exact requirements for connections.

C. Coordination:

1. Submission of a bid for this project infers that the Electrical Contractor has visited the site and has become familiar with the Drawings and site conditions and has included in his proposal, all work necessary to properly install the systems on the project.

D. Pre-Bid Conference:

1. Pre-Bid Conference shall be coordinated by the Owner.

1.9 DRAWINGS AND SPECIFICATIONS

A. General:

1. The Drawings are schematic in nature and indicate approximate locations of the electrical systems, equipment, fixtures and devices, except where specific locations are noted and dimensioned on the Drawings. All items are shown approximately to scale. The intent is to show how these items shall be integrated into the project site. Locate all items by on the job measurements and in accordance with the Contract Documents. Cooperate with other trades to ensure project completion as indicated.

B. Location:

1. Prior to locating electrical devices, light fixtures, and other items, obtain the Engineer's approval as to exact location. Locations shall not be determined by scaling Drawings. Mount lighting fixtures and electrical devices at the heights directed by the Engineer. Contractor shall be responsible for costs of redoing work of trades necessitated by failure to comply with this requirement.
2. All electrical devices, lighting fixtures, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Electrical devices, fixtures, and outlets shall be referenced to such features as wall and ceiling furring, balance, border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the centers of whole tiles and the exact location of each outlet and the arrangements to be followed shall be acceptable to the Engineer. Outlets in wall tile or masonry construction shall occur symmetrically in the centers of whole tiles, bricks, or blocks and the exact location of each outlet and the arrangement to be followed shall be acceptable to the Engineer.
3. The Drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general Drawings and to all detail Drawings, equipment Drawings, rough-in Drawings, etc., by measurements at the building, and in cooperation with the other trades. The Owner and Engineer reserve the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.

C. Specifications:

1. The Specifications are intended to supplement the Drawings and it is not in the scope of the specifications to mention any part of the work that the Drawings are competent to fully explain. Conversely, any part of the work that the specification is competent to fully explain may not be mentioned on the Drawings.

1.10 DISCREPANCIES

A. Clarification:

1. Clarification shall be obtained before submitting a proposal for the Work under this Division as to discrepancies or omissions from the Contract Documents or questions as to the intent thereof.

B. Detailed Instructions:

1. Should it appear that the work hereby intended to be done or any of the materials relative thereto is not sufficiently detailed or explained in the Drawings or Specifications, then the Contractor shall apply to the Engineer for such further Drawings or explanations as may be necessary, allowing a 10 working day time period for the Engineer to respond.

C. Interpretations:

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1. Should any doubt or question arise respecting the true meaning of Drawings or Specifications, reference shall be made to the Engineer, whose written decision shall be final and conclusive.

D. Contractor Agreement:

1. Consideration will not be granted for misunderstanding of the amount of work to be performed. Submission of a bid conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.

1.11 UTILITIES

A. General:

1. Utility information shown on the Drawings has been shown based upon data obtained from the existing single line diagrams and documentation provided by the Owner.
2. The scope of this work does not require modifications or work to the utility, and as such, shall not be modified. If deactivation is required, coordination shall take place with the Owner and Engineer, two (2) weeks prior to outage or downtime.

1.12 SITE OBSERVATION

A. General:

1. Observations at the site to verify general compliance with Contract Documents shall be made periodically by the Engineer or his representative. Written observation comments shall be submitted to the General Contractor for review and a written response.

1.13 COORDINATION OF ELECTRICAL WORK

A. General:

1. Refer to Division 1 for general coordination requirements applicable to the entire work.
2. It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships that must be established within the electrical work and in its interface with other work, including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Contractor. The Drawings show diagrammatically the sizes and locations of the various conduit and raceway systems and equipment items along with the sizes of the major interconnecting distribution, without showing exact details as to elevations, offsets, control lines, and installation details.
3. Arrange electrical work in a neat, well organized manner with services running parallel with primary lines of the building construction and with a minimum of 7' overhead clearance where possible.
4. The Contractor shall carefully lay out his work at the site to conform to the structural conditions, to avoid obstructions and to provide proper grading of lines. Exact locations of outlets, apparatus and connections thereto shall be determined by reference to detail Drawings, equipment Drawings, roughing-in Drawings, etc., by measurements at the building and in cooperation with other Contractors and, in all cases, shall be subject to the approval of the Engineer. Relocations necessitated by the conditions at the site or directed by the Engineer shall be made without any additional cost to the Owner or Engineer.
5. All conduit and boxes except those in the various equipment rooms, in unfurnished spaces or where specifically designated herein or on the Drawings shall be run concealed in furring, plenums, and chases. Wherever conditions exist which would cause any of these items to be exposed in finished spaces, the Contractor whose work is involved shall immediately call the situation to the attention of the Engineer and shall stop work in those areas until the Owner's Representative or General Contractor directs the resumption of the work. Submit for approval a Shop Drawing for any change in equipment placement, etc.

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6. Equipment has been chosen to fit within the available space with all required Code and maintenance clearances and shall be installed as shown. Every effort has been made to also accommodate equipment of other approved manufacturers; however, since equipment and access space requirements vary, the final responsibility for installation access and proper fit of substituted equipment rests with the Contractor.
7. System interferences shall be handled by giving precedence to pipe lines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:
 - a. Building Lines,
 - b. Structural members,
 - c. Soil and drain piping,
 - d. Utility water piping,
 - e. Electrical conduit.
8. Locate electrical equipment properly to provide easy access. Arrange entire electrical work with adequate code access for operation and maintenance.
9. Advise other trades of openings required in their work for the subsequent move in of large units of electrical work (equipment).
10. Coordinate all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: Voltage, ampacity, capacity, electrical connections, space requirements, sequence of construction, building requirements and special conditions.
11. When submitting Shop Drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.14 MATERIAL AND WORKMANSHIP

A. General:

1. Materials and equipment shall be new, of best grade and quality, and standard products of reputable manufacturers regularly engaged in the production of such materials and equipment.

B. Workmanship:

1. Work shall be executed and materials installed in accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen, presenting a neat appearance when completed.

C. Manufacturer's Recommendations:

1. With exceptions as specified or indicated on the Drawings or in the Specifications, apply, install, connect, erect, use, clean, and condition manufactured articles, materials, and equipment per manufacturer's current printed recommendations. Copies of such printed recommendations shall be kept at the job site and made available as required.

1.15 SPACE REQUIREMENTS

A. General:

1. Determine in advance of purchase that the equipment and materials proposed for installation will fit into the confines indicated, leaving adequate code clearances for adjustments, repair, or replacement.

B. Clearance:

1. Allow adequate space for clearance in accordance with requirements of the Code and local inspection department.

- C. Scheduled Equipment:
 - 1. The design shown on the Drawings is based on the equipment scheduled.
- D. Responsibility:
 - 1. Since space requirements and equipment arrangement vary for each manufacturer, the responsibility for initial access and proper fit rests with the Contractor.
- E. Review:
 - 1. Final arrangement of equipment to be installed shall be subject to the Engineer's review.

1.16 SAFETY REGULATIONS

- A. All electrical work shall be performed in compliance with all applicable and governing safety regulations. All safety lights, guards, signs, and other safety materials and provisions required for the performance of the electrical work shall be provided by and operated by the Electrical contractor.

1.17 DELIVERY, STORAGE AND HANDLING OF MATERIALS

- A. General:
 - 1. Protect all materials and equipment to be installed under this Division from physical and weather damage.
- B. Scope:
 - 1. Work under this Division shall include, but not limited to:
 - a) Shipping from point of manufacture to job site,
 - b) Unloading, moving, and storage on site with appropriate protection as required to properly protect equipment from rust, drip, humidity, dust, or physical damage,
 - c) Hoisting and scaffolding of materials and equipment included in this Division,
 - d) Ensuring safety of employees, materials, and equipment using such hoisting equipment and scaffolding as is required for safety.
- C. Coordination:
 - 1. All large pieces of apparatus which are to be installed in the building and which are too large to permit access through doorways, stairways or shafts shall be brought to the job by the Contractor and shall be placed in the spaces before enclosing partitions and structure are completed. All apparatus shall be cribbed up from the floor by Contractor and shall be covered with tarpaulins or other protective covering where required for protection.

1.18 NOISE AND VIBRATION

- A. General:
 - 1. One year warrants the electrical systems, and their component parts to operate without objectionable noise or vibration. Noise from systems or equipment that results in noise within occupied spaces above the recommended NC curves (refer to ASHRAE Standard) shall be considered objectionable. Vibration shall not be apparent to the senses in occupied areas of the building. Objectionable noise, vibration, or transmission thereof to the building shall be corrected.

1.19 CLEANING, ADJUSTING, AND START-UP

- A. Clean up:
 - 1. The Contractor shall clean away from the job site all debris, surplus material, and similar items, resulting from his work or operations, leaving the job and equipment in a clean

ELECTRICAL GENERAL PROVISIONS

condition. The Contractor shall thoroughly clean all pieces of equipment, conduit, boxes, fixtures, and similar items, leaving the installation in a first class condition.

B. Start-up Services:

1. Where specified for any individual item of electrical equipment, provide a factory-authorized representative for testing, start-up of equipment, and instruction of Owner's operating personnel. Certify that these services have been performed by including a properly executed invoice for these services, or a letter from the manufacturer.

C. Lubrication:

1. Provide means for lubricating all bearings and other machine parts. Extend a lubrication tube with suitable fitting to an accessible location and identify it where lubrication fittings are concealed or inaccessible. Lubricate all parts requiring lubrication and keep them adequately lubricated until final acceptance by the Owner.

D. Testing:

1. See Section 26 01 26 – Electrical Testing.

E. Operation Prior to Completion:

1. When any piece of electrical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Engineer's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of final acceptance and the start of the warranty may not be the same date.

1.20 FINAL REVIEW

A. General:

1. Upon completion of the Work, perform a final test of the entire system.
2. The system shall be operating properly and meet commissioning requirements.
3. After the final test, any changes or corrections noted as necessary for the Work to comply with these Specifications or the Drawings shall be accomplished without delay in order to secure final acceptance of the Work.
4. The date for the final test shall be sufficiently in advance of the Contract completion date to permit execution, before expiration of the Contract, of any adjustments or alterations that the final acceptance tests indicate as necessary for the proper functioning of all equipment. Any such modifications shall be completed within the time allotted for completion of the Contract. Retests shall be conducted as directed and shall be of such time duration as necessary to ensure proper functioning of adjusted and altered items. Retests shall not relieve the Contractor of completion date responsibility.
5. Certificates, including certificates of occupancy from local authorities and documents required herein, shall be completely in order and presented to the Engineer at least one week prior to the review.
6. Individuals knowledgeable of the systems and persons approved by the Engineer shall be present at this final inspection to demonstrate the system and prove the performance of the equipment.

1.21 OPERATION AND MAINTENANCE TRAINING (OWNER INSTRUCTION)

A. General:

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1. The Contractor and appropriate factory-trained representatives shall instruct the Owner's representative in the proper operation and maintenance of all electrical and control systems and equipment, and shall explain all warranties.
- B. Training Agenda Outline:
1. Prior to instruction of Owner Personnel, the Contractor shall prepare a typed outline, listing the subjects that will be included in this instruction, and shall submit the outline for review by the Engineer at least 2 weeks prior to the time of the training.
- C. Training Requirements:
1. Training shall be provided per the specific requirements in other sections of these specifications. In addition to training required in other sections of the specifications, the Contractor shall conduct specifically organized training sessions in the overall operation and maintenance of the electrical and control system for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in operations and maintenance of all components of the electrical system outside the training requirements in the other Sections.
 2. Training shall include, but not be limited to, the following:
 - a) Preventative maintenance procedures,
 - b) Trouble-shooting,
 - c) Calibration,
 - d) Testing,
 - e) Replacement of components,
 - f) Equipment operation.
 3. At a minimum, one training session, at least 2 hours in duration, shall be conducted at the facility after start-up of the electrical and control systems. The Contractor shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Owner at least 2 weeks prior to the time of the training.
- D. Certification:
1. At the conclusion of the instruction period, the Contractor shall obtain the signature of each person being instructed on each copy of the approved training outline to signify that the personnel has a proper understanding of the operation and maintenance of the systems, and resubmit the signed outlines.
- E. Other Requirements:
1. Refer to other Division 26 Sections for additional Operator Training requirements for specific pieces of equipment or specific systems.
 2. The Contractor shall coordinate the Operator Training requirements listed above with the Owner Instruction requirements of Division 1.

1.22 CONTRACTOR WARRANTIES AND GUARANTEES

- A. General:
1. Contractor shall guarantee all material and equipment installed by him against defects in workmanship and material for a period of 12 months after final acceptance of the work by the Owner. He shall repair or replace any materials or equipment developing such defects within that time promptly on due notice given him by the Owner and at Contractor's sole cost and expense.
- B. Equipment:
1. All equipment bearing a manufacturer's guarantee, such as electrical equipment, devices, components, and similar items, shall be construed to have an extended guarantee to the Owner by the manufacturer. Any such equipment that proves defective in materials or

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workmanship within the guarantee period is to be replaced by the Contractor in accordance with the manufacturer's guarantee.

PART 2 PRODUCTS

2.1 NOT USED.

PART 3 EXECUTION

3.1 NOT USED.

END OF SECTION

SECTION 26 00 01
ELECTRICAL SCOPE OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project Description
- B. Electrical Scope of Work

1.2 PROJECT DESCRIPTION

- A. The Idaho Transportation Department, District #1 office, located in Hayden, Idaho, as part of electrical upgrades, is replacing the existing diesel generator, automatic transfer switch (ATS), and existing day tank system with one (1) new diesel generator, one (1) new ATS, and one (1) new day tank system.

