

**BENTEH NUUTAH VALLEY NATIVE PRIMARY CARE CENTER
NEW GENERATOR
1001 South Goose Bay Road, Wasilla, Alaska 99654**



**OCTOBER, 27, 2023
PERMIT DOCUMENTS
PROJECT MANUAL**

**Southcentral
Foundation**



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Southcentral Foundation - Benteh Nuutah Valley Native Primary Care Center
1001 S Knik Goose Bay Rd, Wasilla, AK 99654
22007.01 VNPCC New Generator

**SECTION 00 0101
PROJECT TITLE PAGE**

PROJECT MANUAL FOR

ARCHITECT'S PROJECT NUMBER: 22007.01 DESIGN PROFESSIONAL'S PROJECT NUMBER.

**OWNER'S PROJECT: BENTEH NUUTAH VALLEY NATIVE PRIMARY CARE CENTER - NEW
GENERATOR**

PROJECT LOCATION ADDRESS 1: 1001 SOUTH GOOSE BAY ROAD, WASILLA, AK 99654

PREPARED BY:

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END OF SECTION

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**SECTION 01 1000
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: VNPCC New Generator
- B. Owner's Name: Southcentral Foundation.
- C. Architect's Name: KPB Architects, Inc..
- D. The Project consists of the construction of a new generator, associated components and systems for a fully operational backup electrical power..

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5200 - Agreement Form.
- B. Contact Type: A single prime contract based on a stipulated price as described in the Contract.

1.03 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 26 0126
MAINTENANCE TESTING OF ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Feeder Megohm Testing.
- B. Receptacle Branch Circuit Testing.
- C. Ground Fault Circuit Interrupter Testing.
- D. Electrical Service and Separately Derived System Ground Testing.
- E. Ground Fault Protection Testing.
- F. Additional Testing and Maintenance Requirements in Individual Equipment and System Sections.

1.02 REFERENCES

- A. NETA ATS 2021 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. ANSI/IEEE Std 81-1983 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.03 SUBMITTALS

- A. Submit data under provisions of Division 01 and Section 26 0500.
- B. Product Data: Submit technical information for each test instrument to include manufacturer, model number, serial number, ratings, accuracy, and National Institute of Standards and Technology (NIST) Traceable calibration certification.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit Test Reports per Section 26 0500.

1.05 COORDINATION

- A. Provide written 72 hours advance notice of all tests to be performed to allow Owner's Representative to witness testing.

1.06 REQUIRED TEST INSTRUMENTS

- A. MEGOHMMETER.
 - 1. Product Description: 1000 Volt DC, portable, insulation and resistance test Megohmmeter.
 - 2. Equipment Accuracy:
 - a. 2000 Megohm Range - 3% of full Scale.
- B. BRANCH CIRCUIT ANALYZER
 - 1. Product Description: Branch circuit analyzer capable of receptacle testing of voltage drop under load, hot-neutral-ground conductor impedances, common mode (N-G) Voltage, and G.F.C.I. trip point.
 - 2. Manufacturer: Ideal SureTest. Model: 61-164 Circuit Analyzer or approved equal.
 - 3. Equipment Accuracy:
 - a. AC Voltage and Frequency accuracy: 1% full scale \pm 1 digit True RMS.
 - b. Impedance 0.00 – 1.99 Ohms: 5.0% accuracy.
 - c. Ground-Neutral Voltage 0.0 – 24.0V: 2.0% accuracy.
 - d. % Voltage Drop 12A, 15A, 20A load tests: 5.0% accuracy.
 - e. GFCI Test Current/Time 6.0 – 9.0mA/0.00 – 6500mS: 2% accuracy.

C. GROUND RESISTANCE CLAMP-ON METER

1. Product Description: Digital, direct reading clamp-on resistance ground tester capable of measuring ground rod and grid resistance without the use of auxiliary rods, disconnecting the ground system or de-energizing the system under test. Meter shall also be capable of measuring leakage current flowing to ground or circulating in ground loops and ground voltage.
2. Manufacturer: AEMC. Model: 6416 or approved equal.
3. Equipment Accuracy – Ground Resistance – Auto-Ranging 0.01 to 1500 Ohms:
 - a. 0.010 to 49.9Ω: 0.1Ω resolution \pm (1.5% \pm 0.1Ω).
 - b. 50.0 to 99.5Ω: 0.5Ω resolution \pm (2% \pm 0.5Ω).
 - c. 100 to 199Ω: 1Ω resolution \pm (3% \pm 1Ω).
 - d. 200 to 395Ω: 5Ω resolution \pm (5% \pm 5Ω).
 - e. 400 to 590Ω: 10Ω resolution \pm (10% \pm 10Ω).
 - f. 600 to 1150Ω: 50Ω resolution \pm 20%.
 - g. 1200 to 1500Ω: 50Ω resolution \pm 25%.
4. Equipment Accuracy – Current Measurement – Auto-Ranging 0.2mA to 40A:
 - a. 0.200 to 0.999mA: 1μA resolution \pm (2% \pm 50μ).
 - b. 1.000 to 9.99mA: 10μA resolution \pm (2% \pm 50μ).
 - c. 10.00 to 99.9mA: 100μA resolution \pm (2% \pm 100μ).
 - d. 100.0mA to 0.990A: 1mA resolution \pm (2% \pm 1mA).
 - e. 1.000 to 39.99A: 10mA resolution \pm (2% \pm 10mA).
5. Selectable Measurement Frequency: 50, 60 128 or 2083 Hz.
6. Current Measurement Frequency: 47 – 800 Hz.
7. Ground Voltage Display: 0.1 to 75.0VAC
8. Inductance Measurement: 10 to 500μH

D. MULTIMETER

1. Product Description: Digital True RMS Multimeter.
2. Equipment Accuracy:
 - a. AC Voltage Range: 0.75% \pm 3 last single digits at 60 Hz.
 - b. AC Current Range: 0.90% \pm 3 last single digits at 60 Hz.
 - c. DC Voltage Range: 0.25% \pm 1 last single digit.
 - d. DC Current Range: 0.75% \pm 1 last single digit.
 - e. Resistance Ranges: 0.50% \pm 1 last single digit.
 - f. Frequency Range: 0.10% \pm 1 last single digit @ 60 Hz.

1.07 TEST INSTRUMENT CALIBRATION

- A. All test equipment shall be in good mechanical and electrical condition.
- B. Provide calibration for each test instrument directly traceable to the National Institute of Standards and Technology (NIST) of higher accuracy than that of the instrument tested.
- C. Provide calibration labels visible on all test equipment. Records, which show date and results of instruments calibrated or tested, shall be kept up-to-date.

- D. Calibrate instruments in accordance with the following frequency schedule:
1. Field instruments: 12 months maximum.
 2. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument with the equipment.

1.08 MINIMUM REPORT INFORMATION

- A. Report Criteria: After each test, promptly submit one copy of report to the Owner's Representative. [Include information on the ASD report form where included within this specification otherwise] provide form with the minimum following information:
1. Date issued.
 2. Project title and number.
 3. Name and Model of Tester and witnesses.
 4. Date and time of sampling or inspection.
 5. Identification of product and specifications section.
 6. Type of inspection or test.
 7. Date of test.
 8. Results of tests.
 9. Indicate compliance or non-compliance with Contract Documents.
 10. Final adjustment setting values where applicable.
- B. Submit copy of all tests performed in the O&M manual.

1.09 GENERAL REQUIREMENTS

- A. Include a copy of each test result in the O&M manual.
- B. Provide qualified personnel at site to perform all testing.
- C. Perform specified testing of products in accordance with specified standards or as denoted in this specification whichever is more stringent.
- D. Promptly notify Owner's Representative of irregularities or non-conformance of Work or products.
- E. Perform additional tests when test is performed incorrectly, deemed inaccurate, or incorrectly documented.
- F. The Contractor shall provide all forms, instrumentation and test equipment, loads, and other consumables required to demonstrate the systems to Owner's Representative satisfaction.
- G. Perform and submit all testing prior to substantial completion and system acceptance.
- H. Retest all material, cables etc. that are disturbed after testing.
- I. Replace and retest all material installed which does not meet or exceed the minimum acceptable limits set forth in this specification in accordance with the contract original requirements at no additional charge to Contract Sum/Price.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 FEEDER CONDUCTOR TEST

- A. Tests Criteria:
1. Use Megohm meter to test all conductors sized #6AWG and larger.
 2. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential 1000 volts DC for 600 volt rated cable.

3. Perform test immediately after installation.
4. Clean exposed cable ends with clean cloth and alcohol.
5. Test duration shall be one minute.
6. Disconnect conductors from all equipment.
7. Record the resistance of the insulated conductor under test with all other conductors connected together and to ground (metallic raceway, grounding conductor, etc.).
8. Perform continuity test to insure correct cable connection.
 - a. Submit test results to Owner's Representative.

B. Test Values:

1. Minimum insulation-resistance value: 50 megohms.
2. Investigate deviations between adjacent phases.

3.02 RECEPTACLE GROUND FAULT CIRCUIT INTERRUPTER TEST

A. Test Criteria:

1. Use Branch Circuit Analyzer to perform test of each GFCI protected receptacle.
2. Record trip level in ma for each outlet.
3. Submit test results to Owner's Representative.

B. Test Values:

1. Trip Range: Between 6-9 mA.

3.03 ELECTRICAL SERVICE AND SEPARATELY DERIVED SYSTEM GROUND TEST

A. Test Criteria:

1. Use ground resistance clamp-on meter to measure the resistance, leakage current and ground voltage of service ground with meter clamped between system neutral bond and each grounding electrode. Perform this test on new or existing services and all separately derived systems.
2. Record resistance value in Ohms, leakage current in Amperes or milliamperes, as appropriate, and ground voltage in Volts.
3. Submit test results to Owner's Representative.

B. Test Values:

1. Maximum ground resistance: 25 Ohms.

3.04 GROUND FAULT PROTECTION SYSTEMS

A. Visual and Mechanical Inspection:

1. Compare equipment nameplate data with drawings and specifications.
2. Visually inspect the components for damage and errors in polarity or conductor routing.
3. Verify that ground connection is made ahead of neutral disconnect link and on the line side of any ground fault sensor.
4. Verify that neutral sensors are connected with correct polarity on both primary and secondary.
5. Verify that all phase conductors and the neutral pass through the sensor in the same direction for zero sequence systems.
6. Verify that grounding conductors do not pass through zero sequence sensors.
7. Verify that the grounded conductor is solidly grounded.
8. Verify correct operation of all functions of the self-test panel.

B. Electrical Tests:

1. Measure the system neutral-to-ground insulation resistance with the neutral disconnect link temporarily removed. Replace neutral disconnect link after testing.
2. Perform the following pickup tests using primary injection:
 - a. Verify that the relay does not operate at 90 percent of the pickup setting.
 - b. Verify pickup is less than 125 percent of setting or 1200 amperes, whichever is smaller.
3. For summation type systems utilizing phase and neutral current transformers, verify correct polarities by applying current to each phase-neutral current transformer pair. This test also applies to molded-case breakers utilizing an external neutral current transformer.
 - a. The relay shall operate when current direction is the same relative to polarity marks in the two current transformers.
 - b. The relay shall not operate when current direction is opposite relative to polarity marks in the two current transformers.
4. Measure time delay of the relay at 150 percent or greater of pickup.
5. Verify reduced control voltage tripping capability: 55 percent for ac systems and 80 percent for dc systems.
6. Submit test results to Owner's Representative.

C. Test Values:

1. Relay timing shall be in accordance with manufacturer's specifications but shall not exceed one second at 3000 amperes.