1.3 DESCRIPTION OF WORK

- A. Remove and furnish to Owner, one (1) existing 800A automatic transfer switch (ATS), one (1) existing diesel generator, and one (1) existing day tank system.
- B. Installation of one (1) 200kW standby generator and one (1) 800 Amp ATS in existing equipment locations at the Idaho Transportation Department, Hayden, Idaho, facility.
- C. Intercept, preserve, and protect, all conductors, conduit, and appurtenances required for power, control, and signal instrumentation for re-use as applicable for installation of one (1) new diesel generator, one (1) 50-gallon day tank with controls, and one (1) ATS, with integration of the existing outdoor, below-grade, diesel storage tank.
- D. Install generator, ATS, day tank with controls, conduit, and conductors as shown on the design drawings for a complete and operational standby (emergency) power system.
- E. Intercept existing conduit run to existing panelboard PNL-EM1 in electrical room and extend, as needed, to stub up or drop down new conduit with conductors to new generator, ATS, and day tank in the appropriate locations for connections of battery charger, block heater and day tank.
- F. Install new and extend existing conduit and new conductors stubbed up under new ATS in the existing locations for connection to the new generator.
- G. Install and extend concrete housekeeping pad minimum 6" outside new generator footprint.
- H. Intercept existing conduit run from existing panelboard PNL-EM1 in adjacent electrical room to Fire Alarm Control Panel. Install new junction box with DIN rail and terminal blocks near Panel-EM1 as necessary to extend and reroute feeder to Fire Alarm Control Panel from Panel-UPS.
- I. Coordinate, furnish, modify, and install HVAC and ductwork for proper working operation of new generator.
- J. Provide labor, materials, tools, machinery, equipment, fixtures, devices, and services necessary to complete the specified work of this and all other Divisions. Coordinate work with other trades to prevent conflicts without impeding job progress.
- K. Project work includes, but is not limited to:
 - 1. A complete standby power system including, but not limited to:
 - a) Standby generator.

- b) Automatic transfer switch.
 - c) Controls.
 - d) Day Tank and Controls.
 - e) Power Distribution.
 - f) Reroute fire alarm control panel power circuit.
 - g) All other components shown on the Drawings, specified or required for a fully operational system.
2. A complete system of miscellaneous electric controls and control wiring as shown on the Drawings and specified.
 3. Electrical testing and certification as specified.
 4. Concrete housekeeping pads, and other supports as required for electrical equipment and components.
 5. Connections to equipment furnished by the General Contractor or other Divisions.
 6. Additional items as shown on the Drawings or specified.

1.4 RELATED SECTIONS

- A. All division 26 sections.

PART 2 PRODUCTS

2.1 GENERAL

- A. Refer to specific Sections of the Specification for equipment.

PART 3 EXECUTION

3.1 GENERAL

- A. Installation shall be in accordance with the Specification section pertaining to the individual Equipment.

END OF SECTION

SECTION 26 01 26 ELECTRICAL TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material and installation requirements for:
 - 1. Testing of Electrical Systems

1.2 DESCRIPTION OF WORK

- A. Provide testing of electrical work installed under Division 26, as specified herein and in other Division 26 sections. Feeders and equipment shall not be placed in service until they have been checked and tested, as applicable.

1.3 RELATED SECTIONS

- A. Related Sections include but are not necessarily limited to:
 - 1. Section 26 00 00 – Electrical General Provisions
 - 2. Section 26 00 01 – Electrical Scope of Work
 - 3. Section 26 60 02 – Basic Materials and Methods
 - 4. Section 26 05 19 – Wire and Cable

1.4 STANDARDS AND REFERENCES

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform with all applicable NEMA, ANSI and IEEE Standards
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.5 SUBMITTALS

- A. Shop Drawings
 - 1. See Section 26 00 00.
- B. Testing Procedures: Submit four copies of all proposed testing procedures to the Engineer for review at least 10 working days prior to conducting any testing on the project.
- C. Reporting Forms: Submit four copies of the proposed forms to be used in recording testing data and results to the Engineer for review at least 10 working days prior to conducting any testing on the project.
- D. Test Data and Results: Submit four copies of complete data and certified test results for each test performed, including, but not limited to:
 - 1. Test performed,
 - 2. Test procedure,
 - 3. System and area tested,
 - 4. Date(s) and time(s) of test,
 - 5. Weather conditions,

6. Test criteria,
 7. Test results,
 8. Additional pertinent information.
- E. Operational Certification: Submit four certified copies of an operational certification which documents that all equipment and systems have been fully tested to verify proper operation in accordance with the design shown in the Contract documents and manufacturer's recommendations.
- F. Certification: Certifications stating that submitted test data and results are true and correct shall be provided for all submittals under this section. Certification shall be executed by an authorized officer if the Contractor is a corporation, by a partner if the Contractor is a partnership, by the owner if the Contractor is a sole proprietorship or by the authorized representative if the Contractor is a joint venture.
- G. Calibration List: Submit four copies of a listing of testing devices to be used for the project to the Engineer for approval. Listing shall include documentation that the devices are properly calibrated.
- H. Test Log: The Contractor shall maintain a test log at the site to document the results of all successful and unsuccessful testing as it is performed. This log shall be available for review by the Engineer and a copy of the log shall be submitted to the Engineer prior to the Substantial Completion inspection. A space shall be provided on the test log signoff by the Engineer or Owners representative.

1.6 NOTICE

- A. Notify the Engineer in writing 10 working days prior to all scheduled testing to allow time for Engineer to schedule witnessing of testing, where elected by Engineer.

PART 2 PRODUCTS

2.1 TESTING MATERIALS

- A. General: Provide all materials and test equipment required for testing of specified electrical systems, including re-testing until acceptable results are obtained.
- B. Products: Tested products which fail to provide acceptable test results shall be repaired or replaced with suitable materials as required to obtain acceptable results.

PART 3 EXECUTION

3.1 TESTING

- A. General: Test shall be made, in the presence of the Engineer or his/her representative if requested, during the course of the construction as specified and as required by authorities having jurisdiction. Such test shall be conducted by this Division as part of the Work and shall include all personnel, material, and equipment required to perform test until satisfactory results are obtained. Any defects detected during testing shall be satisfactorily repaired or the equipment involved shall be replaced and the test re-executed.
- B. Testing shall include but not be limited to all items in other Sections of this Division and the following:
1. Feeders: Refer to Section 26 05 19.
- C. Test Reports (Attached)
1. ELECTRICAL SYSTEM TEST REPORT - 600V CABLE

END OF SECTION

26 01 26 ELECTRICAL SYSTEM TEST REPORT - 600V CABLE

ELECTRICAL SYSTEM
DESCRIPTION DATA

SERVICE DESCRIPTION:

nominal voltage, phase to phase
 phase to neutral - single or three phase-
 number of conductors

SERVICE CONDUCTORS:

phase size and insulation type
 neutral size and insulation type
 ground size and insulation type

SERVICE DISCONNECT DESCRIPTION:

circuit breaker or disconnect switch
 size (amps)
 fuse (amps)

MEASURED CONDITIONS		DATA
Operating Load Voltage	Volts	Vab_____Vbc_____Vca_____
		Van_____Vbn_____Vcn_____
Operating Load Feeder Current	Amps	Ia_____Ib_____Ic_____
Conductor Insulation Resistance (record the indicated measurement for each of the following circuits:)	Megohms	a-b_____b-c_____c-a_____
	Megohms	a-g_____b-g_____c-g_____
1. ATS to Generator 2. PNL-EM1 to Block Heater & Battery Charger 3. PNL-EM1 to Day Tank 4. PNL-UPS to Fire Alarm Control Panel Junction Box		

SECTION 26 05 19 WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material and installation requirements for:
 - 1. Building wire
 - 2. Power and control cable
 - 3. Wire connectors
 - 4. Insulating tape

1.2 DESCRIPTION OF WORK

- A. This section covers furnishing and installation of all wiring and connections used in the construction of this facility.
- B. All wiring shall be in raceways.

1.3 RELATED SECTIONS

- A. Related Sections include but are not necessarily limited to:
 - 1. Section 26 01 26 – Electrical Testing
 - 2. Section 26 05 33 – Raceways
 - 3. Section 26 00 00 – Electrical General Provisions
 - 4. Section 26 60 02 – Basic Materials and Methods

1.4 STANDARDS AND REFERENCES

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
 - 1. Insulated Cable Engineers Association:
 - a) S-58-679, Control Cable Conductor Identification
 - 2. National Electrical Manufacturers Association (NEMA):
 - a) ICS 4, Terminal Blocks for Industrial Use
 - 3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
 - a) WC 70/ICEA S-95-658, Standard for Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
 - 4. National Fire Protection Association (NFPA):
 - a) 70, National Electrical Code (NEC)
 - 5. Underwriters Laboratories, Inc. (UL):
 - a) 44, Thermoset-Insulated Wires and Cables
 - b) 83, Thermoplastic-Insulated Wires and Cables
 - c) 467, Grounding and Bonding Equipment
 - d) 486A, Wire Connectors and Soldering Lugs for use with Copper Conductors

- e) 486C, Splicing Wire Connectors
 - f) 510, Insulating Tape
 - g) 1581, Reference Standard for Electrical Wires, Cables, and Flexible Cords
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.5 DEFINITIONS

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- B. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, AWG No. 8 and larger.
- C. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, AWG No. 16, AWG No. 14, AWG No. 12 or AWG No. 10.
- D. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.6 SUBMITTALS

- A. Shop Drawings
 - 1. See Section 26 00 00.

PART 2 PRODUCTS

2.1 CONDUCTORS

- A. Conductors shall be stranded copper. Sizes AWG No. 14, 12 and 10 for general purpose lighting and receptacle wiring and all wiring within circuit breaker panels may be solid. All other conductors shall be stranded. Insulation shall be THW-2, THWN-2, or THHN, (90°F) chosen to satisfy environmental conditions. Conductors used for power circuits shall not be smaller than AWG No. 12. Control conductors may be AWG No. 14.

2.2 CONNECTORS

- A. Ideal Industries "Wing Nut" or 3M Company "SCOTCHLOCK" pre-insulated connectors may be used for lighting and receptacle circuits for splices and taps in conductors AWG No. 10 and smaller. For AWG No. 8 and larger conductors, utilize Thomas & Betts compression connectors. Compress using recommended die and tools.
- B. For connections of wire to cord to removable equipment provided with integral cords (such as floats, transmitters, limit switches, aerators, submersible pump motors, etc.) provide junction box with terminals and spade/lug type terminations and coat with liquid insulation.
- C. For connections of wire to cord for submersible motors of all size wire use a water proof motor stub insulator: Thomas & Betts multi splice insulator MSLT112-4 or equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Splicing of power and control wires or cables is not allowed. All wire transitions shall be done on terminals.

- B. Keep all conductors within the allowable tension limits during installation. Lubricants for wire pulling, if used, shall be approved for the insulation and raceway material. Observe cable manufacturer's and industry standard cable bending radius recommendations.
- C. Incoming cables in panels, AWG No. 6 and smaller, shall be bundled and laced at intervals not greater than 6 inches and neatly spread into trees and connected to their respective terminals.
- D. Sufficient slack shall be allowed in cables for alterations in terminal connections. Lacing shall be done with plastic cable ties using a tensioning tool designed for that purpose.
- E. Cables crossing hinges shall be made up into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.

3.2 WIRE AND CABLE TERMINATION

- A. Power conductors, AWG No. 8 and larger may be terminated directly in box-type lugs.
- B. For any power or control wire terminating on screw type terminals; provide spade tongue type terminations.
- C. Stranded control conductors may be directly terminated in box type terminals at control panels. Insulated terminals shall be used also on all stranded instrumentation wiring.
- D. No splices shall be used in power and/or control wiring. The wiring shall be continuous from point-to-point.
- E. Terminals and connectors shall be installed with the compression tool recommended by the terminal manufacturer. Solid wire shall not be lugged, but shall be terminated with a full ring eye of the wire under the binding-head screw or saddle of the terminal block.

3.3 COLOR CODING

- A. Wiring shall conform to the following color code.
- B. Insulation on phase conductor sizes AWG No. 10 and smaller shall be colored, No.8 AWG and larger may have black insulation with plastic tape of the appropriate color from the table below.
- C. Insulation on the grounded conductor (neutral) sizes AWG No. 8 and smaller shall be colored, AWG No. 6 and larger may have black insulation with plastic tape of white or gray in accordance with the table below.

Description	120/208V	277/480V	Control
Phase A (Left)	Black	Brown	--
Phase B (Center)	Red	Orange	--
Phase C (Right)	Blue	Yellow	--
Neutral	White	Gray	White
Ground	Green	Green	Green
120 VAC Control – Power	--	--	Red
120 VAC Control – Neutral	--	--	White
DC Control (+)	--	--	Blue
DC Control (-)	--	--	Gray
External Source	--	--	Yellow

- D. All control wiring in control panels or other enclosures that is powered from an external source and is not disconnected by the control panel disconnect shall be terminated at a disconnecting terminal block upon entering the enclosure. The color of the wire shall then be changed to yellow to identify it as being powered from an external source. Provide identification nameplate on exterior of enclosure to indicate sources of external power.
- E. All wiring in industrial machines and equipment shall be in accordance with NFPA 79. Notify Owner of any deficiencies noted during installation.

3.4 TERMINAL MARKING

- A. All terminals in instrument and relay compartments, motor control centers, control panels, instrument panels, field panels and control stations, as well as connections to mechanical equipment, shall have reference number and letter in accordance to the following:
 1. h = Control power hot (usually 120V or 24V)
 2. n = neutral
 3. g = ground
 4. x = PLC input (number shall correspond to the program input number)
 5. y = PLC output (number shall correspond to the program output number)
 6. ax = PLC signal/analog input (number shall correspond to the program input number)
 7. ay = PLC signal/analog output (number shall correspond to the program output number)
 8. c = control (use if none of the above letters apply)
 9. p = power (usually 480V)
 10. s = signal (usually 4-20ma or 1-5V) (use if none of the above letters apply)
 11. B = DC + and -

3.5 CONDUCTOR SPACING

- A. Unless specifically shown otherwise on the drawings, in all areas maintain a minimum 2-inch separation between all conductors of different voltages. For parallel runs over 6 feet maintain the following minimum separation between conductors:
 1. Signal (12/24) VDC and 120 VAC 6 inches

- | | |
|-------------------------------------|-----------|
| 2. Signal (12/24) VDC and 480 VAC | 12 inches |
| 3. 120 VAC control wire and 480 VAC | 2 inches |

3.6 WIRE BENDING RADIUS

- A. The radius of bends in all wire (conductors and cables) shall not be less than five (5) times the outside diameter of the wire. Any wire installed with bends less than five times the diameter which the Engineer deems has caused that insulation to be damaged shall be removed and new wire shall be installed.