END OF SECTION

**SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General Requirements specifically applicable to Division 26, in addition to Division 01 provisions.
- B. The electrical system equipment and installation shall comply with all provisions and requirements of this specification, as well as any and all applicable national, state and local codes and standards.

1.02 WORK SEQUENCE

- A. Construct Work in sequence under provisions of Division 01.

1.03 COORDINATION

- A. Coordinate the Work specified in this Division under provisions of Division 01.
- B. Prepare drawings showing proposed rearrangement of Work to meet job conditions, including changes to Work specified under other Sections. Obtain permission of Architect prior to proceeding.

1.04 FUTURE WORK

- A. Provide for future work under requirements of Division 01.
- B. Project is designed for future expansion of the electrical system.

1.05 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code, latest adopted edition including all state and local amendments.
- B. NECA - Standard of Installation.
- C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. Electrical Reference Symbols: The Electrical "Legend" on drawings is standardized version for this project. All symbols shown may not be used on drawings. Use legend as reference for symbols used on plans.
- E. Electrical Drawings: Drawings are diagrammatic; complimentary to the Architectural drawings; not intended to show all features of work. Install material not dimensioned on drawings in a manner to provide a symmetrical appearance. Do not scale drawings for exact equipment locations. Review Architectural, Civil, Structural, and Mechanical Drawings and adjust work to conform to conditions shown thereon. Field verification of dimensions, locations and levels is directed.

1.06 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to the latest adopted edition of the International Building Code and the International Fire Code including all state and local amendments thereto.
- C. Obtain electrical permits, plan review, and inspections from authority having jurisdiction.

1.07 SUBMITTALS

- A. Submittal review is for general design and arrangement only and does not relieve the Contractor from any requirements of Contract Documents. Submittal not checked for quantity, dimension, fit or proper operation. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provisions of a complete and satisfactory working installation are the sole responsibility of the Contractor.

- B. In addition to requirements referenced in Division 01, the following is required for work provided under this division of the specification.
1. Provide material and equipment submittals containing complete listings of material and equipment shown on Electrical Drawings and specified herein. Separate from work furnished under other divisions.
 2. Submittals shall be provided in PDF format with each section indexed in the PDF document. Submittals for Division 26 shall be complete and submitted at one time. Unless given prior approval, partial submittals will be returned unreviewed.
 3. Clearly identify all material and equipment by item, name or designation used on drawings and in specifications.
 4. Submit only pages which are pertinent; mark catalog sheets to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring diagrams and controls; component parts; finishes; dimensions; and required clearances.
 5. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
 6. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
 7. Coordinate submittals with requirements of work and of Contract Documents.
 8. Certify in writing that the submitted shop drawings and product data are in compliance with requirements of Contract Documents. Notify Architect/Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.
 9. Do not fabricate products or begin work which requires submittals until return of submittal with Architect/Engineer acceptance.
 10. Equipment scheduled by manufacturer's name and catalog designations, manufacturer's published data and/or specification for that item, in effect on bid date, are considered part of this specification. Approval of other manufacturer's item proposed is contingent upon compliance therewith.

1.08 SUBSTITUTIONS

- A. In accordance with the General Conditions and the General Requirements, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment.

1.09 PROJECT RECORD DRAWINGS

- A. Maintain project record drawings in accordance with Division 01.
- B. In addition to the other requirements, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing of work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.
- C. Record drawing field mark-ups shall be maintained on-site and shall be available for examination of the Owner's Representative at all times.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals for training of Owner's Representative in operation and maintenance of systems and related equipment. In addition to requirements referenced in Division 01, the following is required for work provided under this section of the specifications.

- B. Manuals shall be separate from work furnished under other divisions. Prepare a separate chapter for instruction of each class of equipment or system. Index and clearly identify each chapter and provide a table of contents.
- C. Unless otherwise noted in Division 01, provide one copy of all material for approval.
- D. The following is the suggested outline for operation and maintenance manuals and is presented to indicate the extent of items required in manuals.
 - 1. List chapters of information comprising the text. The following is a typical Table of Contents:
 - a. Electrical power distribution.
 - b. Lighting.
 - c. Fire alarm.
 - d. Standby generator.
 - e. Other chapters as necessary.
 - 2. Provide the following items in sequence for each chapter shown in Table of Contents:
 - a. Describe the procedures necessary for personnel to operate the system including start-up, operation, emergency operation and shutdown.
 - 1) Give complete instructions for energizing equipment and making initial settings and adjustments whenever applicable.
 - 2) Give step-by-step instructions for shutdown procedure if a particular sequence is required.
 - 3) Include test results of all tests required by this and other sections of the specifications.
 - b. Maintenance Instructions:
 - 1) Provide instructions and a schedule of preventive maintenance, in tabular form, for all routine cleaning and inspection with recommended lubricants if required for the following:
 - a) Lighting fixtures.
 - b) Distribution equipment.
 - c) Standby generator.
 - 2) Provide instructions for minor repair or adjustments required for preventive maintenance routines, limited to repairs and adjustments which may be performed without special tools or test equipment and which requires no special training or skills.
 - 3) Provide manufacturers' descriptive literature including approved shop drawings covering devices used in system, together with illustrations, exploded views, etc. Also include special devices provided by the Contractor.
 - 4) Provide any information of a maintenance nature covering warranty items, etc., which have not been discussed elsewhere.
 - 5) Include list of all equipment furnished for project, where purchased, technical representative if applicable and a local parts source with a tabulation of descriptive data of all electrical-electronic spare parts and all mechanical spare parts proposed for each type of equipment or system. Properly identify each component by part number and manufacturer.
 - c. Inspection Certificate: Include copy of certificate of final inspection and acceptance from the Authority Having Jurisdiction.

1.11 DEMONSTRATION OF ELECTRICAL SYSTEMS

- A. During substantial completion inspection:
 - 1. Conduct operating test for approval under provisions of Division 01.
 - 2. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents.
 - 3. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.
 - 4. Have instruments available for measuring light intensities, voltage and current values, and for demonstration of continuity, grounds, or open circuit conditions.
 - 5. Provide personnel to assist in taking measurements and making tests.

1.12 WARRANTY

- A. In addition to the requirements of Division 01, or as specified in other sections. Warrant all materials, installation and workmanship for one (1) year from date of acceptance.
- B. Copies of manufacturer product warranties for all equipment shall be included in the operation and installation manuals.

1.13 INSTRUCTION OF OPERATING PERSONNEL

- A. In accordance with the requirements of Division 01 and this section provide services of qualified representative of supplier of each item or system listed below to instruct designated personnel of Owner in operation and maintenance of item or system.
- B. Make instruction when system is complete, of number of hours indicated, and performed at time mutually agreeable.

System or Equipment	Hours of Instruction
Standby power system	4
Modify/add other sections as necessary	

- C. Certify that an Anchorage or Fairbanks based authorized service organization regularly carries complete stock of repair parts for listed equipment or systems, that organization is available and will furnish service within 48 hours after request. Include name, address and telephone number of service organization.
- D. Have approved operation and maintenance manuals and parts lists for all equipment on hand at time of instruction.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. All Materials and Equipment shall be new.
- B. All Materials and Equipment shall be listed by Underwriter's Laboratories or equivalent third party listing agency for the use intended.
- C. Materials and Equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended when installed per listing and labeling instructions.
- D. No materials or equipment containing asbestos in any form shall be used. Where materials or equipment provided by this Contractor are found to contain asbestos such items shall be removed and replaced with non-asbestos containing materials and equipment at no cost to the Owner.
- E. In describing the various items of equipment, in general, each item will be described singularly, even though there may be numerous similar items.

PART 3 EXECUTION

3.01 WORKMANSHIP

- A. Install Work using procedures defined in NECA Standard of Installation and/or the manufacturer's installation instructions.

3.02 TESTS

- A. Perform tests in accordance with Section 26 01 26 – Maintenance Testing of Electrical Systems.
- B. Notify the Owner's representative at least 72 hours prior to conducting any tests.
- C. Following completion of installation, test system ground in accordance with the requirements of NETA ATS 7.13. and all feeders in accordance with NETA ATS 7.3. Submit logs of values obtained, and nameplate data of instruments used prior to final inspection. Include a copy of all data in the power distribution section of the Operation and Maintenance Manuals.
- D. Perform additional tests required under other sections of these specifications.
- E. Perform all tests in the presence of the Owner's representative.
- F. The Contractor shall provide written notification to the Owner's representative and the State Electrical Inspector thirty days in advance of requests for rough-in and substantial completion inspections.

3.03 PENETRATIONS OF FIRE BARRIERS

- A. Related information to this section appears in Division 07, Fire Stopping.
- B. All holes or voids created to extend electrical systems through fire rated floors, walls or ceiling shall be sealed with an asbestos-free intumescent fire stopping material capable of expanding 8 to 10 times when exposed to temperatures 250°F or higher.
- C. Materials shall be suitable for the fire stopping of penetrations made by steel, glass, plastic and shall be capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM E814 and UL 1479.
- D. The rating of the fire stops shall be the same as the time-rated floor, wall or ceiling assembly.
- E. Install fire stopping materials in accordance with the manufacturer's instructions.
- F. Unless protected from possible loading or traffic, install fire stopping materials in floors having void openings of four (4) inches or more to support the same floor load requirements as the surrounding floor.

END OF SECTION

**SECTION 26 0505
SELECTIVE DEMOLITION FOR ELECTRICAL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical Demolition.

1.02 RELATED SECTIONS

- A. Division 01 - Alteration Project Procedures.
- B. Division 02 - Minor Demolition for Remodeling.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

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

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on a non-destructive walkthrough and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with Utility Company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing Fire Alarm System: Maintain existing system in service.
- F. Existing Telephone System: Maintain existing system in service.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of Division 01, Division 02, and this Division.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Repair adjacent construction and finishes damaged during demolition and extension work. T-bar ceiling tiles damaged under normal construction conditions or having voids where junction boxes were removed shall be replaced by the Contractor.
- E. Maintain access to existing electrical installations which remain active.
- F. Extend existing installations using materials and methods as specified.

- G. Where materials or equipment are to be turned over to Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain condition of materials and equipment equal to the existing condition of the equipment before the work began. Repair or replace damaged materials or equipment at no additional cost to the Owner.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions.

3.05 INSTALLATION

- A. Install relocated materials and equipment under the provisions of Division 01.

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building Wire.
- B. Cable.
- C. Wiring Connections and Terminations.

1.02 RELATED SECTIONS

- A. Section 26 0126 – Maintenance Testing of Electrical Systems.
- B. Section 26 0553 – Identification for Electrical Systems.
- C. Division 31 – Trenching.
- D. Division 31 – Backfill.

1.03 REFERENCES

- A. ANSI/NEMA WC 70-2021 – Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
- B. NETA ATS – Acceptance testing specifications for Electrical Power Distribution and Systems.
- C. NFPA 262 – Standard Method of test for flame travel and smoke of wires and cables for use in air-handling spaces.
- D. UL 83 – Thermoplastic Insulated Wire and Cable.
- E. UL 1063 – Standard for Machine and Tool Wire and Cable.
- F. UL 1424 – Standard for Cables for Power-Limited Fire Alarm.
- G. UL 1479 – Standard for Fire Tests of Through Wall Penetration Fire Stops.
- H. UL 1569 – Standard for Metal Clad Cable.
- I. UL 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.04 SUBMITTALS

- A. Submit data under provisions of Division 01 and Section 26 0500.
- B. Product Data: Submit product data for all components provided which fall under this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.05 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5m) when tested in accordance with NFPA 262.

PART 2 PRODUCTS

2.01 BUILDING WIRE

- A. Thermoplastic-insulated Building Wire: NEMA WC 70.
- B. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THW, THHN/THWN or XHHW-2 as indicated.
- C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN or XHHW-2. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor.
- D. Branch Circuit Wire Color Code:

1. Color code wires by line or phase as follows:
 - a. Black, red, blue and white for 120/208V systems.
 - b. Brown, orange, yellow and gray for 277/480V systems.
 2. For conductors 6 AWG and smaller, insulation shall be colored. For conductors 4 AWG and larger, identify with colored phase tape at all terminals, splices, and boxes.
 3. Grounding conductors 6 AWG and smaller shall have green colored insulation. For 4 AWG and larger, use green tape at both ends and at all other visible points in between, including pull and junction boxes.
- E. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.
- F. Fire Alarm Notification Appliance Circuits: Copper, solid or stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.

2.02 METAL CLAD CABLE

- A. UL 83, 1063, 1479, 1569, and 1581 listed, meets Federal Specification A-A-59544 (formerly J-C-30B). UL rated for installation in cable trays and environmental air handling spaces. Fire wall rated for 1, 2, and 3-hour through penetrations.
- B. Type MC Cable, Size 12 Through 10 AWG: Solid copper conductor, 600 volt thermoplastic insulation, rated 90° C dry, 75° wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar.
- C. Type MC Cable, Size 8 Through 1 AWG: Stranded copper conductor, 600 volt thermoplastic insulation, rated 90° C dry, 75° wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar.
- D. Fire Alarm/Control Type MC Cable, Size 18 through 12 AWG: Complying with UL 66, 83, 1424, 1479, 1569, 1581, and NFPA 262 (formerly UL 910), solid copper conductor, 300 volt thermoplastic insulation, rated 90°C, insulated green grounding conductor, and red-striped galvanized steel armor over mylar. Conductor insulation shall be color-coded in accordance with Section 28 31 00.
- E. All metal clad cable shall be provided with color-coded insulation on all ungrounded conductors in accordance with NEC 210.5(C) and Part 3 of this section.

2.03 REMOTE CONTROL AND SIGNAL CABLE

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 90° C, individual conductors twisted together, shielded, and covered with an overall PVC jacket; UL listed.
- B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90° C, individual conductors twisted together, shielded or unshielded (as required), and covered with a PVC jacket; UL listed.

2.04 WIRING CONNECTIONS AND TERMINATIONS

- A. For conductors 8 AWG and smaller:
 1. Dry interior areas: Spring wire connectors, pre-insulated "twist-on" rated 105 degrees C per UL 468C. Where stranded conductors are terminated on screw type terminals, install crimp insulated fork or ring terminals. Thomas & Betts Sta-Kon or equal.
 2. Motor connections: Spring wire connectors, pre-insulated "twist-on" rated 105 degrees C per UL 468C. Provide a minimum of 8 wraps of Scotch 33+ electrical tape around conductors and connector to eliminate connector back off.
 3. Wet or exterior: Spring wire connectors, pre-insulated "twist-on", resin filled rated for direct burial per UL 486D.
- B. For conductors 6 AWG and larger:

1. Bus lugs and bolted connections: 600 V, 90 degrees C., two hole long barrel irreversible compression copper tin plated. Thomas & Betts or approved equal.
2. Motor connection: 600 V, 90 degrees C., copper tin plated compression motor pigtail connector, quick connect/disconnect, slip on insulator. Thomas & Betts or approved equal.
3. Two way connector for splices or taps: 600 V, 90 degrees C., compression long barrel, copper tin plated. Thomas & Betts or approved equal. Insulate with Scotch 23 rubber insulating base covering and Scotch 33+ outer wrap.

PART 3 EXECUTION

3.01 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 18 AWG for control wiring.
- B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet[, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet].
- C. Splice only in junction or outlet boxes.
- D. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- E. Make Conductor lengths for parallel circuits equal.
- F. Wiring in lighting fixture channels shall be rated for 90° C minimum.
- G. Do not share neutral conductors. Provide a dedicated neutral conductor for each branch circuit that requires a neutral.

3.02 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Verify that raceway is complete and properly supported prior to pulling conductors. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Do not install XHHW-2 conductors when ambient temperatures are below 23F and THHN/THWN conductors when ambient temperatures are below 32F.
- D. Conductors shall be carefully inspected for insulation defects and protected from damage as they are installed in the raceway. Where the insulation is defective or damaged, the cable section shall be repaired or replaced at the discretion of the Owner and at no additional cost to the Owner.
- E. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
- F. Route conductors from each system in independent raceway system and not intermix in the same raceway, enclosure, junction box, wireway, or gutter as another system unless otherwise shown on the plans.
- G. No more than six current carrying conductors shall be installed in any homerun unless otherwise indicated on the drawings or without prior approval from the Engineer.
- H. Completely and thoroughly swab raceway system before installing conductors.
- I. When two or more neutrals are installed in one conduit, identify each with the proper circuit number in accordance with Section 26 05 53.

3.03 WIRING CONNECTIONS AND TERMINATIONS

- A. Stranded wire shall not be wrapped around screw terminals.
- B. Splice only in accessible junction boxes.
- C. Thoroughly clean wires before installing lugs and connectors.

- D. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- E. Terminate spare conductors with twist on connectors or heat shrink insulation to proper voltage rating.
- F. Control systems wiring in conjunction with mechanical, electrical or miscellaneous equipment to be identified in accordance with wiring diagrams furnished with equipment.
- G. Signal systems wiring and any special equipment in accordance with manufacturer's diagrams or recommendations.
- H. Do not exceed manufacturer's recommended pull tensions.

3.04 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01 and Section 26 0126.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque conductor connections and terminations to manufacturer's recommended values.

3.05 WIRE AND CABLE INSTALLATION SCHEDULE

- A. All Locations: Building wire and/or remote control and signal cable in raceways.
- B. At the Contractor's option, Metal Clad cable may be used for branch circuit wiring in dry locations other than homeruns. Homeruns shall be building wire in raceway. Metal Clad cable used for branch circuit wiring from a light switch to the light fixture shall include a neutral conductor.
- C. At the Contractor's option, portions of the fire alarm wiring in dry, concealed locations may be installed in Fire Alarm Metal Clad cable.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power System Grounding.
- B. Electrical Equipment and Raceway Grounding and Bonding.

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Section 26 0500 – Common Work Results for Electrical, Division 27 and Division 28.
- B. Section 26 0126 – Maintenance Testing of Electrical Systems.
- C. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables.

1.03 REFERENCE STANDARDS

- A. ANSI/NEMA GR-1, Ground Rod Electrodes and Ground Rod Electrode Couplings.
- B. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.
- C. AWS A5.8/A5.8M – Specification for Filler Metals for Brazing and Braze Welding.
- D. IEEE Std 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- E. IEEE Std 142 – Recommended Practice for Grounding of Industrial and Commercial Power System.
- F. UL 467 – Standard for Grounding and Bonding Equipment.

1.04 SYSTEM DESCRIPTION

- A. Provide a complete grounding system for services and equipment as required by State and Local Codes, NEC, applicable portions of other NFPA codes, and as indicated herein.

1.05 SUBMITTALS

- A. Product Data: Submit product data for all components provided, showing material type and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.06 CLOSEOUT SUBMITTALS

- A. Project Record Drawings
- B. Test Reports
 - 1. See Section 26 0126 - Maintenance Testing of Electrical Systems for Grounding System Tests.
 - 2. The results of the 3-point fall of potential ground resistance test, performed on the installed grounding system shall be submitted in accordance with the paragraph entitled "Field Quality Control" of this section.
 - 3. Each test report shall include:
 - a. Date of test, soil moisture content, and soil temperature.
 - b. Test operator.
 - c. Instrument or other test equipment used.
 - d. Electrode designation or location matching that shown on shop drawings.

- e. Ground impedance in ohms.
- f. Assumptions made - if required.

1.07 COORDINATION

- A. Division 01 – Administrative Requirements: Requirements for Coordination.
- B. Complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Solid Ground Rods: ANSI/NEMA GR-1, copper-encased steel, $\frac{3}{4}$ inch diameter, minimum length 10 feet. [5/8 inch diameter, minimum length 8 feet] Ground rods shall be clean and smooth.
- B. Bonding Conductors: Solid bare copper wire for sizes No. 8 AWG and smaller diameter. Stranded bare copper wire for sizes No. 6 AWG and larger diameter. Conductors may be insulated conductors if used provide green insulation.
- C. Grounding Conductors: Copper conductor bare or green insulated.
- D. Telecommunications Bonding Backbone: Bare copper, 6 AWG, stranded conductor.
- E. Mechanical Grounding and Bonding Connectors: Non-reversible crimp type lugs only. Use factory made compression lug for all terminations.
- F. In external locations, clamping shall be used only where a disconnect type of connection is required. Connection device may utilize threaded fasteners and shall be constructed such that positive contact pressure shall be maintained at all times. Machine bolts with lock washers shall be used.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide a separate, insulated equipment-grounding conductor in all feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on single lug not permitted. Each grounding conductor shall terminate on its own terminal lug.
- B. Connect grounding electrode conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter and back flow preventors.
- C. Supplementary Grounding Electrode: Use driven ground rod on exterior of building.
- D. Provide grounding and bonding at Utility Company's metering equipment.
- E. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing and fuel systems.
- F. Grounding conductors for branch circuits shall be sized in accordance with NEC, except minimum size grounding conductor shall be No. 12 AWG.
- G. Grounding conductor is in addition to neutral conductor and in no case shall neutral conductor serve as grounding means.
- H. Ground rods shall be installed so that the top of the rod is not less than 12 [18] inches below finished grade. Conceal after inspection.

3.02 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Perform system ground test as specified in Section 26 0126 - Maintenance Testing of Electrical Systems.

- C. Upon completion of the ground installation and before connection to the permanent facility power the Contractor shall measure the ground resistance of the grounding electrode system. The testing shall utilize an earth resistance meter and be conducted in accordance with the IEEE Standard for 3-point fall of potential method. The Contractor shall notify the Owner's representatives a minimum of 5 business days prior to the scheduled ground testing date so they may be present at the time of testing. The Contractor shall immediately notify the Owner's representative if the measured ground resistance is above 20 ohms. The Contractor shall submit a copy of the test report to the Owner's representative within 10 days after testing and before the ground system becomes inaccessible.
- D. Continuity Test: Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

END OF SECTION

**SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section included hangers and supports for Power Systems.
- B. Conduit Supports.
- C. Formed Steel Channel.
- D. Spring Steel Clips.
- E. Sleeves.
- F. Mechanical Sleeve Seals.
- G. Equipment Bases and Supports.

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 0500 – Common Work Results for Electrical and Division 28.
- B. Division 03 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.

1.03 REFERENCES

- A. International Building Code (IBC), Chapter 16 – Structural Design.

1.04 SUBMITTALS

- A. Division 01: Requirements for submittals.
- B. Product Data: Submit product data for specialty supports.

1.05 COORDINATION

- A. Coordinate size, shape and location of concrete pads with Division 03.

1.06 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.
- B. Perform Work in accordance with State of Alaska Standard Specifications.

PART 2 PRODUCTS

2.01 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Minerallac Fastening Systems.
 - 3. O-Z Gedney Co.
 - 4. Substitutions: per Division 01
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

- E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.

2.02 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. B-Line Systems.
 - 2. Allied Tube & Conduit Corp.
 - 3. Unistrut Corp.
 - 4. Substitutions: per Division 01.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.03 SLEEVES

- A. Sleeves Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.04 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Division 01: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.02 PREPARATION

- A. Obtain permission from Owner's Representative before using powder-actuated anchors.
- B. Obtain permission from Owner's Representative before drilling or cutting structural members.