3.7 VISUAL AND MECHANICAL INSPECTIONS

- A. Inspect exposed section for physical damage.
- B. Verify that cable is supplied and connected in accordance with specifications and one line diagram, and that phases are labeled correctly.

3.8 TESTING

- A. See Section 26 01 26 – Electrical Testing.

END OF SECTION

SECTION 26 05 26 GROUNDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material and installation requirements for:
 - 1. Grounding

1.2 DESCRIPTION OF WORK

- A. This section covers furnishing and installing all grounding and/or bonding conductors, connectors, ground rods and terminations as required to meet these specifications and to comply with Article 250 of the National Electric Code.

1.3 RELATED SECTIONS

- A. Related Sections include but are not necessarily limited to:
 - 1. Section 26 05 19 – Wire and Cable
 - 2. Section 26 05 33 – Raceways
 - 3. Section 26 32 13 – Power Generation
 - 4. Section 26 00 00 – Electrical General Provisions
 - 5. Section 26 60 02 – Basic Materials and Methods

1.4 STANDARDS AND REFERENCES

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
- C. American National Standards Institute:
 - a) ANSI/IEEE Standard 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. American Society for Testing and Materials (ASTM):
 - a) B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 3. National Fire Protection Association (NFPA):
 - a) 70, National Electrical Code (NEC).
 - 4. Underwriters Laboratories, Inc. (UL):
 - a) 467, Electrical Grounding and Bonding Equipment.
- D. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.5 SUBMITTALS

- A. Shop Drawings
 - 1. See Section 26 00 00.
 - 2. See Section 26 01 26.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 26 00 00.

PART 2 PRODUCTS

2.1 GENERAL

- A. For each electrical grounding connection, provide a complete assembly of materials to construct a completely grounded electrical system.
- B. Raceways for grounding conductors shall be as specified in Section 26 05 19.
- C. Grounding cable, wire and connectors shall be as specified in Section 26 05 33.
- D. Grounding conductors and jumpers shall be connected to each other and to items to be grounded by means of approved type pressure connectors, clamps, and other suitable methods approved by the Engineer. No solder connections shall be made.

2.2 GROUNDING ELECTRODE CONDUCTORS

- A. All concrete encased or direct buried underground grounding electrode conductors shall be soft drawn stranded bare copper cable, conforming to ASTM B8.
 - 1. Sized as required by Table 250-66 of the NEC, except where a larger size conductor is shown on the Contract Drawings.
 - 2. Minimum conductor allowed: 2/0.

2.3 EQUIPMENT GROUNDING CONDUCTOR:

- A. Green copper conductor: Identical insulation to phase conductors.
- B. Sized as required by Table 250-122 of the NEC, except where a larger size conductor is shown on the Contract Drawings.

2.4 GROUND CLAMPS

- A. Ground clamps for connecting grounding conductors to copper, brass, or lead pipes shall be made of copper. If pipes are of steel or iron, the ground clamps should be made of galvanized iron. These clamps shall be designed to provide permanent and positive pressure and to avoid mechanical injury to the pipe. Use exothermic welds for connecting ground wires to ground rods for all below grade counterpoise grounds, grids, and elsewhere where noted on the Drawings.
- B. High copper alloy content, compression type, noncorrosive.
- C. UL 467 listed.
 - 1. Burndy
 - 2. ILSCO
 - 3. Thomas & Betts

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Remove paint, rust, or other nonconducting material from contact surfaces before making ground connections.

- C. Where ground conductors pass through floor slabs or building walls, sleeves of intermediate metal conduit of the required size, shape, and length shall be provided, unless otherwise specified or shown on Drawings.

3.2 RACEWAY GROUNDING-CONDUIT

- A. All metallic conduit shall be electrically continuous.
- B. Provide grounding-type insulating bushings:
 - 1. For all equipment not supplied with a conduit hub.
 - 2. On ends of metallic conduit.
- C. Bond all conduit, at entrance and exit of equipment, to equipment ground bus or ground lug.
- D. Use manufactured conduit hubs at all panels.
- E. Provide bonding jumpers if conduit are installed in concentric knockouts.
- F. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
- G. Provide bonding jumper from equipment ground lug to RGS conduit if flexible conduit is utilized for equipment connections.
- H. Provide bonding jumpers identical in conductor size to the largest ground conductor run within the conduit.

3.3 EQUIPMENT GROUNDING

- A. Ground all voltage levels at the supply transformer from the secondary neutral to the ground grid. Provide two separate grounding conductors.
- B. Consider control devices (switches, indicating lights, meters, starters, relays, etc.) mounted in MCC's, switchgear, control panels, or other metal enclosures to be adequately grounded, if the enclosure ground lug or ground bus is properly grounded.
- C. Do not splice grounding conductors.
- D. Run all equipment grounding conductors in conduit.
- E. Ground unused and spare power and control cable at both ends.
- F. Size all grounding conductors in accordance with Article 250 of the NEC unless larger size is shown on the Drawings.

3.4 STRUCTURAL GROUNDING

- A. Bond concrete foundation reinforcing steel to the ground at all corners of the structure. Utilize a bare 2/0 conductor, unless otherwise shown on Contract Drawings. Do not use exothermic welding if it will damage the structural integrity of the foundation.
- B. Make all reinforcing steel electrically continuous.

END OF SECTION

SECTION 26 05 33 RACEWAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material and installation requirements for:
 - 1. Conduits
 - 2. Conduit fittings
 - 3. Conduit supports
 - 4. Wireways
 - 5. Outlet boxes
 - 6. Pull and junction boxes

1.2 DESCRIPTION OF WORK

- A. Provide electrical raceway and fitting work as shown, scheduled, indicated, and specified.
- B. All electrical conductors shall be installed in conduit or surface metallic raceways. Conduit shall be as specified herein. In addition, empty conduit shall be installed for the voice/data system and for other systems as indicated on the Drawings and in the Specifications.
- C. The types of electrical raceways and fittings required for the project include, but are not limited to, the following.
 - 1. Rigid metallic conduit (RMC),
 - 2. Liquidtight flexible metal conduit,
 - 3. Rigid nonmetallic conduit.

1.3 RELATED SECTIONS

- A. Section 26 05 26 – Grounding
- B. Section 26 00 00 – Electrical General Provisions
- C. Section 26 60 02 – Basic Materials and Methods

1.4 STANDARDS AND REFERENCES

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. Products and installation shall comply with applicable sections of the following standards:
 - 1. American Iron and Steel Institute (AISI)
 - 2. American National Standards Institute (ANSI):
 - a) C80.1, Rigid Steel Conduit - Zinc-Coated
 - 3. ASTM International (ASTM):
 - a) A123, Standard Specification for Zinc Coating (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b) A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - c) D1784, Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds

- d) D2564, Solvent Cements for PVC Plastic Pipe, Tubing, and Fittings
 - e) E84, Standard Test Method for Surface Burning Characteristics of Building Materials
 - f) F512, Standard Specification for Smooth-Wall PVC Conduit and Fittings for Underground Installation
4. National Electrical Manufacturers Association (NEMA):
- a) FB 1, Fittings and Supports for Conduit and Cable Assemblies
 - b) OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
 - c) RN 1, PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - d) TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - e) TC 6, PVC Plastic Utilities Duct for Underground Installations
 - f) 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
5. Underwriters Laboratories, Inc. (UL):
- a) 1, Flexible Metal Conduit
 - b) 6, Rigid Metal Conduit
 - c) 50, Standard for Safety Enclosures for Electrical Equipment
 - d) 360, Liquid-Tight Flexible Steel Conduit
 - e) 467, Grounding and Bonding Equipment
 - f) 514A, Standard for Safety Metallic Outlet Boxes
 - g) 514B, Fittings for Cable and Conduit
 - h) 651, Schedule 40 and 80 Rigid PVC Conduit
 - i) 870, Wireways, Auxiliary Gutters, and Associated Fittings
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.5 SUBMITTALS

- A. Shop Drawings
 - 1. See Section 26 00 00.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 26 00 00.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide metal conduit, tubing, and fittings of the type, grade, size, and weight (wall thickness) as shown and required for each service. Where type and grade are not indicated, provide proper selection determined by this Section to fulfill the wiring requirements and complying with the NEC for electrical raceways.
- B. For each electrical raceway system indicated, provide a complete assembly of conduit, tubing, or duct with fittings, including, but not necessarily limited to, connectors, nipples, couplings, expansion fittings, bushings, locknuts, other components and accessories as needed to form a complete system of the type indicated.
- C. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, except insulated throat grounding bushings shall be used on all conduits without ground conductors and where required by N.E.C. Article 250.

2.2 ACCEPTABLE MANUFACTURERS

A. Provide products complying with these specifications and produced by one of the following:

1. Rigid metallic conduits:
 - a) Allied Tube and Conduit Corporation
 - b) Triangle PWC Inc.
 - c) Western Tube and Conduit Corporation
 - d) Wheatland Tube Company
 - e) LTV Steel Company
2. Liquidtight Flexible Metal:
 - a) AFC
 - b) Anaconda Metal Hose
 - c) Electri-Flex Company
 - d) Flexi-Guard, Inc.
 - e) Triangle PWC, Inc.
 - f) Wheatland
3. Rigid Nonmetallic Conduit
 - a) Carlon
 - b) Cantex
 - c) Triangle PWC, Inc.
4. Raceway Fittings:
 - a) Appleton Electric Company
 - b) Cantex (PVC)
 - c) Carlon (PVC)
 - d) Crouse Hinds
 - e) Efcor Division
 - f) ETP-Uni-Couple
 - g) O.Z. Gedney Company
 - h) Racor, Inc.
 - i) Republic Steel Corporation
 - j) Steel City
 - k) Thomas and Betts
5. Support systems:
 - a) Unistrut Building Systems
 - b) B-Line Systems Inc.
 - c) Kindorf
 - d) Minerallac Fastening Systems
 - e) Caddy
6. Outlet, pull and junction boxes:
 - a) Appleton Electric Co.
 - b) Crouse-Hinds
 - c) Killark
 - d) O-Z/Gedney
 - e) Steel City
 - f) Racor
 - g) Bell
 - h) Hoffman Engineering Co.
 - i) Wiegmann

- j) B-Line Circle AW
- k) Adalet

2.3 RIGID METALLIC CONDUITS

- A. Rigid Galvanized Steel Conduit (RGS):
 - 1. Mild steel with continuous welded seam,
 - 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing; threads galvanized after cutting,
 - 3. Internal Coating: Baked lacquer, varnish or enamel for a smooth surface.
 - 4. Standards: ANSI C80.1, UL 6.

2.4 RIGID NON-METALLIC CONDUIT

- A. Schedules 40 (PVC-40) and 80 (PVC-80):
 - 1. Polyvinyl-chloride (PVC) plastic compound which meets, as a minimum, ASTM D1784 cell classification PVC 12233-A, B, or C,
 - 2. Rated for direct sunlight exposure,
 - 3. Fire retardant and low smoke emission,
 - 4. Shall be suitable for use with 90 Deg C wire and shall be marked "maximum 90 Deg C".
 - 5. Standards: ASTM D1784, NEMA TC 2, UL 651.

2.5 FLEXIBLE CONDUIT

- A. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
 - 1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked,
 - 2. Extruded PVC outer jacket positively locked to the steel core,
 - 3. Liquid- and vapor-tight.
 - 4. Standard: UL 360.

2.6 CONDUIT FITTINGS AND ACCESSORIES

- A. Fittings for Use with RGS:
 - 1. Locknuts:
 - a) Threaded steel or malleable iron,
 - b) Gasketed or non-gasketed,
 - c) Grounding or non-grounding type.
 - 2. Bushings:
 - a) Threaded, insulated metallic,
 - b) Grounding or non-grounding type.
 - 3. Hubs: Threaded, insulated and gasketed, metallic, for rain-tight connection.
 - 4. Couplings:
 - a) Threaded, straight-type: Same material and finish as the conduit with which they are used on.
 - b) Threadless type: Gland compression or self-threading type, concrete tight.
 - 5. Unions:
 - a) Threaded galvanized steel or zinc plated malleable iron.
 - 6. Conduit bodies:
 - a) Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs,

- b) Standard and mogul size.
- c) Cover: Clip-on type with stainless steel screws. Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
- 7. Sealing fittings:
 - a) Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs,
 - b) Standard and mogul size, with or without drain and breather.
 - c) Fiber and sealing compound: UL listed for use with the sealing fitting.
- 8. Service entrance head:
 - a) Malleable iron, galvanized steel or copper free aluminum,
 - b) Insulated knockout cover for use with a variety of sizes and number of conductors.
- 9. Expansion couplings:
 - a) 2 IN nominal straight-line conduit movement in either direction.
 - b) Galvanized steel with insulated bushing.
 - c) Gasketed for wet locations.
 - d) Internally or externally grounded.
- B. Fittings for Use with FLEX-LT:
 - 1. Connector:
 - a) Straight or angle type
 - b) Metal construction, insulated and gasketed
 - c) Composed of locknut, grounding ferrule and gland compression nut
 - d) Liquid-tight.
 - 2. Standard: UL 467, 514B.
- C. Fittings for Use with Rigid Non-Metallic Conduit:
 - 1. Coupling and adapters shall be of the same material, thickness, and construction as the conduits with which they are used.
 - 2. Standards: UL 651, NEMA TC 3.
 - 3. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
 - a) Standard: ASTM D2564.
- D. Weather and Corrosion Protection Tape:
 - 1. PVC based tape, 10 mils thick,
 - 2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct burial,
 - 3. Used with appropriate pipe primer.

2.7 OUTLET BOXES

- A. Metallic Outlet Boxes:
 - 1. Hot-dip galvanized steel,
 - 2. Conduit knockouts and grounding pigtail,
 - 3. Accessories:
 - a) Flat blank cover plates,
 - b) Barriers,
 - c) Extension, plaster, or tile rings,
 - d) Box supporting brackets in stud walls,
 - e) Adjustable bar hangers.
 - 4. Standards: NEMA OS 1, UL 514A.
- B. Cast Outlet Boxes:

1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish,
2. Threaded hubs and grounding screw.
3. Styles:
 - a) "FS" or "FD",
 - b) "Bell",
4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
5. Standards: UL 514A and 886.