3.03 INSTALLATION - GENERAL

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, beam clamps, or spring steel clips.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not support raceways, low voltage pathways, cables, telecommunication pathways or boxes from ceiling suspension wires or suspended ceiling systems. Provide support from building structure independently to allow ceiling removal and replacement without removal of electrical system. If dedicated support wires are used, wires and wire clips must be painted or color-coded. Exception: Outlet boxes for ceiling-mounted light fixtures and smoke detectors may be mounted in the ceiling system.
- D. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or ceiling suspension system.
- E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

- F. In wet locations install free-standing electrical equipment on concrete pads. Pad top shall be a minimum of 3 ½" above the surrounding grade and shall be reinforced in accordance with Division 3 of these specifications.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- I. Securely fasten fixtures and equipment to building structure in accordance with manufacturer's recommendations and to provide necessary earthquake anchorage.
- J. Provide wall attached fixtures and equipment weighing less than 50 pounds with backing plates of at least 1/8" x 10" sheet steel or 2" x 10" fire retardant treated wood securely built into the structural walls. Submit attachment details of heavier equipment for approval.
- K. Earthquake Anchorages:
 - 1. Equipment weighing more than 50 pounds shall be adequately anchored to the building structure to resist lateral earthquake forces.
 - 2. Total lateral (earthquake) forces shall be 1.5 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.
- L. Provide one seismic support wire for all fixtures weighing less than 10lbs. two minimum color-coded dedicated seismic support wires for each ceiling mounted light fixture weighing less than 50 pounds. Secure each end with three tight wraps within 1 inch at each end of the wire. Provide four supports on fixtures >50 lbs.
- M. Attach the supporting cables for all pendant fixtures to both the building structure and to the ceiling grid which they pass through.
- N. Power-driven fasteners are prohibited for tension load applications (such as supporting luminaries or conduit racks from ceiling above). Use drilled-in expansion anchors or drilled and screw-in anchors such as Kwik-Con II or Tapcon.

3.04 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

END OF SECTION

SECTION 26 0533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Conduit.
- B. Boxes.
- C. Wireway

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Division 26, Division 27 and Division 28.
- B. Division 07 Thermal and Moisture Protection.
- C. Division 08 Openings: Access Doors and Frames.
- D. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables.
- E. Section 26 0526 – Grounding and Bonding for Electrical Systems.
- F. Section 26 0529 – Hangers and Supports for Electrical Systems.
- G. Section 26 0553 – Identification for Electrical Systems.
- H. Section 26 2726 – Wiring Devices.

1.03 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 123 – Specification for Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 2. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

1.04 RACEWAY AND BOX INSTALLATION SCHEDULE

- A. Underground more than 5 feet from foundation wall:
 - 1. Raceway: Provide rigid steel conduit or intermediate metal conduit, shall be used in non-traffic areas, schedule 80 shall be used.
 - 2. Boxes and Enclosures: Provide concrete type 1A handhole.
- B. Under or in concrete slab, or underground within 5 feet of foundation wall:
 - 1. Raceway: Provide rigid steel conduit or intermediate metal conduit. All metal conduit in contact with concrete or block shall be rigid steel conduit half lapped wrapped with pipe wrap or be plastic-coated conduit. Provide transition to rigid steel conduit 12 inches prior to exit penetration through foundations, concrete walls, or block walls. Provide transition to rigid steel conduit elbow and riser for penetration through slab. Arrange raceway so the curved portion of bend is not visible above finished slab.
 - 2. Boxes and Enclosures: Provide concrete tight cast and listed sheet metal boxes.

- C. In or through CMU walls:
 - 1. Raceway: Provide rigid steel conduit or intermediate metal conduit. EMT conduit may penetrate through CMU walls where the EMT is installed in a sleeve and does not come in direct contact with the CMU. All conduit in contact with concrete or block shall be rigid steel conduit half lapped wrapped with pipe wrap or be plastic-coated conduit.
 - 2. Boxes and Enclosures: Provide concrete tight cast and listed sheet metal boxes.
- D. Outdoor Above Grade, Damp or Wet Interior Locations:
 - 1. Raceway: Provide rigid steel conduit or intermediate metal conduit.
 - 2. Boxes and Enclosures: Provide weatherproof malleable iron for branch circuit junction and outlet boxes. Provide weatherproof NEMA 3R sheet metal enclosures for safety and disconnect switches.
 - 3. Fittings: Provide galvanized malleable iron with gaskets. Provide Myers threaded hubs for all conduit entries into top and side of sheet metal enclosures.
- E. Concealed Dry Locations:
 - 1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.
 - 2. Boxes and Enclosures: Provide sheet-metal boxes.
 - 3. Fittings: Provide galvanized malleable iron and steel.
- F. Exposed Dry Locations:
 - 1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or electrical metallic tubing. EMT conduit shall not be used where subject to physical damage.
 - 2. Boxes and Enclosures: Provide sheet-metal boxes with raised steel covers.
 - 3. Fittings: Provide galvanized malleable iron and steel.
 - 4. Surface Raceway and Boxes: Where specifically noted on the Drawings, provide surface raceway and boxes.
- G. Branch Circuits and Feeders 100 Amperes or Larger:
 - 1. Raceway: Provide rigid steel conduit or intermediate metal conduit.
 - 2. Boxes and Enclosures: Provide sheet-metal boxes.
 - 3. Fittings: Provide galvanized malleable iron and steel.
- H. Equipment Connections: Provide short extensions (three feet maximum) of flexible metal conduit for connections to light fixtures, motors, transformers, vibrating equipment or equipment that requires removal for maintenance or replacement. Use Liquidtight flexible conduit and fittings for motors and equipment in damp or wet locations or subject to spilling of liquids as at pumps, kitchen equipment, in mechanical rooms, boiler rooms, pump rooms, etc.
- I. Liquidtight flexible nonmetallic conduit and electrical nonmetallic tubing raceway systems for this project.

1.05 DESIGN REQUIREMENTS

- A. Raceway Minimum Size:
 - 1. Below Grade: Provide 1 inch minimum, unless otherwise noted.
 - 2. Above Grade or Within Slab: Provide 1/2 inch minimum, unless otherwise noted.
 - 3. Line Voltage Circuits: Raceway is sized on the drawings for copper conductors with 600-Volt type XHHW insulation, unless otherwise noted. Where a raceway size is not shown on the drawings, it shall be calculated to not exceed the percentage fill specified in the

NEC Table 1, Chapter 9 using the conduit dimensions of the NEC Table 4, Chapter 9 and conductor properties of the NEC Table 5, Chapter 9.

4. Fire Alarm, Telecom, Intercom and other Low-Voltage Circuits: Raceway size shall be calculated to not exceed the percentage fill specified in the NEC Table 1, Chapter 9, using the conduit dimensions of the NEC Table 4, Chapter 9, and cable diameter provided by the manufacturer.
- B. Box Minimum Size: Provide all boxes sized and configured per NEC Article 370 and as specified in this section.
- C. Seismic Support: Provide support in accordance with Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.06 SUBMITTALS

- A. Submit product data under provisions of Division 01.
- B. Product Data: Submit data for products.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

- A. Rigid Steel Conduit: ANSI C80.1, UL 6.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; Galvanized malleable iron with threaded hubs for all conduit entries. Provide threaded connections and couplings only. Set Screw and running thread fittings are not permitted. Provide copper free aluminum fittings and conduit bodies with Aluminum Conduit.
- C. Provide insulated throat bushings at all conduit terminations.

2.02 INTERMEDIATE METAL CONDUIT (IMC)

- A. Product Description: ANSI C80.6, UL 1242; Galvanized Steel Conduit.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; use fittings and conduit bodies specified above for rigid steel conduit.
- C. Provide insulated throat bushings at all conduit terminations.

2.03 FLEXIBLE METAL CONDUIT (FMC)

- A. Product Description: UL 1, FS WW-C-566; galvanized or zinc-coated flexible steel, full-wall or reduced wall thickness.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron with insulated throat bushings. Die cast zinc or threaded inside throat fittings are not acceptable.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Product Description: UL 360, flexible metal conduit with interlocked steel construction and PVC jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; liquid tight steel or malleable iron with insulated throat bushings. Die cast fittings are not acceptable.

2.05 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3, UL 797; galvanized steel tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression or set screw type with insulated throat bushings. Zinc die cast or indentor fittings are not acceptable.
- C. Provide factory elbows on sizes 1-1/2" and larger.

2.06 POLYVINYL CHLORIDE CONDUIT (PVC)

- A. Not approved for use on this project.

2.07 HIGH DENSITY POLYETHYLENE CONDUIT (HDPE)

- A. Not approved for use on this project.

2.08 ELECTRICAL NONMETALLIC TUBING (ENT)

- A. Not approved for use on this project.

2.09 FLEXIBLE NONMETALLIC OPTICAL FIBER RACEWAY

- A. Product Description: UL2024 Plenum Rated; Indoor, corrugated, 1-inch in diameter. Color Orange.
- B. Fittings: By same manufacturer as optical fiber raceway. Plenum Rated.

2.10 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, UL514A galvanized steel, with plaster ring where applicable.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
 - 2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required. Minimum Size: 4 inches square or octagonal, 2-1/8 inches deep.
- B. Cast Boxes: NEMA FB 1, Type FD, galvanized malleable iron or copper-free cast aluminum. Furnish gasketed cover by box manufacturer. Furnish threaded hubs. "Bell" boxes are not allowed.
- C. Wall Plates: As specified in Section 26 27 26 – Wiring Devices.

2.11 PULL AND JUNCTION BOXES

- A. Sheet Metal Pull and Junction Boxes: ANSI/NEMA OS 1, UL514A galvanized steel.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
- B. Sheet Metal Boxes Larger Than 12 Inches in Any Dimension: Hoffman or approved equal.
- C. Boxes for Outdoor and Wet Location Installations: NEMA 250, Type 3R; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron Type 316 stainless steel or thermoset NEMA 4X.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover and screws.
- D. Type 1A Junction Box: Fiberglass Concrete composite Type 1A Handholes: Die-molded glass-fiber concrete composite hand holes with pre-cut 6 x 6 inch cable entrance at center bottom of each side:
 - 1. Cover: Glass-fiber concrete composite, weatherproof cover with non-skid finish.
 - 2. Cover Legend: "ELECTRIC, LIGHTING, or COMM" to match load shown on plans.
- E. Polymer Concrete Junction Boxes for Underground Installations: Polymer concrete consisting of sand and aggregate bound together with a polymer resin. Internal reinforcement shall be provided by means of steel, fiberglass or a combination of the two. The installed enclosure shall be rated for a minimum test load of 7500 pounds distributed over a 10 inch by 10 inch area and used in occasional, non-deliberate vehicular traffic or pedestrian traffic application. All hardware shall be stainless steel.

2.12 EXPANSION FITTINGS

- A. Galvanized malleable iron, galvanized with grounding bond jumper.

2.13 BUSHINGS

- A. Non-grounding: Threaded impact resistant plastic.
- B. Grounding: Insulated galvanized malleable iron/steel with hardened screw bond to raceway and conductor lug.

2.14 LOCKNUTS

- A. Threaded Electro Zinc Plated Steel designed to cut through protective coatings for ground continuity.

2.15 WIREWAY

- A. Product Description: General purpose type wireway.
- B. Size per NEC minimum fill capacity unless otherwise indicated on Drawings.
- C. Knockouts: Field-installed, no factory knockouts acceptable.
- D. Cover: Screw cover. Provide raintight were installed outdoors.
- E. Fittings and Accessories: Include factory couplings, offsets, elbows, adapters and support straps required for a complete system. Provide internal ground bonding jumper bonded to each section.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 0526.
- B. Provide support and fasten raceway and box supports to structure and finishes in accordance with Section 26 0529.
- C. Identify raceway and boxes in accordance with Section 26 0553.
- D. Unless otherwise noted, do not inter-mix conductors from separate panelboards or any other system in the same raceway system or junction boxes.

3.02 INSTALLATION - GENERAL RACEWAY

- A. Install raceway for all systems, unless otherwise noted.
- B. Install an equipment grounding conductor inside of all raceways containing line voltage conductors.
- C. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, motor and equipment connections and in Mechanical and Electrical Equipment rooms. Do not route conduits on roofs, outside of exterior walls, or along the surface of interior finished walls unless specifically noted on the plans.
- D. Raceway routing and boxes are shown in approximate locations unless dimensioned. Where raceway routing is not denoted, field-coordinate to provide complete wiring system.
- E. Do not route raceways on floor. Where surface raceways are allowed in equipment rooms, arrange raceway and boxes to maintain a minimum of 6 feet 6 inches of headroom and present a neat appearance. Install raceways level and square. Route exposed raceways and raceways above accessible ceilings parallel and perpendicular to walls, ceiling, and adjacent piping.
- F. Maintain minimum 6-inch clearance between raceway and mechanical and piping and ductwork. Maintain 12-inch clearance between raceway and heat sources such as flues, steam pipes, heating pipes, heating appliances, and other surfaces with temperatures exceeding 104 degrees F.
- G. Do not install raceway embedded in spray applied fire proofing.

- H. Route raceway through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. Coordinate all requirements with Division 07 of these specifications.
- I. Where raceway penetrates fire-rated walls and floors, seal raceway penetrations of fire-rated walls, ceilings, floors in accordance with the requirements of Section 26 05 00 and Division 07.
- J. Raceways and boxes penetrating vapor barriers or penetrating areas from cold to warm shall be taped and sealed with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall include a vapor barrier on the outside.
- K. Conduit embedded in concrete or solid masonry shall not be larger than 1/3 the thickness of the wall or slab and shall be spaced not less than three diameters apart. No cutting of reinforcing bars shall be permitted unless specifically approved. Should structural members prevent the installation of conduit or equipment, notify the Owner or Contracting Officer before proceeding.
- L. Route conduits in slabs to have 1 inch minimum cover. Conduits in slab shall not compromise the structural integrity of the slab.
- M. [Field coordinate the installation of all conduit installed in or through concrete slabs containing radiant heating piping to avoid conflict with the piping prior to the concrete being poured. Core drilling of slabs with radiant heat piping installed is not allowed.]
- N. Arrange raceway supports to prevent misalignment during wiring installation.
- O. Do not attach raceway to ceiling support wires or other piping systems and do not fasten raceway with wire or perforated pipe straps. Remove all wire used for temporary raceway support during construction, before conductors are pulled. Raceway shall be installed to permit ready removal of equipment, piping, ductwork, or ceiling tiles.
- P. Group raceway in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps, as specified in Section 26 05 29. Provide space on each rack for 25 percent additional raceway.
- Q. Cut conduit square; de-burr cut ends. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- R. Use threaded raintight conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Sealing locknuts are not acceptable.
- S. Install no more than 360-degrees of bends between boxes.
- T. Install conduit bodies to make sharp changes in direction, such as around beams. "Goosenecks" in conduits are not acceptable.
- U. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.
- V. Provide protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.
- W. Avoid moisture traps; install junction box with drain fitting at low points in raceway system.
- X. Install fittings and flexible metal conduit to accommodate 3-axis movements where raceway crosses seismic joints.
- Y. Install fittings designed and listed to accommodate expansion and contraction where raceway crosses control and expansion joints.
- Z. Stub a minimum of 2 inches above floor all raceways terminated beneath free standing service equipment, pad mounted equipment, etc.
- AA. Provide weatherhead or threaded cap on all raceway stub ups which are outdoors and do not terminate into equipment.

- BB. Use cable sealing fittings forming a watertight non-slip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor outside diameter. Use Appleton CG series or equal cable sealing fittings.
- CC. Use suitable caps to protect installed raceway against entrance of dirt and moisture.
- DD. Provide nylon "jet-line" or approved equal pull string in empty raceway, except sleeves and nipples.
- EE. Paint all exposed conduit in finished spaces to match surface to which it is attached or crosses. Clean greasy or dirty conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors or walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings.

3.03 REUSE OF EXISTING CONDUITS

- A. Where shown on Drawings that existing conduits may be used, that is only applicable if the existing conduit meets the following minimum criteria:
 - 1. Conduit is sized per minimum NEC requirements.
 - 2. Conduit is properly supported as required in the Contract Documents.
 - 3. Conduit is in good, useable condition and is not deformed, damaged or showing signs of corrosion.
 - 4. Conduit is of the type specified and allowable in the Contract Documents.

3.04 INSTALLATION – GENERAL BOXES

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.
- B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel. Coordinate locations and sizes of required access doors with Division 08.
- C. Coordinate layout and installation of boxes to provide adequate headroom and working clearance and to present a neat appearance. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- D. Unless otherwise dimensioned on Plans, align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems and where normal and emergency power circuits occur in the same box.
- F. Adjust box location up to 6 feet prior to rough-in to accommodate intended purpose.
- G. Unless otherwise specifically noted, locate outlet boxes for light switches within 6 inches of the door jamb on the latch side of the door.
- H. Position outlets to locate luminaires as shown on reflected ceiling plans.
- I. Provide knockout closures for unused openings.
- J. Install boxes in walls without reducing effectiveness of wall insulation or vapor barrier.
- K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness.
- L. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes. Accurately position bridges to allow for surface finish thickness.

- M. Do not install flush mounted boxes back-to-back in walls; install with minimum 6 inches separation.
- N. Install with minimum 24 inches separation in fire rated walls. Limit penetrations in fire rated walls to 16 square inches each and a maximum total combined penetration area of 100 square inches in any given 100 square feet of wall. Where penetrations are in excess of these requirements, provide UL listed fire stop wrap acceptable to Authority having Jurisdiction.
- O. Do not fasten boxes to ceiling support wires or other piping systems.
- P. Support boxes independently of conduit.
- Q. Clean interior of boxes to remove dust, debris, and other material and clean exposed surfaces and restore finish.
- R. Provide blank covers or plates for all boxes that do not contain devices.

3.05 INSTALLATION – WIREWAY

- A. Bolt wireway to steel channels fastened to the wall or ceiling or in self-supporting structure. Install level.
- B. Mount wireway per manufacturer's installation instructions.

3.06 INSTALLATION – BURIED CONDUITS

- A. Excavation and backfilling shall be in accordance with these specifications and the applicable portions of Division 31:
 - 1. Excavate and backfill as necessary for proper installation or work.
 - 2. Provide bracing and shoring as necessary or required.
 - 3. Compact backfill under footings, floor slabs and paving using materials and methods specified under Division 31, Earthwork.
 - 4. All conduits outside the building perimeter shall be buried a minimum of 24 inches below grade or as shown on Plans. Bottom of trench shall be smoothed and all rocks and cobbles 3 inches and larger shall be removed. Provide 3/4 inch minus material 6 inches above and below conduit. Backfill remaining trench with non-frost susceptible material free of debris or rocks greater than 1 inch in diameter. Provide detectable warning tape over raceways per Section 26 0553.
 - 5. Conduits shall be bedded in a minimum of 2 inches of sand and shall have a cover of 2 inches minimum of sand. Trench shall be backfilled with non-frost susceptible material and compacted.
 - 6. Conduits below slab on grade shall be installed in the top 6 inches of classified material.
 - 7. Damage to existing underground utilities shall be repaired immediately by the Contractor at no cost to the Owner.

END OF SECTION

SECTION 26 0548
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section includes requirements for vibration and seismic restraints for electrical equipment installed in seismic categories C, D, E or F.

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, Section 26 0500 – Common Work Results for Electrical and Division 28.
- B. Section 26 0533 - Raceway and Boxes for Electrical Systems.
- C. Section 26 0529 – Hangers and Supports for Electrical Systems.
- D. Section 26 2413 – Switchboards.
- E. Section 26 2416 – Panelboards.
- F. Section 26 3200 – Packaged Generator Assemblies.
- G. Section 26 3623 – Automatic Transfer Switches.
- H. Section 26 5000 –Lighting.

1.03 DESCRIPTION

- A. Provide seismic anchorage and restraint of electrical systems including, equipment, raceways, cable trays, lighting fixtures, etc.
- B. Seismic Category D, E and F:
1. All electrical items that are of Importance Factor (I_p) = 1.5 are required to be seismically braced. This applies to the following:
 - a. The component is required to function for life safety purposes after an earthquake, including fire protection systems, fire alarm systems, emergency lighting, etc.
 - b. The component contains hazardous materials.
 - c. The component is in or attached to an Occupancy Category IV structure (Hospitals, fire station, police station, emergency shelters, etc. per ASCE 7-16, Table 1.5-1) and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- C. All other electrical equipment shall be assigned a component importance factor (I_p) = 1.0 and are required to be seismically braced unless one of the following conditions is satisfied:
1. Component is MOUNTED (connection to structure) at less than 4' above the floor (to the center of gravity of the component), and weighs less than 400 lbs.
 2. Component is mounted higher than 4' (to the center of gravity of the component), but weighs less than 50 lbs (if it is concealed).
 3. Component is mounted higher than 4' (to the center of gravity of the component), but weighs less than 100 lbs (if it is exposed).
 4. Flexible connections between the components and associated conduit are provided.
 5. All runs or groupings of conduits on or off of trapezes shall be seismically braced, unless the distribution system (including conduit, wiring and fittings) weighs less than 5 pounds per linear foot.

6. Lighting fixtures, lighted signs and ceiling fans that are not rigidly connected to ducts or piping, that are supported by chains or otherwise suspended from structure, are not required to be seismically braced, as long as:
 - a. The attachment points can carry at least 140% of the weight of the fixture, and
 - b. The swinging light will not create a falling debris problem by bumping into ceiling of other finishes, and
 - c. Connections to structure allow for movement of the fixture without damaging the connections.
- D. In accordance with ASCE 7-16 13.6.3, all electrical components with $I_p = 1.5$ shall also satisfy the following requirements:
 1. Provisions shall be made to eliminate seismic impact between components.
 2. Loads imposed on the components by attached utility or service lines that are attached to separate structures shall be evaluated.
 3. Batteries on racks shall have wrap-around restraints to ensure that the batteries will not fall from the rack. Spacers shall be used between restraints and cells to prevent damage to cases. Racks shall be evaluated for sufficient lateral load capacity.
 4. Internal coils of dry type transformers shall be positively attached to their supporting substructure within the transformer enclosure.
 5. Electrical control panels, computer equipment, and other items with slide-out components shall have a latching mechanism to hold the components in place.
 6. Electrical cabinet design shall comply with the applicable National Electrical Manufacturers Association (NEMA) standards. Cutouts in the lower shear panel that have not been made by the manufacturer and reduce significantly the strength of the cabinet shall be specifically evaluated.
 7. The attachments of additional external items weighing more than 100 lbs shall be specifically evaluated if not provided by the manufacturer.
 8. Where conduit, cable trays, or similar electrical distribution components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacements defined in ASCE 7-16 Section 13.3.2.
- E. Unless otherwise exempted above, electrical component supports and the means by which they are attached to the component shall be designed for the Seismic Category they are installed in accordance with ASCE 7-16 Section 13.6.4.