2.8 PULL AND JUNCTION BOXES

- A. NEMA 1 Rated:
 1. Body and cover: 14 GA, galvanized steel or steel finished with rust inhibiting primer and manufacturers standard paint inside and out,
 2. With or without concentric knockouts on four sides,
 3. Flat cover fastened with screws.
- B. NEMA 4 Rated:
 1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out,
 2. Seams continuously welded and ground smooth,
 3. No knockouts,
 4. External mounting flanges,
 5. Hinged or non-hinged cover held closed with stainless steel screws and clamps,
 6. Cover with oil resistant gasket.
- C. NEMA 4X Rated (metallic):
 1. Body and cover: 14 GA Type 304 or 316 stainless steel,
 2. Seams continuously welded and ground smooth,
 3. No knockouts,
 4. External mounting flanges,
 5. Hinged door and stainless steel screws and clamps,
 6. Door with oil-resistant gasket.
- D. NEMA 4X Rated (non-metallic):
 1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes,
 2. No knockouts,
 3. External mounting flanges,
 4. Hinged door with quick release latches and padlocking hasp,
 5. Door with oil resistant gasket.
- E. NEMA 12 Rated:
 1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out,
 2. Seams continuously welded and ground smooth,
 3. No knockouts,
 4. External mounting flanges,
 5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps,
 6. Flat door with oil resistant gasket.

2.9 SUPPORT SYSTEMS

- A. Multi-conduit surface or trapeze type support and pull or junction box supports:
 - 1. Material requirements.
 - a) Galvanized steel: ASTM A123 or ASTM A153.
 - b) Stainless steel: AISI Type 316.
 - c) PVC coat galvanized steel: ASTM A123 or ASTM A153 and 20 mil PVC coating.
- B. Single conduit and outlet box support fasteners:
 - 1. Material requirements:
 - a) Zinc plated steel
 - b) Stainless steel
 - c) Malleable iron
 - d) PVC coat malleable iron or steel: 20 mil PVC coating
 - e) Steel protected with zinc phosphate and oil finish.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install electrical raceways and fittings as shown in accordance with the manufacturer's written instructions, the applicable requirements of the NEC, and in accordance with recognized industry practices to ensure that products serve the intended function. Complete electrical raceway installation before starting the installation of wire and cable.
- B. Conduit Size:
 - 1. Minimum conduit size for power wiring shall be $\frac{3}{4}$ ". Minimum conduit size for control wiring shall be $\frac{3}{4}$ ". Minimum conduit size for voice/data wiring shall be 1".
- C. Rigid Steel Conduit:
 - 1. Use rigid steel to run all electrical raceway systems where exposed to weather; in damp or wet locations; where subject to physical damage; and where cast in concrete walls or floors slabs which have waterproof membranes and where cast in masonry walls. Use rigid steel for all exposed feeders. Use threaded type couplings and fittings. Split type couplings and fittings are not acceptable. The interior of all buildings shall be considered a damp or wet area.
- D. Liquidtight Flexible Metal:
 - 1. Use liquidtight flexible metal conduit and fittings for all motor connections, and for other electrical equipment connections where subject to movement and vibration and when subject to one or more of the following conditions: (1) exterior locations, moist or humid atmosphere where condensation can be expected to accumulate; (2) corrosive atmosphere, subject to water spray; subject to dripping oil, grease or water. Install internal ground wire in flexible conduit with grounding bushings. Maximum length shall be 6'0" and minimum length shall be 3'0".
- E. Rigid Nonmetallic:
 - 1. Use PVC conduit directly buried in earth, concrete encased, cast in concrete slabs, and where subject to corrosive environment. PVC may be used for all raceways on the interior of the building, which do not contain 480 volt conductors or motor feeders. Use Schedule 40 where direct buried and Schedule 80 where exposed, with size adjusted to have same fill area as if Schedule 40 were used.

3.2 INTERIOR CONDUIT SYSTEM:

- A. Ground all metallic conduit in accordance with the requirements of the latest edition of the NEC.
- B. Install all conduit as a complete system without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in such a manner as to ensure a tight joint. Field-cut threads shall be cold-galvanized after cutting. The entire conduit system shall be secured at all joints and boxes in such a manner that each system shall be electrically continuous throughout. Fasten the entire conduit system securely into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting. Install approved expansion fittings in all conduit runs as specified in paragraph 3.2.P.
- C. Ream all ends of conduit properly to remove rough edges. Whenever a rigid steel conduit enters a switchboard, panelboard, enclosure, or box it shall be securely fastened by the use of a locknut inside and outside and an approved insulating bushing shall be installed. Insulated grounding bushings shall be installed on all conduits without ground conductors and where required by NEC Article 250. Lay out and install all conduit systems as to avoid all other services or systems, the proximity of which may prove injurious to the conduit or the wires or conductors which the conduit confines.
- D. Conceal conduit systems in finished areas. Concealed metallic conduits shall be run in a direct manner, basically parallel to, and at right angles with the lines of the building, and with as long a bend as possible. Conduit may be exposed in mechanical rooms and where otherwise shown or indicated. On exposed systems, run the conduit parallel or perpendicular to the structural features of the building and rigidly support with malleable iron conduit clamps at intervals as required by NEC, or on conduit racks, neatly racked and bent in a smooth radius at corners insofar as practicable. All bends shall be field-made using an approved bending machine designed for the purpose, or using standard ells having a radius not less than that required by the National Electrical Code, and with approved fittings or connectors. All bends shall be free from dents or flattening.
- E. All conduit shall be run without traps. Where traps are unavoidable, a junction or pull box shall be placed at the low point. Metallic conduit systems, which are exposed to the weather or water, shall be made watertight. As soon as conduit has been permanently installed in place, conduit shall be capped or plugged with standard accessories. All metallic conduit shall be swabbed after plaster and drywall is finished and dry.
- F. Support exposed raceway or grouped concealed raceways on galvanized channel using compatible galvanized fittings (bolt, beam clamps, and similar items) and galvanized threaded rod pendants to secure raceway to channel and channel to structure. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt/nut and threaded rod. Support-spacing shall not exceed 10' apart for all rigid conduit 2" and smaller, and 15' apart for rigid conduit 2-1/2" and larger and within 3' from boxes and changes in direction. Support flexible conduit on maximum 4-1/2' centers and within one foot (1') of boxes. All raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on all conduit passing through walls and ceilings in finished areas.
- G. Support conduit sized one inch (1") and larger as described in Paragraph F.
- H. Make all joints and connections to ensure mechanical strength and electrical continuity. PVC conduit shall be joined, or have fittings attached, by using a fusing (solvent) compound recommended by and applied as instructed by, the conduit manufacturer.
- I. Run conduit to avoid proximity to heat producing equipment, piping and flues, keeping a minimum of 8" clear. Whenever possible, install horizontal raceway runs above water piping.

- Unless shown otherwise, do not install conduit horizontally in concrete slabs without written approval. All roof penetrations shall be made in adequate time to allow the roofer to make proper flashings.
- J. Carefully review electrical Drawings and place boxes and conduit to avoid conflicts with structural members or other general construction.
 - K. Conduit larger than ¾" shall not be embedded in structural slabs without prior written permission from the Engineer. Conduits embedded in structural slabs shall be installed in the middle of the slab below the top and above the bottom reinforcing steel. Maintain a minimum concrete coverage of one (1") except where penetration is made.
 - L. Furnish sleeves for timely placing in construction for all conduit passing through concrete walls, partitions, beams, floors, and roofs while same are under construction.
 - M. All conduit passing through the housing on connected equipment, shall pass through a cleanly cut hole protected with an approved grommet.
 - N. Metallic conduit installed below grade shall have its entire length painted with two coats of protective finish unless encased in concrete. Each coat shall consist of 5mils of PPG "Coat Cat Epoxy Coating" applied in accordance with the manufacturer's recommendations. The entire length of metallic conduit, including fittings, shall be protected to a point 6" above finished grade (or concrete slab).
 - O. Install expansion fittings in all conduit as follows:
 - 1. All conduits crossing building expansion joints; unless some other form of thermal expansion compensation is approved in writing by the Engineer,
 - 2. All conduit straight runs in excess of 200', and 400' centers in all longer conduit runs.
 - 3. Conduit entering environmental rooms,
 - 4. Locations subject to thermal expansion and as required by NEC.
 - 5. Unless expansion fitting has an integral bonding braid, an external braid approved for the purpose shall be installed around the fitting.

3.3 IDENTIFICATION

- A. See Section 26 60 02 for applicable labeling requirements.
- B. Conduit Markers
 - 1. All conduits scheduled shall be identified at each end with a permanent metallic tag. Conduits shall be labeled as identified on the Conduit and Wire Schedule. Attach tags to cables or conduit by using a nylon cable tie. Identify concealed conduits entering equipment, panelboards, or enclosures by attaching marker tag to cables as they exit the conduit. Embedded conduits and conduits routed underground shall be labeled also at all points of entry and exit including handholes and buildings, by attaching a marker tag to the exterior of the conduit.

3.4 FIELD INSPECTION

- A. Prior to backfilling and encasing conduits installed underground or covering conduits concealed in walls and ceilings, all raceways shall be inspected by the Engineer. Engineer shall be contacted a minimum of one week in advance for field inspection of concealed raceway. No raceway shall be concealed or backfilled until inspected by the Engineer.

END OF SECTION

SECTION 26 28 00
OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material and installation requirements for:
 - 1. Fuses
 - 2. Circuit Breakers

1.2 DESCRIPTION OF WORK

- A. This section covers furnishing and installing the furnishing and installation of all fuses and circuit breakers used in this project.

1.3 RELATED SECTIONS

- A. Related Sections include but are not necessarily limited to:
 - 1. Section 26 32 13 – Power Generation
 - 2. Section 26 00 00 – Electrical General Provisions
 - 3. Section 26 60 02 – Basic Materials and Methods

1.4 STANDARDS AND REFERENCES

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
 - 1. American National Standards Institute:
 - a) ANSI/UL 198E Class R Fuses.
 - b) ANSI/UL 198C High-interrupting-Capacity Fuses, Current-Limiting types, Class L.
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.

1.5 SUBMITTALS

- A. Shop Drawings
 - 1. See Section 26 00 00.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 26 00 00.

PART 2 PRODUCTS

2.1 FUSES

- A. Fuses shall be of the type and amperage indicated on the drawings. The voltage rating shall be appropriate for the application indicated. The fuse types indicated on the drawings imply a

OVERCURRENT PROTECTIVE DEVICES

certain set of fuse characteristics. No substitutions of fuse types will be allowed without written approval from the Engineer.

- B. All fuses used on the project shall be provided with "blown fuse" indicators.
- C. Where fuses in motor circuits are indicated but not sized, provide Manufacturer's recommended fuse size based on actual motor installed.
- D. Provide in-line or integrally-mounted fuse clips on control power or low-voltage transformer.
- E. Provide fuse puller or pullers for fuse sizes used.
- F. Provide a minimum of two (2) spare fuses for each fuse used.
- G. Acceptable Manufacturers:
 - 1. BUSSMAN
 - 2. GOULD SHAWMUT
 - 3. LITTLEFUZE
 - 4. RELIANCE

2.2 MOLDED CASE CIRCUIT BREAKERS

- A. Molded case circuit breakers shall be quick-make and quick-break type. They shall have wiping type contacts. Each shall be provided with arc chutes and individual trip mechanisms on each pole consisting of both thermal and magnetic trip elements. Two and three pole breakers shall be common trip. Circuit breakers utilizing handle ties shall not be allowed. All breakers shall be calibrated for operation in an ambient temperature of 40°C. Molded case circuit breakers shall be trip-free. Each breaker shall have trip indication independent of the ON or OFF positions.
- B. Breakers shall have lugs UL listed for both copper and aluminum.
- C. Circuit breakers shall be capable of accepting the cable shown on the drawings. Circuit breakers not capable of accepting the cable shown shall not be acceptable.
- D. Breakers shall have the interrupting rating and trip rating indicated on the drawings.
- E. Circuit breakers 250-ampere frame and below shall be Cutler-Hammer type Westinghouse Series C with thermal-magnetic trip units and inverse time-current characteristics. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- F. Circuit breakers 400-ampere through 1200-ampere frame shall be Cutler-Hammer type Westinghouse Series C with microprocessor based RMS sensing trip units. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- G. Replacement circuit breakers shall be Siemens BL series or approved equal.

2.3 USES

- A. Breakers covered under this specification may be installed in switchboards, panelboards, motor control centers, combination motor starters, and individual enclosures.

2.4 ENCLOSURES

- A. Unless otherwise shown on the drawings, enclosures for protective devices shall be NEMA rated for the environment in which they are installed. In general, devices installed indoors shall be in NEMA 12 enclosures, devices installed outdoors shall be in NEMA 4x enclosures.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Fuses and circuit breakers shall be installed in their respective enclosures and locations in such a manner as to insure tight connections so as to preclude arcing and overheating.
- B. Install fuses in fuse holders immediately prior to energization of the circuit in which the fuses are installed. Fuses shall not be installed and shipped with equipment.
- C. Labels
 - 1. Place fuse identification labels, showing fuse size and type installed, inside the cover of each switch or other location where fuses are installed.

END OF SECTION

SECTION 26 32 13 POWER GENERATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material and installation requirements for:
 - 1. Standby power generator
 - 2. Automatic transfer switch
 - 3. Day tank system

1.2 DESCRIPTION OF WORK

- A. This section covers installing a standby power generator set including diesel engine-driven generator with controls, output circuit breaker, automatic transfer switch, day tank system and controls, connections and appurtenances for integration with existing primary diesel tank, and all required auxiliary systems.

1.3 RELATED SECTIONS

- A. Related Sections include but are not necessarily limited to:
 - 1. Section 26 05 19 – Wire and Cable
 - 2. Section 26 05 26 – Grounding
 - 3. Section 26 05 33 – Raceways
 - 4. Section 26 28 00 – Overcurrent Protective Devices
 - 5. Section 26 00 00 – Electrical General Provisions
 - 6. Section 26 60 02 – Basic Materials and Methods

1.4 STANDARDS AND REFERENCES

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. Products and installation shall comply with applicable sections of the following standards:
 - 1. American National Standards Institute (ANSI):
 - a) C37.13, Low Voltage AC Power Circuit Breakers Used In Enclosures
 - b) C37.50, Test Procedures For Low Voltage AC Power Circuit Breakers Used in Enclosures
 - c) C37.90a, IEEE Guide for Surge Withstand Capability (SWC) Test
 - 2. National Electrical Manufacturers Association (NEMA):
 - a) AB 1, Molded Case Circuit Breakers
 - b) ICS 2, Standards for Industrial Control Devices, Controllers and Assemblies
 - c) ICS 4, Terminal Blocks for Industrial Use
 - d) ICS 6, Enclosures for Industrial Controls and Systems
 - e) MG 1, Motor and Generators
 - f) MG 2, Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
 - 3. National Fire Protection Association (NFPA):

- a) 70, National Electric Code (NEC)
- b) 37, Installation and Use of Stationary Combustion Engines and Gas Turbines
- c) 110, Emergency and Standby Power Systems
- 4. Underwriters Laboratories, Inc. (UL):
 - a) 489, Molded Case Circuit Breakers and Circuit Breakers Enclosures
 - b) 1004B, Standard for Electric Motors (and Generators)
 - c) 1008, Standard for Transfer Switch Equipment
 - d) 2200, Standard for Stationary Engine Generator Assemblies
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electrical Code, NEC.
- D. All electrical equipment and materials, and the design, construction, installation, and application thereof, shall comply with all applicable provisions of the National Electrical Code (NEC), the Occupational Safety and Health Act (OSHA), and any applicable Federal, State, and local ordinances, rules, and regulations.
- E. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which that are used and shall bear their label.

1.5 SUBMITTALS

- A. Shop Drawings
 - 1. See Section 26 00 00.
- B. In accordance with the "submittals" requirements in Section 26 00 00, the following project data shall be submitted by the Owner prior to placement of a purchase order for the equipment:
 - 1. Submitted materials shall be bound in a 3-hole binder with section tabs and an index.
 - 2. Wiring diagrams with details specific to this project showing all interface points and terminal numbers clearly identified.
 - 3. Specific information on the components provided for this project and all optional equipment provided.
 - 4. Provide specific and detailed wiring and connection diagram showing all details of field wiring connections and component connections for transfer switch, fuel monitor, louver controls, battery charger alarm contacts and customer contacts as specified in control panel, etc. Drawings shall show all terminal numbering and physical locations of terminals.
 - 5. Operations and programming/adjustments manual.
 - 6. Provide specific detailed information on the control features, their ranges, recommended set points etc.
 - 7. Detailed plan and elevation drawings of the generator set indicating overall dimensions and the specific location of all components, including the engine exhaust system, fuel tank, and enclosure.
 - 8. Detailed drawings indicating installation requirements and the specific location of vibration isolators and seismic snubbers.
 - 9. Detailed plan of the face of the control panel indicating overall dimensions and the specific location of all components.
 - 10. Detailed specifications and standard operating characteristics of the engine, the generator, and all components.
 - 11. Certification by the manufacturer and documentation that appropriate linear and torsional vibration analyses have been performed and that engine and generator are compatible units.

12. Certification by the manufacturer and documentation that the generator set will meet or exceed the general requirements as specified in Article 1.02 of this section and the required performance as specified in Article 1.04 of this section.
 13. Generator control schematic.
 14. Engine control schematic.
 15. Certification by the engine manufacturer of review and approval of the proposed engine application.
 16. Certification by the generator manufacturer of review and approval of the proposed generator application.
 17. Detailed specifications and drawings of the engine exhaust system.
 18. Detailed specifications and drawings of the enclosure.
 19. Detailed drawing showing generator plan and elevation views as proposed to be installed in the building, including all required electrical and mechanical code clearances.
- C. After break-in and testing of the generator set, the following project data shall be submitted by the Contractor:
1. Certified results of testing of the engine by the engine manufacturer.
 2. Certified results of testing of the generator by the generator manufacturer.
 3. Certified results of break-in and testing of the generator set by the manufacturer of the assembly.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 26 00 00.
- B. The standby generator set(s) shall be stored at the factory until they must be shipped to the job site to prevent building construction delay.
- C. The standby generator set(s) shall be crated and covered to protect it from damage during shipment and subsequent storage at the job site.

1.7 WARRANTY

- A. The Contractor shall guarantee all connections, equipment, labor, and material for a complete working system to be free of defects in design, materials, and workmanship for a period of one (1) year following the date of acceptance, by formal action of the Owner, of all work under the contract. The guarantee shall include all parts and labor and shall be secured by a written guarantee from the Contractor to the Owner. The written guarantee shall be delivered to the Owner prior to date of acceptance of all work under the Contract.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The generator set shall be manufactured by the following acceptable manufacturer:
 1. Cummins
 2. Caterpillar Tractor Company (CAT)
 3. Kohler
- B. The dimensional data for the sizing of the generator is from Cummins. The equipment of the manufacturer selected must fit within the space restrictions as shown on the plans.
- C. Description of the service capabilities normally provided by the company, including resumes of employees assigned to field service and listing of service equipment.

- D. Detailed plan and elevation drawings of the proposed generator set indicating overall dimensions and the specific location of all components, including the engine exhaust system.
- E. Detailed specifications and standard operating characteristics of the engine, the generator and all components.
- F. Additional information that may assist the Engineer in evaluation of the manufacturer and/or proposed generator set.
- G. Acceptability of the manufacturers will be determined by the Owner and the acceptable manufacturers will be designated by Addendum mailed to holders of plans and specifications at least ten (10) working days prior to the date of opening of bids.

2.2 REQUIRED PERFORMANCE

- A. Performance of the generator set shall be based on operation of the assembly with fan, battery charging alternator and all specified and required appurtenances.
- B. The generator set shall be rated for continuous standby service, however the temperature rise of the generator shall not exceed 105 degrees C above a 40 degree C ambient, when producing full rated load for a continuous period of time.
- C. Voltage Drop: The engine generator unit supplied must start the indicated load with a sustained RMS voltage drop no greater than 15% of rated phase to phase voltage during the starting period. The starting period shall be from zero up to 3 seconds. The instantaneous voltage dip may be greater than 15% but shall not cause motor starter chatter or relay drop out or exceed a level which causes undesirable motor starting. If motor starting problems are encountered the size of the generator set shall be increased as required to reduce voltage dip until the motors can be started without problems. No additional cost shall be incurred by the Owner for the increased size of the generator set. The method of measurement shall be by light beam oscilloscope.
- D. Frequency Regulation: Plus or minus 3 hertz maximum, no load to rated load.
- E. Voltage Regulation: Plus or minus 2% maximum.
- F. The generator set shall be capable of starting and operating the intended load as shown in the design drawings and as intended by the Engineer without exceeding the temperature ratings of the engine or the generator.
- G. The generator set shall be sized by the manufacturer to start and operate the load while meeting the performance requirements set forth herein. The minimum acceptable engine generator set shall be capable of producing at least at .8 power factor, continuously.
- H. Power monitoring of no less than thirty (30) days is in place, and as such, by acknowledgement of the Engineer, may modify the size of the generator via addendum during the time of bid if they shall deem it necessary. The basis of design is 200kW diesel generator.

2.3 ENGINE

- A. The engine shall be a water-cooled, in-line or V-type, four-stroke cycle, compression ignition, diesel-fueled unit. The engine shall be fully and completely capable of and equipped for driving electrical generators. The specific model of engine selected by the manufacturer of the generator set shall have an acceptable history of successful similar applications.
- B. The engine shall be equipped with an electronic governor which shall control the speed of the engine and generator. The speed shall be controlled to maintain the generator output frequency within 0.25 percent of rated frequency from no load to full load.

- C. The engine shall be equipped for operation with diesel fuel.
- D. The engine shall be equipped with a pressurized oil lubricating system which shall include threaded, spin-on type, full flow lubricating oil filters which are located for easy removal. The lubricating system shall be equipped with spring-loaded bypass valves which will allow oil circulation if the filters are plugged.
- E. The engine shall be equipped with an electric starting system which includes a lead acid battery set, an engine-driven battery charging alternator and appropriate electrical controls. The system shall be minimum 12 V. The batteries shall be mounted adjacent to the generator set on a fabricated steel housing. Batteries shall be rated minimum 225 ampere-hours.
- F. The engine shall be equipped with a unit-mounted, radiator type cooling system which shall maintain the jacket water temperature at the level required for proper operation of the engine from no load to full load. The engine shall be equipped with one or two, as required, water jacket heater(s), which shall be thermostatically controlled to maintain the coolant temperature at 120 degrees F. Operation of the heater(s) shall be stopped while the engine is turning.

2.4 GENERATOR

- A. The generator shall be brushless, revolving field-type, and shall be fully and completely capable of and equipped to be driven by a natural gas engine, and able to produce the starting and running kVA demanded by the connected load. The specific model of generator, selected by the manufacturer of the generator set, shall have an acceptable history of successful similar applications.
- B. The generator shall comply with NEMA standard MG1 Parts 16 and 22. The generator shall be insulated to Class F requirements, however, the unit shall be sized and rated so that the temperature rise of the unit will not exceed 105 degrees C over ambient temperature of 40 degrees C under continuous, full load conditions in accordance with NEMA MG1-22.40. The generator shall be fully guarded in accordance with NEMA MC1-1.25.
- C. The rotating brushless exciter shall incorporate a full wave, three phase rotating rectifier with hermetically sealed, metallic type, silicon diodes to supply main field excitation. A multiplate selenium surge protector shall be connected across the diode network to protect it against transient conditions.
- D. The generator shall be coupled directly to the engine flywheel through a flexible driving disc for positive alignment. The generator housing shall bolt directly to the engine flywheel housing and shall have a single ball bearing support for the rotor. The rotor shall be dynamically balanced up to 25 percent overspeed. The rotor shaft bearing shall be shielded type with provisions for easy servicing through grease pipes which extend to the exterior of the generator frame. The bearing shall be designed for a minimum B-10 bearing life of 40,000 hours.
- E. The generator shall be designed and manufactured to be capable of sustaining at least 300 percent of rated current for at least 10 seconds under three-phase symmetrical short circuit conditions by inherent design of the unit or by a current boost system. The generator shall be designed and manufactured to be capable of sustaining at least 50 percent increase in rated speed for an unlimited time without mechanical damage.
- F. The generator shall be equipped with a solid-state, volts-per-hertz type regulator which is compatible with both the engine and the generator. The regulator shall be capable of regulating the generator under sudden zero to full load changes.
- G. The regulator shall be housed and mounted for protection of all components against moisture and vibration. The regulator assembly shall be mounted on the generator.

2.5 CONTROL PANEL

- A. The generator shall be equipped with a control panel. The control panel shall be readily accessible, visible and shall be mounted such that the top of the control panel is no higher than 6'-0" above the finished floor when installed.
- B. The generator control panel shall include the following:
 - 1. Engine coolant temperature gauge,
 - 2. Engine lubricating oil temperature gauge,
 - 3. Engine lubricating oil pressure gauge,
 - 4. Engine running time meter,
 - 5. Battery charge ammeter,
 - 6. Engine/generator tachometer,
 - 7. Voltmeter,
 - 8. Ammeter,
 - 9. Ammeter-voltmeter phase selector switch,
 - 10. Frequency meter (45 to 65 hertz),
 - 11. Voltage adjustment rheostat (minimum plus/minus 5%),
 - 12. Emergency stop push button,
 - 13. Individual indicating lights for:
 - a) Selector switch in OFF position,
 - b) Selector switch in AUTOMATIC position,
 - c) High water temperature,
 - d) Low water temperature,
 - e) Low water level,
 - f) Low lubricating oil pressure,
 - g) Engine starting prohibited after three (3) cranking cycles,
 - h) High engine/generator speed,
 - i) Generator run failure,
 - j) High battery voltage,
 - k) Low battery voltage,
 - l) Battery charger failure,
 - m) Low fuel alarm,
 - n) Low fuel shutdown.
- C. Lamp test push-button for all indication lights listed above.
- D. Dry contacts wired to a terminal strip for:
 - 1. Each alarm light as listed above,
 - 2. Common remote "trouble" alarm,
 - 3. Common remote "fail" alarm,
 - 4. Low fuel alarm,
 - 5. Low battery voltage.
- E. Three position (automatic/off/test) selector switch which shall:
 - 1. In the automatic position - allow the engine to automatically start when contacts in the transfer switch control circuit close and stop after the control circuit contacts open.
 - 2. In the off position - prohibit starting of the engine
 - 3. In the test position - cause the engine to start and remain in operation until the selector switch is moved to either of the other positions.

4. Provide separate dry contact for each switch position.
- F. An automatic starting system that shall cause and control operation of the engine starter motor until the engine has started. The starting system shall include manually adjustable timing circuits for control of the time of operation of the engine starter motor and the time from stopping of operation of the starter motor (after the engine has failed to start) to re-initiation of operation of the starter motor. The starting system shall enable the number of starting cycles to be manually selected and shall prohibit operation of the starter motor if the engine fails to start after three (3) starting cycles. The starting system circuitry shall include dry contacts for remote indication of generator set running and not running conditions.
- G. Engine emergency shutdown controls that shall include sensors and control circuits which shall stop operation of the engine when the engine coolant temperature rises to a preselected value, when the engine coolant drops below a preselected level, the engine lubricating oil pressure drops to a preselected value, when the fuel level reaches the critical low level, and the engine speed rises to a preselected value. The controls shall prohibit subsequent restarting of the engine until a reset switch is manually engaged.

2.6 MAIN CIRCUIT BREAKER

- A. A main line, molded case, 3-pole circuit breaker, 208 volts, shall be installed as a load circuit interrupting and protection device. It shall operate both manually as an isolation switch and automatically during overload and short circuit conditions.
- B. The trip unit for each pole shall have elements providing inverse time delay during overload and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electric Manufacturer's Association, and National Electric Code.
- C. The circuit breaker shall be mounted in a NEMA 1 enclosure adjacent to the generator control panel.
- D. The main circuit breaker pickup setting shall be adjusted to protect the feeder conductors as shown in the design drawings.