1.04 REFERENCE STANDARDS

- A. Seismic anchorage and restraints shall be designed and installed in accordance with codes and standards as enforced by authorities having jurisdiction in Alaska. Authorities shall include Owner's insurance company.
- B. Where applicable, building standards supersede those of other evaluation or listing agencies referenced in specification.
- C. International Building Code (IBC), Chapter 16 – Structural Design.
- D. ASCE 7-16 Chapter 13 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

1.05 SUBMITTALS

- A. Provide structurally engineered shop drawings for seismic restraint of all electrical equipment required by the International Building Code (IBC), Chapters 16, 17. Structural design shall be

based on the Seismic Use Category and Seismic Design Category as designated in these chapters.

- B. Provide complete calculations, drawings and details.
- C. Shop drawings shall be stamped by a professional engineer registered in the State of Alaska.
- D. Submittals shall be coordinated with building Structural engineer.
- E. Submit for approval, seismic restraint calculations, drawings and details to authorities having jurisdiction as required by those authorities.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials and devices shall be in accordance with applicable codes and standards and shall be appropriate for intended use.
- B. Anchors and attachments to building structure shall be as approved by building Structural engineer.
- C. Seismic restraints used in conjunction with vibration isolators may consist of loose cables, telescoping pipes or box sections, angles or sections, flat plates used as limit stops or snubbers, or other types of housing used either integral with or separate from vibration isolators to accomplish necessary seismic restraint.

2.02 EQUIPMENT

- A. Equipment available with seismic rating shall be provided with rating applicable to seismic zone of project location.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Secure stationary equipment, raceways and equipment supports to structure, concrete bases, or special supports to provide protection against earthquakes and to restrain lateral or vertical movement. Where vibration isolators are used, seismic restraints shall be designed to limit lateral or vertical movement during earthquake without short-circuiting vibration isolation system.
- B. Coordinate seismic restraints with building Structural engineer and incorporate building Structural engineer's requirements.
- C. Seismic restraint methods and materials shall be supplementary to support devices specified in other sections of this specification and together shall serve as equipment support criteria.
- D. Installation of devices shall be in accordance with seismic Structural engineer's drawings and details and in accordance with seismic guidelines.
- E. Coordinate installation of devices with other trades and incorporate their requirements.
- F. Modify raceway and equipment locations as required for seismic restraint system.
- G. Seismic restraint systems shall not interfere with installation of other building systems or access.

END OF SECTION

**SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates
- B. Tape Labels.
- C. Wire and Cable Markers.
- D. Fire Alarm Conduit and Box Identification.
- E. Working Clearance Striping
- F. Underground Warning Tape.
- G. Power One-line Diagram and Panel Map.

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 0500 – Common Work Results for Electrical.
- B. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 0533 – Raceway and Boxes for Electrical Systems.
- D. Section 26 2413 – Switchboard.
- E. Section 26 2416 – Panelboards.
- F. Section 26 2726 – Wiring Devices.
- G. Section 27 1000 – Structured Cabling.

1.03 SUBMITTALS

- A. Division 01 and Section 26 0500 – Common Work Results for Electrical.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color-coding, tag number, location, and function.

1.04 CLOSEOUT SUBMITTALS

- A. Electrical One-Line Diagrams and Panel Maps: Provide electronically in PDF format, submitted with the O&M manuals.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.01 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved white letters on black background. Nameplate for service disconnect shall be engraved white letters on red background.
- B. Letter Size:
 - 1. 1/4-inch high letters for identifying individual panel or equipment.
 - 2. 1/8-inch high letters for remaining lines with 1/8 inch spacing between lines.

- C. Minimum nameplate size: 1/8 inch thick with a consistent length and height for each type of nameplate wherever installed on the project.

2.02 TAPE LABELS

- A. Product Description: Adhesive tape labels, with 3/16 inch Bold Black letters on clear background made using Dymo Rhino series label printer or approved equal.
- B. Embossed adhesive tape will not be permitted for any application.

2.03 WIRE AND CABLE MARKERS

- A. Power and Lighting Description: Machine printed heat-shrink tubing, cloth or wrap-on type, for all neutrals and Phase conductors.
- B. Low Voltage System Description: Self-adhesive machine printed label with unique wire number that is shown on shop drawing for system.
- C. Telecommunications Cable Markers: Self-laminating vinyl with translucent band and minimum 1"W x .5"H printable area with matte white finish. Brady #B-427 series or approved equal.

2.04 FIRE ALARM CONDUIT AND BOX IDENTIFICATION

- A. Product Description: Red spray paint for fire alarm boxes.
- B. Fire alarm conduit shall have red finish, as specified in Section 26 05 33.

2.05 WORKING CLEARANCE STRIPING

- A. Product description: 2" wide epoxy yellow paint with 2 inch high block letters within the clearance area to read: "ELECTRICAL CLEARANCE – NO STORAGE WITHIN THIS ZONE".

2.06 UNDERGROUND WARNING TAPE

- A. Product Description: Red, 6-inch wide, detectable.
- B. Wording to read "Caution – Buried Electric Line Below".

2.07 POWER DISTRIBUTION SYSTEM ONE-LINE DIAGRAM AND PANEL MAP

- A. Product Description: One-line diagram and building floor plan panel map. One-line diagram shall show the complete building power system for each MDP. Panel map shall show the plan view location of all distribution panels and branch panelboards. Minimum size shall be 11"x17" but larger maps are recommended. All text shall be legible without magnification.
- B. Install one-line and panel map behind a Plexiglas cover screwed to wall on four corners, adjacent to each MDP.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Degrease and clean surfaces to receive nameplates and tape labels.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Underground Warning Tape Installation: Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

3.02 NAMEPLATE INSTALLATION

- A. Secure nameplates to equipment fronts using machine screws tapped and threaded into panelboard or using rivets. The use of adhesives is not acceptable. Machine screws to not protrude more than 1/16 inch on back side.
- B. Service Disconnect Nameplate: Provide nameplate on exterior service disconnect that reads "SERVICE DISCONNECT".
- C. Distribution Panel Nameplates:
 - 1. Provide overall equipment identification.

- a. Line 1: Distribution panel name.
 - b. Line 2: Source which panelboard is fed.
 - c. Line 3: Voltage, phase and wire configuration.
 - d. Line 4: AIC rating of the panel.
 - e. Line 5: Where applicable, indicate that panel is series-rated.
2. Provide circuit breaker identification for each feeder breaker.
 - a. Line 1: Name of panelboard or equipment served.
 - b. Line 2: Location of served panelboard.
- D. Branch Panelboard Nameplates:
1. Provide nameplate for each panelboard with the following information:
 - a. Line 1: Panelboard name.
 - b. Line 2: Source from which the panelboard is fed.
 - c. Line 3: Voltage, phase and wire configuration.
 - d. Line 4: AIC rating of the panelboard.
- E. Disconnects, Starters, or Contactors:
1. Provide nameplate for each device with the following information:
 - a. Line 1: Load served.
 - b. Line 2: Panelboard and circuit number from which the device is fed.
 - c. Line 3: Fuse or Circuit amperage and poles. Where fused disconnect is installed, denote the maximum fuse size to be installed.

3.03 LABEL INSTALLATION

- A. Conduit Feeder Labels - Provide conduit labels on all feeder raceways as follows:
1. Distribution Panels – “PANEL xxxx IN ROOM #xxx”.
 2. Panelboards – “PANEL xxxx FED FROM MDP xxx”.
- B. Spare Raceways: Provide raceway label on each individual raceway denoting the source and termination point at each end.
- C. Fire Alarm Device Labels: As specified in Section 28 46 00.
- D. Low-Voltage System Device Labels: Provide label on each device, denoting device ID or address where applicable. Affix label to device faceplate for ceiling-mounted devices or wall-mounted devices above 8'-0" AFF. Affix label inside backbox for exterior devices.

3.04 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identification shall be as follows:
1. Markers shall be located within one inch of each cable end, except at panelboards, where markers for branch circuit conductors shall be visible without removing panel deadfront.
 2. Each wire and cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.
 3. Color code phases, neutral, and ground per NEC requirements and Section 26 0519.
 4. Color-code all low-voltage system wires and cables in accordance with the individual sections in which they are specified.
 5. For power and lighting circuits, identify with branch circuit or feeder number.
 6. Control Circuits: Control wire number as indicated on schematic and shop drawings.

7. Fire Alarm Circuits: Provide cable markers showing NAC or SLC loop identification number at all fire alarm junction boxes and pullboxes.
- B. Provide pull string markers at each end of all pull strings. Marker shall identify the location of the opposite end of the pull string.

3.05 JUNCTION BOX IDENTIFICATION

- A. Fire Alarm: In accessible ceiling spaces, exposed ceiling spaces, mechanical/electrical rooms, and other non-public spaces, paint fire alarm junction boxes and pullboxes with red spray paint. In all finished spaces where fire alarm boxes are visible, they shall be painted to match the surrounding finish. If there are any questions as to whether fire alarm boxes shall be painted red in a specific area, the Contractor shall get clarification from the Owner prior to painting.
- B. Label each lighting and power junction box with the panelboard name and circuit number.
- C. For junction boxes above ceilings, mark the box cover with the circuit or system designation using permanent black marker. For junction boxes in finished areas, mark the inside of the cover with the circuit or system designation using permanent black marker.

3.06 DEVICE PLATE IDENTIFICATION

- A. Label each receptacle device plate or point of connection denoting the panelboard name and circuit number.
- B. Install adhesive label on the top of each plate.

3.07 PANELBOARD IDENTIFICATION

- A. Provide panelboard circuit directories in accordance with Section 26 2416.
- B. Install one-line and panel map adjacent to each MDP.

3.08 LOW-VOLTAGE SYSTEM IDENTIFICATION

- A. Install all labeling in accordance with the requirements of this section and of each section where the individual systems are specified.

END OF SECTION

**SECTION 26 2413
SWITCHBOARDS**

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes service switchboards.

1.02 RELATED SECTIONS:

- A. Section 03 3000 - Cast-In-Place Concrete.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0548 – Vibration and Seismic Controls for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems.

1.03 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C12.1 - Code for Electricity Metering.
- B. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
 - 2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. National Electrical Manufacturers Association:
 - 1. NEMA PB 2 - Deadfront Distribution Switchboards.
 - 2. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- D. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- E. Underwriters Laboratories Inc.:
 - 1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 2. UL 891 - Dead-Front Switchboards.

1.04 SUBMITTALS

- A. Submit product data under provisions of Division 01 and Section 26 0500.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details. Provide wiring diagrams showing all factory wired components to include, but not limited to, ground fault protection equipment, transient voltage surge suppression devices, arc-flash reduction devices, metering, shunt trip/remote close devices, etc.
- C. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- D. Submit structurally engineered shop drawings as specified in Section 26 0548 – Vibration and Seismic Controls for Electrical Systems for seismic restraint of all equipment required by the 2012 IBC. Equipment requiring structural shop drawings includes, but is not limited to the following: Free-standing or pad mounted distribution switchboards.

1.05 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals under provisions of Section 26 0500 – Common Work Results for Electrical and General Conditions in MASSB and Supplementary Conditions to the Contract.
- B. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.
- C. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Division 01.
- B. Deliver in 72-inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.
- C. Accept switchboards on site. Inspect for damage.
- D. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 MAINTENANCE MATERIALS

- A. Furnish two of each key.