2.7 SUPPORT FRAME

- A. The engine and generator shall be mounted on and supported by a welded support frame fabricated of structural steel members. The support frame shall specifically be designed by the manufacturer of the generator set to:
 1. Resist bending forces and loads imposed by the engine and generator during transportation and during operation.
 2. Limit torsional and bending movement caused by torque reactions
 3. Prevent resonant vibration
 4. Resist the bending and seismic loads per the UBC 2336 C.
- B. The support frame shall be mounted on and supported by spring-type vibration isolators and shall be restrained by all-directional seismic snubbers as required by earthquake zone 3 conditions. The isolators and snubbers shall be selected by the manufacturer of the generator set. The manufacturer shall design the support frame for incorporation of and attachment to the isolators and snubbers and shall define all requirements for mounting of the isolators and snubbers on to the supporting surface.

2.8 FUEL TANK SYSTEM

- A. The Contractor shall be responsible to coordinate the fuel system requirements with the local building and fire codes for installation. The Contractor shall verify all necessary space, containment, alarming and monitoring requirements are met. The Contractor shall provide all

necessary equipment, raceway, wiring etc. to meet the requirements of the local codes, Fire Marshall, NEC, and as recommended by the generator manufacture. Specific requirements are as follows:

- B. The fuel tank system shall be double walled, have . The system shall include the following:
 - 1. Dry contacts wired to terminals in the control panel for a low level fuel alarm,
 - 2. Critical low fuel alarm which shall also cause the generator engine to shutdown,
 - 3. Manual fuel fill cap,
 - 4. Level gage mounted in generator room,
 - 5. Fuel strainer,
 - 6. Plastic sight glass,
 - 7. Interstitial monitoring, leak detection, and alarming per local requirements.
- C. The low level fuel alarm shall be set to trip when the fuel tank quantity reaches 25% of capacity.

2.9 DAY TANK SYSTEM

- A. The day tank system shall have 50 gallon capacity with integral gear pump and controls. The system shall include the following:
 - 1. Dry contacts for low level fuel alarm,
 - 2. Dry contacts for critical low fuel alarm and generator engine shutdown,
 - 3. High level fuel alarm,
 - 4. Manual fuel fill cap,
 - 5. Fuel strainer,
 - 6. Plastic sight glass,
 - 7. Cover,
 - 8. Fuel intake normally closed solenoid valves,
 - 9. Circuit breaker and motor starter.
- B. The day tank system shall be factory packaged Tramont TRS-50 or equal.

2.10 DAY TANK LEVEL MONITOR

- A. Provide a fuel tank monitoring, indicating and alarming system for tank gauging and non-discriminating leak detection. The monitor shall operate on a 120VAC power and shall be microprocessor based, have 4 programmable relay outputs, selectable level indication in inches or gallons, programmable overfill and low level alarms.
- B. The console display shall display level and have status indicators for alarms and leak detection.
- C. Provide level sensor and leak detection sensors and all cabling between sensors and electronic monitor. System shall be PNEUMERCATOR E700-1 as Manufactured by the PNEUMERCATOR Company, Farmingdale, NY or Engineer approved equal.

2.11 ENGINE COOLING

- A. Engine cooling shall be accomplished with a skid mounted radiator; provide sheet metal cowling between the generator and exhaust louver. Engine shall be filled with manufacturers recommended antifreeze.
- B. Coordinate existing building penetrations and ductwork with inlet air requirements of the generator.

2.12 EXHAUST SYSTEM

- A. The exhaust system shall include a flexible stainless steel bellows exhaust pipe connection to the engine exhaust manifold, exhaust piping, silencer, exhaust pipe flashing, collar, and rain cap and support system.
- B. The Contractor shall be responsible to coordinate the exhaust system requirements with the local building and fire codes for installation. The Contractor shall verify that all necessary space requirements are met. The Contractor shall provide all necessary insulation, heat shields, etc. Exhaust system components shall be of size(s) as recommended by the generator manufacturer. Current building codes, standards, and general practices shall be followed during exhaust ventilation installation. Specific requirements for both locations are as follows:
 - 1. Silencer shall be a critically rated unit in accordance with engine manufacturers recommendations.
 - 2. Flexible bellows exhaust pipe shall be seamless stainless steel with a minimum length of 12 inches of bellows piping.
 - 3. Exhaust pipe shall be Schedule 40 steel and shall have welded or flanged end connections except connections at engine exhaust manifold, and silencer shall be flanged or NPT. All elbows shall be long radius. Size shall be same as silencer end connections. The silencer and exhaust pipe shall be supported from the ceiling joist system with 3/8 - inch threaded rod, adjustable steel clevis (GRINNEL Figure 299) and 1 - 1/2 inch by 1/8 inch steel strap.
- C. Coordinate existing building penetrations and ductwork with exhaust air requirements of the generator.
- D. Final installation shall be painted, grouted, and modified to match existing surrounding architecture and building characteristics as approved by the Owner.

2.13 AUTOMATIC TRANSFER SWITCH

- A. General
 - 1. One (1) automatic system load transfer switch shall be supplied as an integral component of the generator set. The transfer switch for this project was designed around the features and space requirements of Cummins. The transfer switch shall be manufactured by the following manufacturer:
 - a) Cummins
 - b) Caterpillar Tractor Company (CAT)
 - c) Kohler
 - 2. Transfer switch shall be well documented with clear wiring diagrams, and submittals shall include wiring diagram showing clearly all connections for field wiring with terminal numbering.
 - 3. The transfer switch shall be equipped with three (3) poles for normal and emergency service of 208 volts, 60 hertz, 3 phase. The transfer switches shall be rated 800 amperes.
 - 4. The transfer switch shall be mechanically and electrically held and rated to 600 volts for all classes of load and continuous inductive duty.
 - 5. The transfer switch shall conform to UL 1008 Revision 4 provisions for Withstand Current Ratings and Closing Ratings.
 - 6. The switch shall be capable of enduring 6000 cycles of complete opening and closing at rated current and voltage at a rate of 6 cycles per minute without failure.
 - 7. The switch shall be double throw, inherently interlocked mechanically and electrically to prevent supplying the load from both sources simultaneously. The operating current shall be obtained from the source to which the load is to be transferred. The

transfer mechanism shall be of the double break design with solid silver cadmium surface contacts and individual heat resistant arc chambers.

8. Single break contacts will also be acceptable if arc barriers and magnetic blow out coils are used. The contacts shall be capable of carrying 20 times the continuous rating for interrupting current.
 9. All contacts, coils, etc. shall be readily accessible for replacement from front of panel without major disassembly of associated parts.
 10. The transfer switch shall have UL 1008 label and listing.
 11. The transfer switch shall be rated NEMA 1, or approved equal, for the environment installed.
 12. The transfer switch shall be mounted as indicated on the drawings. The manufacturer of the transfer switch shall ship the automatic transfer switch, with generators, to the Owner's respective facilities for storage.
- B. Controls hardware
1. All relays shall be provided with indicating LED lights for energized position indication.
 2. Time delay relays shall be provided with timing and timed out LED indicators.
 3. Panel front Indication lights shall be push-to-test or the switch shall have a push to test feature for indication lights, unless lights are LED.
 4. All fuses shall be provided with "blown fuse" indicators.
 5. All wiring shall be numbered at each end with basic wiring numbering scheme.
 6. All terminals shall be clearly labeled.
 7. All internal equipment shall be labeled.
 8. All external devices shall be clearly labeled.
 9. Provide nameplate on transfer switch as shown on the drawings.
 10. If available as an option, provide a transfer switch with solid state logic equal to CONTROL CUTLER HAMMER IQ TRANSFER or ONAN -POWER SENTRY CONTROL.
- C. Controls Features
1. The transfer switch shall include the following accessories:
 - a) Undervoltage Sensor: Adjustable solid state low voltage sensing relays (pick up at 85 to 98 percent of normal voltage - set at 98%; drop out at 75 to 100 percent - set at 90% of pickup setting). Provide for each phase.
 - b) Time Delay Start and Stop on Drop Out: Solid state adjustable time delay on start (0 to 15 seconds). Set start delay for 15 seconds. Timer will send start signal to generator set CP (genset), where louver timer will allow 15 second delay for louvers to open prior to starting genset.
 - c) Time Delay Stop: Solid state adjustable time delay (0 to 10 minutes) to allow generator to cool down after normal power is restored and retransfer occurs. Set at 5 minutes.
 - d) Time Delay Transfer & Retransfer: Solid state, time delay, relay adjustable; 2 to 120 seconds for transfer to emergency and 0 to 30 minutes for retransfer to normal. Set at 5 minutes for retransfer to normal. Set at 3 seconds for transfer to emergency.
 - e) With or Without Load Selector Switch: Switch to select exercise with or without load.
 - f) Normal-Test Switch: Switch such that in the "Normal" mode the transfer switch will operate automatically and in the "Test" mode the generator will start for test purposes. This switch shall work in conjunction with the "With" or "Without" load

- switch. An extra contact block shall be provided on the normal-test switch for wiring to the Programmable Controller, if one is required.
- g) Exercise Clock: An exerciser clock shall be provided which shall be programmable to exercise the generator set. The exerciser shall be adjustable from 15 to 60 minutes once each week. The exercise shall be either with or without load. If power fails during the exercise cycle, the load shall automatically pick up.
 - h) Programmed Transition: The load transfer control shall be capable of remaining in the neutral position for an adjustable time of .5 to 60 seconds, when transferring from one line power source to the other, to allow residual voltages to decay before application of the source. Set to 3 seconds for less than 50 hp loads.
- 2. Provide the following dry contacts each with terminals for field connection, 2 Amp rated at 120VAC.
 - a) Two, separate, normally open dry auxiliary contacts; one indicating transfer switch is in NORMAL position and one indicating switch is in EMERGENCY position,
 - b) Four, separate, normally open, dry contacts; two indicating "commercial power / normal power" available, and two indicating generator / emergency power available.
 - c) Normally open, dry contact indicating generator called to run.
 - 3. Position lights for normal and emergency position indication.
 - 4. Two indication lights, one for emergency power available and one for normal power available.
 - 5. Note: provide push to test type lights or push to test feature for all indication lights.

2.14 GENERATOR BATTERY CHARGER

- A. Provide fully automatic constant voltage, current limiting battery charger sized for the generator starting batteries.
- B. Charger shall have the following features: Protection fuses, DC ammeter, Temperature compensating voltage regulator, and LED alarm lamps indicating AC power fail, Low battery voltage, High battery voltage. Form C contacts for alarm indication, high and low battery alarm adjust pots, float voltage adjustment pot.
- C. Charger shall monitor the battery voltage and control the SCR to deliver the optimum current level to the battery. The battery shall be permanently connected and when the battery approaches full charge preset voltage, the charging current shall automatically taper to zero amperes or to the steady state load on the battery. The battery charger shall be mounted in the generator enclosure.

2.15 GENERATOR ENCLOSURE

- A. No enclosure is necessary for this installation of one (1) below-grade standby generator.

2.16 RADIATOR & DUCTING

- A. The radiator assembly, including all fans, cowling, and ductwork shall be field verified and installed per the requirements of the existing building exhaust and intake air.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. The generator set shall be installed by the Contractor or, at the option of the Contractor, by the manufacturer of the generator set in accordance with the installation drawings and instructions prepared by the manufacturer. Installation shall be performed by workers who are skilled and experienced in the installation of generator sets and electrical systems.
- B. It is the Contractor's responsibility to coordinate installation via existing openings for the genset to fit into the building. It is also the Contractor's responsibility to provide necessary optional equipment to provide clearance requirements for the entire genset installation and to verify all mechanical and electrical clearance requirements are met.
- C. Install fuel system, ventilation system, and exhaust system in accordance to the requirements of the drawings, specifications, manufacturer, local codes, and the NEC. Any additional requirements or equipment necessary for a complete installation shall be provided by the Contractor at no additional expense to the Owner.
- D. Control Panel & Circuit breaker Mounting
 - 1. The control panel shall be installed so that there is a minimum of 3 feet clear space in front of the panel, and the top of the panel is no more than 6 feet above the finished floor.
 - 2. Install the control panel for the generator on the generator at a height no more than 6 feet above the finished floor to the top of the control panel. If the control panel mounted on the generator is higher than 6 feet, then the Contractor shall mount the control panel on a separate stand or on the wall. The Contractor shall provide all necessary raceway, wiring, and mounting equipment at no additional cost to the Owner.
 - 3. The main circuit breaker shall be installed so that there is a minimum of 3½ feet clear space in front of the breaker. The Contractor shall coordinate the breaker installation with the generator manufacturer to meet this requirement.
 - 4. The installation and space requirements stated above shall be verified prior to construction. Any discrepancies shall be stated in the submittals.
 - 5. If the physical size of the structure in which the generator is being installed will not allow for these space requirements; The Contractor shall bring this to the immediate attention of the Engineer.

3.2 IDENTIFICATION

- A. Refer to Section 26 60 02 for applicable painting, nameplates, and labeling requirements.

3.3 INSPECTION AND VERIFICATION OF INSTALLATION

- A. After completion of the installation of the generator set, the manufacturer shall inspect the installation and verify that all components and wiring are correctly installed. The manufacturer shall determine the exact scope and nature of work required to correct any deficiencies and errors in the work and shall supervise the performance of such work.
 - 1. All components of the generator set shall be calibrated by the manufacturer after completion of installation. Each component shall be adjusted to be within the manufacturer's required range and for the specific application. Components that cannot be properly calibrated or that are found to exceed the manufacturer's specified range or accuracy shall be removed and replaced.
 - 2. After installation of the generator set is completed, the generator set shall be placed into operation by the manufacturer. The manufacturer shall revise, modify, adjust and

reprogram the various components as required during and following start-up to provide proper operation.

3.4 ON-SITE OPERATION AND LOAD TEST

- A. After the Manufacturer has inspected and verified the generator installation, the generator set shall be tested by the manufacturer. All components of the generator set shall be fully and completely operated and tested under simulated power failure conditions and under a full load for a period of at least two continuous hours. Load banks shall be provided by the manufacturer of the generator set as required to supplement the connected facility load and to provide full load conditions. Operating temperature, load amperes and voltage shall be recorded every 1/2 hour.
- B. Fuel shall be supplied by the Contractor for the day tank and as needed for the existing tank storage to supply the loads shown below plus 10% as to not use any existing fuel from the Owner's fuel tank system.
- C. The on-site operation testing shall take place in the presence of the Engineer. The Contractor shall inform the Engineer a minimum of 7 days prior to the testing taking place. All controls and functions of the generator shall be operable and all auxiliary equipment shall be connected and all field wiring complete before the testing is to take place.
- D. Test Load: Testing shall be performed at 0.8 PF with loads as specified below. Where the specific set has been tested at 0.8 PF as specified herein below, field-testing can be performed at 1.0 PF. The supplier of the engine-generator set shall provide a load bank of sufficient capacity to complement the available building load for testing. The field test shall include running the emergency power system under loads as specified below:
 - 1. 30 minutes at 25% of rated load (field load bank),
 - 2. 15 minutes at 50% of rated load (field load bank),
 - 3. 15 minutes at 75% of rated load (field load bank),
 - 4. 30 minutes at 100% of rated load (field load bank).
 - 5. Miscellaneous building loads may be used to supplement load bank.
- E. Test Readings: The voltage current and frequency readings shall be recorded at 15-minute intervals throughout the test. Each automatic transfer switch shall automatically operate a minimum of four times during the test. There shall be a 15 minute unloaded run at the conclusion of the test to allow engine to cool before shutdown. The Contractor shall make all necessary hook-ups to facilitate field-test and shall furnish all fuel necessary for field-testing. Refer to Section 26 01 26, "Electrical Testing", for additional testing requirements.
- F. At the conclusion of the load testing, the generator fuel day tank shall be filled by Contractor.

3.5 OPERATION AND MAINTENANCE TRAINING

- A. The manufacturer of the generator set shall conduct specifically organized training sessions covering operation and maintenance of the unit for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in maintenance and operation of all components of the unit. Training shall include, but not be limited to, the following:
 - 1. Preventative maintenance procedures,
 - 2. Trouble-shooting,
 - 3. Calibration,
 - 4. Testing,

5. Replacement of components,
 6. Automatic mode operation,
 7. Manual mode operation,
 8. Fuel and monitoring system.
- B. At least one (1) training session, at least two (2) hours in duration, shall be conducted at the site after start-up of the system. The manufacturer shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Owner at least two (2) weeks prior to the time of the training.

3.6 OPERATION AND MAINTENANCE DATA

- A. See Section 26 00 00.
- B. The supplier of the engine-generator set shall provide Operation and Maintenance Manuals which shall include, but not be limited to, the following:
1. OEM overhaul manual for the engine,
 2. Preventive maintenance procedures,
 3. Trouble-shooting Calibration Testing,
 4. Replacement of components,
 5. Automatic mode operation,
 6. Programming,
 7. Manual mode operation,
 8. System schematics,
 9. As-built wiring diagrams of overall system,
 10. Catalog data and complete parts list for all equipment and control devices,
 11. Listing of recommended spare parts,
 12. Listing of recommended maintenance tools and equipment.
- C. The supplier of the engine-generator set shall review and revise the generic O&M manual provided by the manufacturer so that only pertinent information relevant to this particular project is included. Non-relevant information, such as part lists, option lists, wiring diagrams, etc., should be crossed out if it can not be removed from the manuals.

3.7 MAINTENANCE SUPPORT PROGRAM

- A. The manufacturer of the generator set shall provide a maintenance support program covering all routine service maintenance and repair of the engine generator set for a period of one year from the date of acceptance. The cost of the maintenance support program shall be shown individually, but must be included in the engine generator total bid price.
- B. Under the maintenance support program contract, the generator set manufacturer shall be solely and completely responsible for correction of all deficiencies and defects and shall make any and all repairs, replacements, modifications and adjustments as malfunctions or failure occur.
- C. The contract will cover the furnishing of all material, labor, testing equipment, load banks, tools, and transportation necessary to perform the preventative maintenance work herein described.
- D. The vendor shall stock common replacement parts (i.e. filter, etc.) for service or repair work for engines, generators, control panels, switchgear, and automatic transfer switches.

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- E. The vendor shall be equipped with service technicians, tools, and transportation "on-call"; 24 hours a day, 365 days a year, to provide emergency service.
- F. It is the responsibility of the vendor to notify the Owner of the scheduled maintenance interval at least two (2) weeks prior to the actual performance of their contractual obligations. The Owner reserves the right to witness the evaluation, testing, and maintenance of the equipment at its discretion. It is the responsibility of the vendor to coordinate testing and preventative maintenance on the existing operational system.
- G. Three (3) copies of the evaluation, testing, and preventative maintenance work shall be submitted no later than (14) days following the completion of the service interval. All site documentation shall be typed.
- H. The reports shall contain but shall not be limited to:
 - 1. Summary of findings and corrective work.
 - 2. Recommendations of repairs, overhauls, and other maintenance work that should be scheduled prior to the next scheduled service interval.
 - 3. Complete documentation of all test and inspection results on each significant item (i.e. engine, generator, transfer switch, and alarm functions).
- I. As a minimum, the maintenance program shall include work as shown on the attached maintenance schedule. Any deletions from the schedule must be noted in writing as a part of the bid package.

END OF SECTION

ATTACHMENT: ENGINE-GENERATOR SET MAINTENANCE SCHEDULE.

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ENGINE-GENERATOR SET MAINTENANCE SCHEDULE

			<u>6 mos.</u>	<u>1 yr.</u>
Air Intake	Check	- for leaks	x	x
		- air cleaner restriction	x	x
		- piping and connections	x	x
	Clean or change	- crankcase breather	x	x
		- air cleaner element	x	x
Fuel	Check	- for leaks	x	x
		- fuel level/take sample	x	x
		- governor linkage	x	x
		- fuel lines and connections	x	x
		- sediment from tanks & filter	x	x
	Drain	- float tank breather		x
	Clean	- float tank breather		x
Exhaust	Check	- for leaks	x	x
		- for exhaust restriction	x	x
		- turbocharger bearing clearances		x
		- condensate trap	x	x
	Torque	- exhaust manifold & turbocharger cap-screws		x
	Clean	- turbocharger comp. wheel and diffuser		x
Electrical	Check	- battery charging system	x	x
		- battery electrolyte level and specific gravity/check battery voltage	x	x
		- safety controls and alarms	x	x
Engine Related	Check	- for unusual vibration	x	x
		- tighten mounting hardware		x
		- fan belt wear/cracking		
	Clean	- engine		x
	Grease	- fan pillow block bearings		x
	Test	- oil analysis or metals and coolant for DCA/pH		x
	Change	- oil and filter and fuel filter		x
Main Generator	Check	- air inlet and outlet for restriction	x	x
		- windings & elect. connections		x
		- operation of generator heater strips		x
		- bearing		x
	Grease	- measure and record generator winding resistance		x
		- generator	x	x

SECTION 26 60 02
BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Basic requirements for electrical systems, including but not limited to:
 - 1. Manner of running conduits,
 - 2. Hangers and supports,
 - 3. Attachment,
 - 4. Openings, cutting, and patching,
 - 5. Excavation, trenching, and backfilling,
 - 6. Penetration flashing and seals,
 - 7. Cleaning and painting of electrical work,
 - 8. Electrical system identification,
 - 9. Warning signs and operational tags,
 - 10. Prohibited markings,
 - 11. Equipment housekeeping pads and anchor bolts,
 - 12. Wiring device and equipment mounting heights.

1.2 DESCRIPTION OF WORK

- A. This section covers the basic materials and methods of electrical construction as shown, scheduled, indicated, and specified.

1.3 DEFINITIONS

- A. For the purposes of providing materials and installing electrical work, the following definitions shall be used:
 - 1. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
 - 2. Architecturally Finished Area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
 - 3. Non-architecturally Finished Area: Pump, chemical, mechanical, electrical rooms and other similar process-type rooms.
 - 4. Highly Corrosive and Corrosive Areas: Rooms or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
 - 5. Shop Fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 RELATED SECTIONS

- A. Related Sections include but are not necessarily limited to:
 - 1. Section 26 05 33 – Raceways
 - 2. Section 26 00 00 – Electrical General Provisions

1.5 STANDARDS AND REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. C2, National Electrical Safety Code
 - 2. Z535.1, Safety Color Code
 - 3. Z535.2, Environmental and Facility Safety Signs
 - 4. Z535.3, Criteria for Safety Symbols
 - 5. Z535.4, Product Safety Signs and Labels.
- B. National Fire Protection Association (NFPA):
 - 1. 70, National Electrical Code (NEC)
 - 2. 79, Electrical Standard for Industrial Machinery
- C. Occupational, Health and Safety Administration (OSHA):
 - 1. 1910.145, Specification for Accident Prevention Signs and Tags
- D. All materials and equipment specified herein shall within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.

1.6 SUBMITTALS

- A. Shop Drawings
 - 1. See Section 26 00 00.
 - 2. The Contractor shall submit to the Engineer, for review, a list of proposed manufacturers and product data on hangers, supports, and methods of attachment to the structure.
 - 3. Excavation and trenching plan, designed and sealed by a registered professional engineer.
 - 4. Cut sheets and samples of Electrical System Identification products.
 - 5. Refer to Division 1 for additional submittal requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Section 26 00 00.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Refer to specific Division 26 sections and specific material paragraphs below.
- B. Provide all components of a similar type by one manufacturer.

2.2 ELECTRICAL EQUIPMENT SUPPORTS

- A. Approved manufacturers:
 - 1. Unistrut Building Systems
 - 2. B-Line
 - 3. Globe Strut
- B. Material requirements:
 - 1. Galvanized steel: ASTM A123 or ASTM A153
 - 2. Stainless steel: AISI Type 316
 - 3. PVC coat galvanized steel: ASTM A123 or ASTM A153 and 20 mil PVC coating

4. Fiberglass: Fire-retardant polyester or vinylester resin, ASTM E84, UL 94

2.3 NAMEPLATES

- A. For labeling equipment enclosures and equipment that is visible with the enclosure door closed:
 1. Approved manufacturers catalog numbers:
 - a) W. H. Brady Co., #B-1.
 - b) Seton, "Setonply".
 2. Materials: Phenolic, 2-ply engraved.
 3. Size:
 - a) Surface: As required for the text.
 - b) Thickness: 1/16 IN.
 4. Fabrication:
 - a) Two layer laminated.
 - b) Legend engraved through top lamination into bottom lamination.
 - c) Drilled holes in each corner, for screw mounting.
 5. Colors: Black top surface, white core, unless otherwise indicated.
 6. Fasteners: Self-tapping stainless steel screws.
- B. For labeling components inside equipment enclosures:
 1. Approved manufacturers catalog numbers:
 - a) W. H. Brady Co., "Industrial Strength Tape" #42018
 - b) Seton, "Component and General Identification Labels" #45553
 - c) Panduit, "Standard Labeling Tape" LS4-33
 2. Materials: vinyl tape or vinyl cloth with printable topcoat.
 3. Colors: White background, black printing.

2.4 WIRE MARKERS

- A. For control panels, electrical gear, pull and junction boxes:
 1. Material: vinyl or polyester tape.
 2. Approved manufacturer's catalog numbers:
 - a) W. H. Brady Co., Indoor/Outdoor Vinyl Tape, B-580
 - b) Seton, "Self-Laminating Wire Marker Labels" M7340
 - c) Panduit, LS4M "Industrial Labeling Tape"
 3. Material: Heat shrinkable polyolefin.
 4. Approved manufacturer's catalog numbers:
 - a) Seton, Welded Wire Marking Sleeves
 5. Colors: White background, black printing.
- B. For manholes, handholes and exterior pad mounted electrical gear:
 1. Material: Aluminum or stainless steel.
 2. Approved manufacturer's catalog numbers:
 - a) Panduit META-X or META54-X
 3. Legend: Embossed.
 4. Fasteners: Nylon, urethane or polypropylene strap.

2.5 SAFETY SIGNS

- A. Approved manufacturers catalog numbers:

1. W. H. Brady Co., #B-302 or #B-120
 2. Seton, Pressure Sensitive Vinyl or Tedlar Coated Plastic
 3. Panduit, GMM Polyester Film (Type PPS) or GMPE1 Rigid Polyethylene (Type PRS)
- B. Materials, size and fabrication:
1. For indoor use: Polyester or vinyl, surface area as required by the text, 4 mil minimum thickness, self-adhesive.
 2. For outdoor use and on entrances to electrical rooms or stations: Fiberglass or coated plastic, surface area as required by the text, minimum area 7 x 10 IN, 60 mil thickness, drilled holes for screw mounting .
- C. Color in accordance with ASME (ANSI Z535.1, .2, .3 and .4) and OSHA 1910.145.
- D. Minimum letter size on indoor signs, 3/16 in.
- E. Maximize the letter size on outdoor signs to sufficiently fill the printable area on the sign.
- F. Standards: ASME/ANSI Z535.1, Z535.2, Z535.3 and Z535.4, OSHA 1910.145.

PART 3 EXECUTION

3.1 MANNER OF RUNNING CONDUITS

- A. All conduits shall be concealed in pipe chases, walls, furred spaces, topping, or above the ceilings of the building unless otherwise indicated.
- B. Conduit may be run exposed in mechanical rooms, duct and piping chases, but only where necessary. All exposed conduit shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.
- C. All conduit and surface raceways shall be adequately and properly supported from the building structure by means recommended by the manufacturer, or by the use of hanger rods or clamps as herein specified.
- D. Where limited space is available above the ceilings and below concrete beams or other deep projections, conduit shall be sleeved through the projection where it crosses rather than hung below them in a manner to provide maximum above-floor clearance.
- E. No sleeves shall be installed through any concrete beam or other deep projection without written approval of the Engineer.
- F. Run conduit to avoid proximity to heat producing equipment, piping and flues, keeping a minimum of 8" clear.
- G. Whenever possible, install horizontal conduit runs above water piping.
- H. Install all conduit to allow for adequate maintenance and access clearances to all equipment and so as to not inhibit removal of ceiling tiles.
- I. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Construction Inspector and resolve the conflict prior to erection of any work in the area involved.
- J. Conduit and raceway connections, rough-in, and stub-up locations for equipment shall be coordinated by the Contractor to provide raceways in locations indicated on approved manufacturers equipment shop drawings. Connection, rough-in and stub-up locations shown on the Drawings are diagrammatic for general reference only.