PART 2 PRODUCTS

2.01 SERVICE AND MAIN DISTRIBUTION SWITCHBOARDS

- A. Manufacturers:
 - 1. Eaton (Basis of Design).
 - 2. Square D.
 - 3. Siemens
 - 4. Substitutions: Under provisions of Division 01 and 26 0500.
- B. Product Description: NEMA PB 2, enclosed switchboard with electrical ratings and configurations as indicated on Drawings.
- C. Device Mounting as shown on the Drawings.
- D. Bus:
 - 1. Material: Copper with silver or tin plating, standard size.
 - 2. Connections: Bolted, accessible from front for maintenance.
- E. Ground Bus: Extend length of switchboard.
- F. Minimum Short Circuit Rating: As shown on the Drawings.
- G. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials and sizes as indicated on Drawings.
- H. Incoming Utility Section: Provide Current Transformer/Metering section as shown on the drawings and in accordance with local utility company requirements.
- I. Fire Pump Tap Section: Provide Fire Pump Tap section as shown on the drawings and in accordance with the NEC.

- J. Service Disconnect Section: Provide Service Disconnect section with main circuit breaker and associated accessories as shown on the drawings.
- K. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, insulated and braced for short circuit currents. Furnish continuous current ratings.
- L. Enclosure: NEMA type as indicated on Drawings.
- M. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.02 MOLDED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. Same manufacturer as Switchboards.
- B. Product Description: UL 489, molded-case circuit breaker.
- C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 400 amperes and larger have mechanism for adjusting long time, short time, instantaneous, and ground fault (if required) current pickup setting for automatic operation.
- D. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault.

2.03 GROUND FAULT DEVICES

- A. Manufacturers:
 - 1. Same manufacturer as Switchboards.
- B. Ground Fault Sensor: Provide integral to breaker were shown on the Drawings.
- C. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Furnish monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

2.04 ARC ENERGY REDUCTION

- A. Manufacturers:
 - 1. Same manufacturer as Switchboards.
- B. Where the highest continuous trip setting of a circuit breaker is rated or adjustable to 1200 amps or higher, provide an energy reducing maintenance switch (ERMS) with local status indicator in accordance with NEC 240.87.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify surface is suitable for switchboard installation.

3.02 PREPARATION

- A. Concrete Pad: Comply with requirements of Section 03 3000 – Cast-in-Place Concrete.

3.03 INSTALLATION

- A. Install in accordance with NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Install engraved plastic nameplates in accordance with Section 26 0553 – Identification for Electrical Systems.
- D. Install breaker circuit directory for main and distribution switchboards.
- E. Ground and bond switchboards in accordance with Section 26 0526 – Grounding and Bonding for Electrical Systems.

3.04 FIELD QUALITY CONTROL

- A. Section 26 0126 – Maintenance Testing of Electrical Systems.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.1.
- D. Provide performance testing on all ground fault protection systems in accordance with NEC 230.95. This test shall be conducted by qualified persons using a test process of primary current injection.

3.05 ADJUSTING

- A. Adjust operating mechanisms for free mechanical movement.
- B. Tighten bolted bus connections.
- C. Adjust circuit breaker trip and time delay settings to values as recommended by the manufacturer based upon project Drawings.

3.06 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

**SECTION 26 2416
PANELBOARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Branch Circuit Panelboards.

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements, and Section 26 0500 – Common Work Results for Electrical.
- B. Section 26 0526 – Grounding and Bonding for Electrical Systems.
- C. Section 26 0553 – Identification for Electrical Systems.
- D. Section 26 0548 – Vibration and Seismic Control for Electrical Systems.

1.03 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.
- B. NEMA PB 1 - Panelboards.
- C. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- D. UL 50 – Enclosures for Electrical Equipment.
- E. UL 67 – Panelboards.
- F. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.
- G. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.

1.04 SUBMITTALS

- A. Submit data under provisions of Division 01 and Section 26 0500.
- B. Product Data: Submit product data for all components provided which fall under this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.
- C. Shop drawings: Submit shop drawings for each panelboard [load center] indicating features and device arrangement and size. Include outline and support point dimensions, voltage, main bus ampacity, and integrated short circuit ampere rating.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Submit final record panel schedules as hardcopy and in Microsoft Excel format. Submit under Section 26 0500.
- B. Operation and Maintenance Manuals: Provide product data and shop drawing information including replacement parts list. Provide installation, operation and maintenance information per manufacturer.
- C. Panel Schedules: Prior to Substantial Completion, submit copies of all panel schedules for review by the Owner. The Owner will note any changes to the room numbers/names and the Contractor shall provide revised typed panel schedules to reflect all changes, at no additional cost to the Owner.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Division 01.
- B. Upon arrival at the site inspect equipment and report on any damage.

- C. Handle carefully on site to avoid any damage to internal components, enclosures and finishes.
- D. Store in a clean, dry environment. Maintain factory packaging and provide an additional heavy canvas or plastic cover to protect enclosures from dirt, water, construction debris and traffic.

1.07 WARRANTY

- A. Manufacturer shall warrant specified equipment to be free of defects for a period of one year from the date of installation.

1.08 SPARE PARTS

- A. Keys: Furnish 2 each to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS - PANELBOARDS

- A. Square D.
- B. Eaton.
- C. General Electric.
- D. Siemens.
- E. Substitutions: Under provisions of Division 01.

2.02 BRANCH CIRCUIT PANELBOARDS

- A. Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
- B. Enclosure: NEMA PB 1; Type 1 or 3R as indicated on Drawings. Boxes shall be galvanized steel constructed in accordance with UL50 requirements. Interiors shall be field convertible for top or bottom incoming feed. Interior leveling provisions shall be provided for flush mounted applications.
- C. Cabinet Size: 6 inches deep; 20 inches wide minimum.
- D. Provide flush or surface cabinet front as indicated on the Drawings with [door-in-door cover] concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper [aluminum] bus, ratings as scheduled on Drawings. Provide one continuous bus bar per phase each. Panelboards shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. Bussing shall be fully rated.
- F. Integrated Short Circuit Rating: Provide panelboards with short circuit ratings as shown on the Drawings. Minimum ratings shall be 10,000 amperes RMS symmetrical for 250 volt panelboards; 14,000 amperes RMS symmetrical for 600 volt panelboards.
- G. Branch Circuit Breakers: NEMA AB 1; Provide panelboards with bolt-on type thermal magnetic trip circuit breakers.
 - 1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free with common trip handle for all poles.
 - 2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90°C rated wire, sized according to the 75 °C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.
 - 3. Provide circuit breakers UL listed as Type SWD for lighting circuits.
 - 4. Provide circuit breakers UL listed as type HACR for use with heating, air conditioning and refrigeration equipment.
 - 5. Provide UL Class A ground fault interrupter circuit breakers were scheduled on Drawings.

2.03 PANELBOARD IDENTIFICATION

- A. For each panelboard, provide typed schedule denoting each circuit load by the load type and final name and room number actually in use in the facility. Schedule shall not be typed with names shown on the Contract Drawings unless names are acceptable to the Owner.
- B. Provide panel schedule in O&M manual for every new panelboard.
- C. Where more than one nominal voltage system is present on the premises, the conductor color-coding legend shall be permanently posted at each branch circuit and distribution panelboard per NEC requirements.
- D. All panelboards shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment. At a minimum the signage shall state the following:

Warning

Arc Flash and Shock Hazard

Appropriate PPE Required

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1.
- B. Height: 6 feet, 6 inches to top of panelboard.
- C. Provide filler plates for unused spaces in panelboards.
- D. Panel Schedules: Revise schedules to reflect circuiting changes required to balance phase loads.

3.02 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION

**SECTION 26 2726
WIRING DEVICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall Switches.
- B. Receptacles.
- C. Device Plates and Box Covers.

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements and Section 26 0500 – Common Work Results for Electrical.
- B. Section 26 0526 – Grounding and Bonding for Electrical Systems.
- C. Section 26 0533 – Raceway and Boxes for Electrical Systems.
- D. Section 26 0553 – Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 – Federal Specification for Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- B. FS W-S-896 – Federal Specification for Switches, Toggle (Toggle and Lock), Flush Mounted.
- C. NEMA WD 1 - General Color Requirements for Wiring Devices.
- D. ANSI/NEMA WD 6 – Wiring Devices – Dimensional Requirement.
- E. UL 20 – General-Use Snap Switches.
- F. UL 498 - Attachment Plugs and Receptacles.
- G. UL 943 – Ground-Fault-Circuit-Interrupters.

1.04 SUBMITTALS

- A. Product Data: Submit product data for all components provided that are specified in this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - WALL SWITCHES

- A. Hubbell.
- B. Leviton.
- C. Pass & Seymour.
- D. Arrow Hart
- E. Substitutions: Under provisions of Division 01.

2.02 WALL SWITCHES

- A. Wall Switches for Lighting Circuits: UL 20; ANSI/NEMA WD-6; and Federal Specification FS W-S-896 AC industrial grade snap switch with toggle handle, rated 20 amperes and 120-277 volts AC. Handle: White nylon. Provide single-pole, 3-way, or 4-way switches as indicated on Plans.

2.03 ACCEPTABLE MANUFACTURERS - RECEPTACLES

- A. Hubbell.
- B. Leviton.

- C. Pass & Seymour.
- D. Arrow Hart
- E. Substitutions: Under provisions of Division 01.

2.04 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: UL 498, ANSI/NEMA WD-6 and Federal Specification FS W-C-596 industrial grade receptacle.
- B. Convenience Receptacle Configuration: ANSI/NEMA WD-6; Type 5-20R, white [ivory] nylon face.
- C. GFCI Receptacles: ANSI/NEMA WD-6; 20A, duplex convenience receptacle with integral class 'A' ground fault current interrupter, LED indicator lamp and integral lockout.
- D. Weather-Resistant Receptacles: ANSI/NEMA WD-6; Listed to the weather-resistant supplement of UL498 and complying with the requirements of NEC 406.9.

2.05 DEVICE PLATES

- A. Decorative Cover Plate: Smooth 430 or 302 stainless steel with metal, counter sunk screws to match device plate.
- B. Weatherproof Cover Plate: UL listed, cast aluminum, hinged outlet cover/enclosure, with gasket between the enclosure and the mounting surface, suitable for wet locations while in use and identified as "Extra Duty" per NEC 406.9 (B)(1).
- C. Exposed Work Cover Plate: ½ inch raised, square, pressed, galvanized or cadmium plated steel cover plate supporting devices independent of the outlet box.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install wall switches 48 inches above floor, OFF position down.
- B. Unless otherwise noted install wall switches within 6 inches of the door jamb on the strike side.
- C. Install convenience receptacles 18 inches above floor, 4 inches above counters or backsplash, grounding pole on bottom.
- D. Unless otherwise noted, mounting heights are for finished floor to center line of outlet.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas. Use midsize or jumbo plates for outlets installed in masonry walls, where required to cover up imperfections in the wall opening.
- F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- G. Install devices and wall plates flush and level.
- H. Ground receptacles to boxes with a grounding wire. Grounding through the yoke or screw contact is not an acceptable alternate to the ground wire.
- I. Install circuit label on each receptacle and light switch in accordance with Section 26 0553.

END OF SECTION

**SECTION 26 3200
PACKAGED GENERATOR ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Contractor designed and installed packaged, pre-wired, turnkey generator power distribution system and walk-in module. This is a performance type specification describing the minimum acceptable packaged engine generator system. The Contractor shall design and install the packaged engine generator system and power distribution system in accordance with the requirements of NFPA 70, NFPA 110 and IBC. The packaged engine generator and power distribution system and module on the drawings are shown in suggested locations and suggested dimensions, the final layout, location and dimensions of equipment and devices shall be solely determined by the Contractor and shall be in accordance with NFPA 70, NFPA 110 and IBC:
 - 1. Packaged engine generator systems.
 - 2. Walk-in enclosure.
 - 3. Walk-in enclosure Electrical and Mechanical systems.
 - 4. Genset accessories.