3.2 HANGERS AND SUPPORTS

- A. All supports required for the proper installation of equipment, cable tray, wire-way, and conduit shall be provided as hereinafter specified unless otherwise indicated on the Drawings.
- B. All conduits throughout the building shall be supported as specified in Section 26 05 33, unless specifically noted differently on the Drawings or in the Specifications, but in every case shall be adequate to support the raceway being suspended. The supports shall be from the structure to line of grade, with proper provision for expansion, contraction, vibration elimination, and anchorage.
- C. Vertical conduits shall be supported from floor lines with riser clamps sized to fit the conduit and to adequately support their weight, with allowance for expansion and contraction. At the bases of conduit, where required for proper support, provide anchor base fittings or other approved supports.
- D. Conduit shall not be supported from ductwork, piping, or equipment.
- E. All electrical conduits and surface raceways exposed to view shall be run parallel to the adjacent building construction. All hangers shall be fastened to the building structure in a manner as hereinafter specified under "Attachment".
- F. Single conduits running horizontally shall be supported by Caddy, Minerallac, or approved equal; adjustable conduit hangers from adequately sized rods (minimum 1/8") from the building structure. Refer to Section 26 05 33 for additional requirements.
- G. Multiple conduits running horizontally shall be supported by trapeze channels suspended on rods or bolted to vertical building members. Channels shall be as manufactured by Unistrut, Superstrut, Kindorf, or approved equal. Conduits shall be secured to the channel with galvanized or stainless steel clamps. Refer to Section 26 05 33 for additional requirements.
- H. Vertical conduits, both concealed and exposed, shall be supported by clamping to vertical surfaces or by means of clamps resting on adjacent beams, or floor slabs, or both as required by the installation. Refer to Section 26 05 33 for additional requirements.
- I. Conduits and raceways run against building surfaces shall be supported by means recommended by the manufacturer, or by means of single or two hole rigid conduit clamps. Two-hole clamps shall be provided where size of conduit and installation conditions warrant. Refer to Section 26 05 33 for additional requirements.
- J. All auxiliary steel required for conduit, cable tray, and wire-way supports, etc. shall be provided by the Electrical Trades unless specifically indicated to be provided by others. All support steel and fasteners shall be galvanized.
- K. Contractor shall review all Drawings, including Structural Drawings, for details regarding supports.
- L. All supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- M. Perforated strap shall not be used as a hanger material.

3.3 ATTACHMENT

- A. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including the concrete that holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required.
- B. All conduits not embedded in concrete or masonry shall be securely and independently supported so that no strain will be transmitted to outlet box and pull box supports, etc. Supports shall be rigid enough to prevent distortion of conduits during wire pulling.

- C. Inserts shall be of a type which will not interfere with reinforcing, as indicated on the Structural Drawings, and which will not displace excessive amounts of structural concrete. All methods of attachment to the structure and the use of after-set inserts shall be approved in writing by the Engineer.
- D. All conduit supports shall be designed and installed to avoid interference with other piping, hangers, ducts, conduit, supports, building structures, equipment, etc. All conduit, cable tray, and wire-way shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.
- E. Hangers shall be attached to structure as follows:
 - 1. Poured-in-place Concrete:
 - a) Where conduits, equipment, etc., are supported under poured-in-place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which shall be set into a UL-listed universal concrete insert placed in the form work before concrete is poured.
 - b) Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly, or where a larger insert would require displacement of a bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc., spanning across to adjacent joist. The angle iron shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
 - 2. Steel Bar Joist:
 - a) Where light loads are supported under bar joists, hanger rods may be run with a washer and two nuts.
 - b) Where larger loads are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
 - 3. Steel Beams: Where loads are supported under steel beams, approved type beam clamps shall be used.
 - 4. Wood Framing: Where loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.
 - 5. Miscellaneous Steel: All miscellaneous steel members, angles, rods, supports, and similar items specified or required for this project shall be galvanized for indoor use or hot dipped galvanized for exterior use and where exposed to ambient conditions. All required miscellaneous steel shall be provided by this Division.
- F. Fastening of conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine - screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans. Power-actuated fasteners (shooting) will not be acceptable under any circumstances unless approved by the Engineer in writing.

3.4 OPENINGS, CUTTING AND PATCHING

- A. General:
 - 1. The Contractor shall be responsible for coordinating openings in the building construction for installation of electrical systems. Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation or electrical work.

BASIC MATERIALS AND METHODS

Except as individually authorized by the Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

- B. Cut and Patch:
 - 1. Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.
- C. Methods of Cutting:
 - 1. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Engineer. Impact-type equipment may be used upon written approval of the Engineer. Openings in pre-cast concrete slabs for conduits, outlet boxes, etc., shall be core drilled to exact size.
- D. Approval:
 - 1. If holes or sleeves are properly installed and cutting and patching becomes necessary, it shall be done at no change in Contract amount. Undertake no cutting or patching without first securing written approval from the Engineer. Patching shall create a surface which is structurally and aesthetically equal to the surface surrounding the area patched and shall be performed by the trade whose work is involved at no change in the Contract amount.
- E. Protection:
 - 1. Openings through exterior walls or roofs shall be provided with suitable covers while they are left open to protect the property or materials involved. Any openings through walls below grade shall be properly protected to prevent entrance of water or other damaging elements.
- F. Restoration:
 - 1. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes. Restoration work shall be performed by the trades who originally installed the work being restored and shall be performed at no cost to the Owner or Engineer.
- G. Masonry:
 - 1. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Engineer.
- H. Plaster:
 - 1. All electrical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- I. Special Note:
 - 1. No coring, boring, or excavating which will weaken the structure shall be undertaken.

3.5 EXCAVATING, TRENCHING AND BACKFILLING

- A. General:
 - 1. The work hereunder includes whatever excavating and backfilling is necessary to install the electrical work. Coordinate the electrical work in the same area, including excavating and backfilling, dewatering, floor protection provisions, other temporary facilities needed for protection and proper performance of excavating and backfilling.
- B. Standards:
 - 1. Except as otherwise indicated, comply with the applicable provisions of Division 2 for electrical work excavating and backfilling. Refer instances of uncertain applicability to the Engineer for resolution before proceeding with the Work.

BASIC MATERIALS AND METHODS

- C. The bottoms of trenches shall be excavated to required depths, slope and grade. The bottom of the trench shall be accurately excavated to provide firm, uniform bearing for the bottom of the raceways and duct-banks. Where mud or unstable soil is encountered in bottom of trench, it shall be removed to firm-bearing and the trench shall be back filled with bedding sand to proper grade and tamped to provide uniform firm support.
- D. The bottom of trenches shall be accurately graded to provide proper fall and uniform bearing and support for each section of the conduit on undisturbed soil or 2" of sand fill at every point along its entire length. In general, grading for electrical duct-banks and conduits shall be from building to manhole, and from a high point between manholes to each manhole.
- E. Exercise care not to excavate below required depth, leaving a flat bed of undisturbed earth; firm and secure before laying cable and duct-banks. In the event rock is encountered, excavate 6" below required depth and backfill to required depth with bedding sand, and compact to minimum 95% compaction.
- F. All grading in the vicinity of excavation shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or other acceptable method. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins. Material unsuitable for backfilling shall be wasted and removed from the site and properly disposed of.
- G. The Contractor shall be fully responsible for the safety of persons, materials and equipment in or near trenches or other excavations and provide all required sloping, shoring, railings and other protective provisions. The Contractor shall provide a trench shoring plan and design that is sealed by a registered professional engineer. Refer to Divisions 1 and 2 for additional requirements.
- H. If any unknown and/or uncharted utilities are encountered during excavation, promptly notify Engineer and wait for his/her instruction before proceeding,
- I. If such unknown utilities are encountered and work is continued without contacting the Engineer for instructions, and damage is caused to said utilities, the Contractor shall repair at his own expense, such damage to the satisfaction of the owner or utility company concerned.
- J. Trenches shall not be backfilled until all required tests have been made by the Contractor and approved by the Engineer and any local authorities having jurisdiction.
- K. Backfill shall be compacted or cement stabilized sand up to 6" above the top of conduit or duct-bank. Backfill up to grade shall be in maximum 6" lifts with minimum 95% compaction of lifts. Refer to Division 2 or elsewhere in Contract Documents for additional trenching and backfill requirements.
- L. Opening and Reclosing Pavement, Landscape Areas and Lawns: Where excavation requires the opening of existing walks, street, drives, other existing pavement or lawns; such surfaces shall be cut as required to install new conduit and to make new connections to existing conduits. The sizes of the cut shall be held to a minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled and flooded, the area shall be patched or replaced, using materials to match those cut out or removed. Patches shall thoroughly bond with the original surfaces; these shall be level with them and shall meet all the requirements established by the authorities having jurisdiction over such areas. All removed work shall be replaced by craftsmen who regularly install the types of work being replaced.
- M. Excavation in Vicinity of Trees:
 - 1. All trees, including low hanging limbs within the immediate area of construction, shall be adequately protected to a height of at least 5' to prevent damage from the construction operations and/or equipment. All excavation within the outermost limb radius of all trees shall be accomplished with extreme care. All roots located within this outermost limb

radius shall be brought to the attention of the Engineer before they are cut or damaged in any way. The Engineer will give immediate instructions for the disposition of same. All stumps and roots encountered in the excavation that are not within the outermost limb radius of existing trees shall be cut back to a distance of not less than 18" from the outside of any concrete structure or pipeline. No chips, parts of stumps, or loose rock shall be left in the excavation. Where stumps and roots have been cut out of the excavation, clean, compacted, dry bank sand shall be backfilled and tamped.

3.6 PENETRATION FLASHING AND SEALS

- A. Conduit sleeves, pitch pockets, and flashings compatible with the roofing and waterproofing installation shall be provided for all roof and wall penetrations and roof-mounted equipment and supports. Coordinate flashing details with the Architectural details and the roofing/waterproofing contractors.
- B. Conduits passing through walls where exposed to weather or below grade shall pass through water-stop sleeves (new construction) or core-drilled openings (existing construction). The space between the conduit and sleeve/opening shall be sealed using segmented annular seals to prevent the entry of water or foreign materials. Segmented annular seals shall be Thunderline Incorporated; Type LS Series, Style C insulating type link seals for temperatures up to 250 degrees Fahrenheit, or approved equal. Water-stop sleeves shall be Thunderline Corporation, Century-Line or equal non-corroding thermoplastic sleeves with a molded in water stop.

3.7 CLEANING AND PAINTING OF ELECTRICAL WORK

- A. Prime, protective touch-up painting is included in the Work of this Division. Finish painting in equipment spaces, concealed locations, and other locations not exposed to the view of building occupants is included in the work of this Division. Finished painting in areas exposed to the view of building occupants is specified under Division 9.
- B. All equipment and materials furnished by the electrical subcontractor shall be delivered to the job with suitable factory finish.
- C. Electrical switchgear, disconnect switches, contactors, etc., with suitable factory-applied finishes shall not be repainted; except for aesthetic reasons where located in finished areas as directed by the Engineer and in a color selected by the Engineer. Where factory-applied finishes are damaged in transit, storage or installation; or before final acceptance, they shall be restored to factory-fresh condition by competent refinishers using the spray process.
- D. All equipment not finished at the factory shall be given a prime coat and then finish painted with two coats of enamel in color as directed by the Engineer. No nameplates on equipment shall be painted, and suitable protection shall be afforded such plates to prevent their being rendered illegible during the painting operations.
- E. The surfaces finish-painted shall first be prepared as follows:
 - 1. Galvanized and black steel surfaces shall first be painted with one coat of galvanized metal primer.
 - 2. Aluminum surfaces shall first be painted with one coat of zinc chromate primer.
- F. All ferrous metal surfaces without protective finish and not galvanized, in exposed and concealed areas including chases, under floor and above ceilings, shall be painted with two coats of zinc chromate primer as the construction progresses to protect against deterioration.
- G. All conduit exposed to view shall be finish painted as directed by the Engineer.
- H. Before painting, all surfaces to be painted shall be suitably prepared. This shall include removing all oil, rust, scale, dirt, and other foreign material. Surfaces shall be made smooth by grinding, filing, brushing, or other approved method. In the painting operations, the primer for metal surfaces shall be of the zinc dust type unless specified otherwise, and where finish

painting is specified, it shall be painted using materials and colors selected and approved by the Engineer. Refer to front end specifications for additional requirements.

3.8 WARNING SIGNS AND OPERATIONAL TAGS

- A. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
- B. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: "DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING".

3.9 EQUIPMENT HOUSEKEEPING PADS AND ANCHOR BOLTS

- A. Concrete pads for electrical equipment (Housekeeping Pads) will be furnished under this Division.
 - 1. All concrete used all be 6 sack mix with 3/8" maximum aggregate and 4000 psi compressive strength when tested after 28 days in accordance with ASTM 039-44, "Standard Method of Test for Compressive Strength of Concrete" and Idaho Transportation Department Class 40B. Refer to front end specifications for additional requirements.
 - 2. Use forms except where the earth is firm enough to support the concrete.
 - 3. Keep concrete wet at least 48 hours after forms are removed to ensure proper curing.
 - 4. Concrete shall be reinforced where noted on the Drawings.
 - 5. Concrete shall be carefully spaded during the pouring to eliminate all voids under and between the ducts and to prevent honeycombing of the exterior surfaces. Power driven tampers or agitators shall not be used unless specifically designed for the application.
 - 6. Concrete shall be poured in one continuous operation.
- B. Pads shall be nominal 3-1/2" high and shall extend a minimum of 3" beyond all equipment and supports while generally conforming to the shape of the equipment.
- C. Furnish galvanized anchor bolts with layout templates for installation in equipment pads. Bolts shall be of the size and quantity recommended by the manufacturer and where vibration isolators are used, they will be anchor bolted to the equipment pad.

END OF SECTION