1.02 RELATED SECTIONS

- A. Division 03 - Cast-In-Place Concrete.
- B. Section 26 0500 – Common Work Results for Electrical.
- C. Section 26 0519 – Low Voltage Electrical Power Conductors and Cables.
- D. Section 26 0526 – Grounding and Bonding for Electrical Systems.
- E. Section 26 0529 – Hangers and Supports for Electrical Systems.
- F. Section 26 0533 – Raceway and Boxes for Electrical Systems.
- G. Section 26 0548 – Vibration and Seismic Controls for Electrical Systems.
- H. Section 26 0553 – Identification for Electrical Systems.
- I. Section 26 2416 – Panelboards.
- J. Section 26 2726 – Wiring Devices.
- K. Section 26 5000 – Lighting.
- L. Section 26 3600 – Automatic transfer switches.

1.03 REFERENCES

- A. ASCE 7 Chapter 13.
- B. ANSI/NEMA AB 1 – Molded Case Circuit Breakers.
- C. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. ANSI/NEMA MG 1 - Motors and Generators.
- E. ANSI/NFPA 70 - National Electrical Code.
- F. ANSI/NFPA 110 – Emergency and Standby Power Systems.
- G. ASTM A36 – Specification for Carbon Structural Steel.
- H. ASTM A653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- J. IBC, Chapter 16 – Structural Design.

- K. IEEE446 - Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- L. ISO 8528 – Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets.
- M. UL 2200 – Stationary Engine Generator Assemblies.
- N. UL 142 - Aboveground Flammable Storage Tanks

1.04 SYSTEM DESCRIPTION

- A. Engine generator system to provide source of standby power for entire facility. The engine generator assembly shall be listed in accordance with UL 2200.
- B. System Capacity: 900kW, 1,125 KVA, emergency/standby rated at elevation of 1000 feet above sea level, and ambient temperature between -40 and 104° F.
- C. Operation: In accordance with ANSI/NFPA 110.
- D. The Packaged Generator Assembly, enclosure, all dimensions, and performance data are based on Kohler model: KD900. The CONTRACTOR shall make all necessary modifications required for other manufacturers, at no additional cost to the OWNER, if Kohler Generation's equipment is not supplied.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 01.
- B. Submit shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- C. Submit product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, sub-base fuel day tank, duct-mount load bank, and remote annunciator.
- D. Provide structurally engineered shop drawings as specified in Section 26 0548 for seismic restraint of all equipment required by the 2012 IBC, Chapter 16 (1621).
- E. Submit shop drawings, product data and calculations for the walk-in enclosure and all associated equipment. Shop drawings shall include dimensioned layout of all equipment in plan view and elevation view. Drawings and calculations shall show compliance with IBC seismic, wind, and snow loading criteria specific to the Project location, and shall be stamped by a Licensed Professional Structural Engineer in the State of Alaska.
- F. Submit technical data including features, performance, electrical characteristics, physical characteristics, ratings and finishes for the load bank. Shop drawings shall include dimensional plans and mounting details sufficient to properly install the load bank. Load bus configuration and load connections and load termination area shall be clearly identified. Electrical schematic drawings shall be provided to detail the operation of the load bank and the provided safety circuits. Over-current protection and control devices shall be identified and their ratings marked. A system interconnection drawing shall be included for control wiring related to the load bank.
- G. Submit manufacturer's installation instructions under provisions of Division 01.

1.06 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Division 01.
- B. Accurately record location of packaged generator assembly, and all external mechanical and electrical connections. Provide dimensioned routing of underground utilities from building to enclosure, as applicable.
- C. Submit onsite test records showing the results of the testing per Part 3.3 below.

1.07 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Division 01.
- B. Include instructions for the following:
 - 1. Normal operation.
 - 2. Routine maintenance requirements, including replacement of filters.
 - 3. Starting battery inspection/maintenance.
 - 4. System coolant and other fluid inspection and replacement.
 - 5. Oil sampling and analysis for engine wear.
 - 6. Emergency maintenance procedures.
- C. Provide manufacturer's service manuals for all equipment, including but not limited to the following: Engine, generator, radiator, and fuel tank.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in packaged generator assemblies with a minimum of five years of documented experience.
- B. Supplier: Authorized distributor of the packaged generator assembly with service facilities in Anchorage, AK. Supplier shall be authorized by the manufacturer to maintain and administer the warranty and employ factory certified mechanics to perform warranty work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Division 01.
- B. Store and protect products under provisions of Division 01.
- C. Accept packaged engine generator set and accessories on site in crates and verify damage.
- D. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.10 WARRANTY

- A. Under the provisions of Division 01, the complete electrical power system (generator sets, enclosure, controls, automatic transfer switches and associated switches and accessories) shall be warranted by the manufacturer against defects in materials and workmanship for a period of five years or 1,500 hours from the date of generator commissioning, whichever occurs first. Warranty shall include parts, labor, travel expenses and labor to remove/reinstall equipment. There shall be no deductibles applied to the warranty.

1.11 MAINTENANCE SERVICE

- A. Furnish service and maintenance of packaged engine generator system for three years from Date of Substantial Completion. The maintenance service shall include two semi-annual inspections and test run the engine to perform manufacturers recommended preventative maintenance service on the equipment furnished.

1.12 EXTRA MATERIALS

- A. Submit maintenance materials under provisions of Division 01.
- B. Furnish one set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.
- C. Provide two additional sets of each fuel, oil, and air filter element required for the engine generator system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Kohler (Basis of Design).

- B. Substitutions: Under provisions of Division 01.

2.02 ENGINES

- A. Type: Water-cooled inline or V-type, four stroke cycle, compression ignition internal combustion engine.
- B. Rating: Emergency power rated per ISO 8528 at specified elevation and ambient limits.
- C. Fuel System: Appropriate for use of #2 fuel oil.
- D. Engine Speed: 1800 rpm.
- E. Governor: Isochronous type to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes.
- F. Safety Devices: Engine shutdown on high water temperature, high lube oil temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.
- G. Engine Starting: Electric DC starting system capable of three complete cranking cycles without overheating. Starters shall have positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
- H. Engine Jacket Heater: Model 10305000145-KA6 UL listed and labeled thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 120° F, and suitable for operation on 208 volts AC.
- I. Radiator: Integral cooling system that is closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump. Engine-driven fan shall be blower type and rotating parts shall be guarded against accidental contact.
1. Modular radiator cores for ease of maintenance, repair, or replacement.
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives. Coolant must be part GM109949.
 3. Size of Radiator: Adequate to contain expansion of total system coolant to 110 percent of capacity.
 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by Kohler.
 6. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant material.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 215° F, and noncollapsible under vacuum.
- J. Engine Accessories:
1. Oil Pump: Positive displacement, mechanical, full pressure, lubrication oil pump.
 2. Fuel Pump: An engine driven, mechanical, positive displacement fuel pump. Include fuel priming pump.
 3. Fuel filter with a replaceable spin-on canister element. Provide Kohler 230510003 or approved equal pre-filter, with water shutdown sensor tied to control panel.
 4. Replaceable dry element air cleaner with restriction indicator.
 5. Water pump.
 6. Lube oil cooler.

7. Lube Oil Drain: Extend the lube oil drain to the outside of the generator skid using Areoquip fittings. Install a Nibco T - 113 shut off valve on the hose at an accessible location of the unit and cap the end of the hose with a ¾" NPT cap.
- K. Mounting: Provide structural steel base for mounting the genset. Include vibration isolators between the genset and skid base per the manufacturer's IBC Seismic Certified package requirements.

2.03 GENERATORS

- A. Generator: ANSI/NEMA MG 1; three phase, four pole, reconnectible brushless synchronous generator with brushless PMG excitation.
- B. Rating: 900kW, 1,125 kVA, at 0.8 power factor, 480Y/277 volts, 60Hz at 1800 rpm.
- C. Insulation and Temperature Rise: ANSI/NEMA MG 1, Class F, 130° C, standby.
- D. Enclosure: ANSI/NEMA MG 1; open drip proof.
- E. Voltage Regulation: Microprocessor-based, high-speed digital voltage regulator, separate from exciter, with three-phase, true RMS sensing, providing performance as specified.
 1. Maintain steady-state voltage within 0.25 percent from no load to full load.
 2. Adjusting Feature on Control and Monitoring Panel: Provide plus or minus 10 percent adjustment of output-voltage operating band.
- F. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady state operating band within 5 seconds. On application of a 100% load step, the generator set shall recover to stable voltage within 10 seconds.
- G. Frequency Regulation: Isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
- H. Transient Frequency Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of 100% load step, the generator set shall recover to stable frequency within 10 seconds.
- I. Output Waveform: The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall not exceed 50 in accordance with NEMA MG 1.
- J. Sustained Short-Circuit Current: For a 3-phase bolted short circuit at system output terminals, the generator set shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to the generator system components. For a single-phase bolted short circuit at system output terminals, the system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
- K. Start Time: Comply with NFPA 110, Level 1, Type 10 system requirements.
- L. Generator Leads: The generator leads shall be brought out and terminated on a unit-mounted generator circuit breaker. The generator leads shall have sufficient length to allow for any connection configuration.

2.04 WALK-IN ENCLOSURE

- A. Manufacturer: Enclosure manufacturer shall be qualified to perform the work under this section with a minimum of five (5) years documented experience with similar enclosures. The walk-in module and all associated equipment shall be furnished as an integral unit, packaged, turnkey with generator by a single supplier.

- B. The building structural design shall meet the seismic, wind, and snow loads as required by the IBC for the specific project area. The building structure shall comply with the requirements for the rain test and accumulation of water under abnormal conditions for NEMA 3R enclosures.
- C. Structural design shall be stamped and signed by a Licensed Professional Engineer in the State of Alaska.
- D. Structural Framing:
 - 1. Framing consists of rolled structural shapes in accordance with ASTM-A36 specifications.
 - 2. All connections shall be of all welded design in accordance with the International Building Code (IBC) latest edition and amendments.
 - 3. The roof shall be shed type and sloped 2" in one direction as shown on the Drawings.
 - 4. All structural steel shall be primed with a marine alkyd primer preceding fabrication. No top coat is applied.
- E. Walls and Roof:
 - 1. Exterior wall panels of the module shall be formed and welded 14-gauge galvanized Steel Satin Coat per ASTM-A653.
 - 2. Roof shall be 12-gauge galvanized Steel Satin Coat per ASTM-A653 and is fully seam-welded, guaranteed not to leak.
 - 3. Walls insulated with 5" mineral wool (R20) and lined 22 gauge perforated galvanized steel sheets mechanically fastened to the framing members.
 - 4. Roof insulated with 5" mineral wool (R20) and lined 22 gauge perforated galvanized steel sheets mechanically fastened to the framing members.
 - 5. Two (2) Fall Restraint pads shall be provided on the roof.
 - 6. Enclosure paint system shall require exterior wall panels surface prep to SSPC-SP1: Solvent Clean. Prime with two-part epoxy primer to 2.0 to 4.0 mils dft. Finish coat two-part aliphatic urethane to 2.0 to 4.0 mils dft. High Standard Power Systems standard paint system color shall be per the project Architect. Sub-Base Tank shall be surface prep to SSPC-SP6: Commercial Blast. Prime with two-part epoxy primer to 3.0 to 5.0 mils dft. Finish coat two-part aliphatic urethane to 3.0 to 5.0 mils dft. Color shall match the enclosure color.
 - 7. Exterior Doors shall be High Standard Power Systems Standard formed and welded 14-gauge galvanized Steel Satin Coat to ASTM-A653 construction with an insulated core. Doors shall be flush on the exterior and sealed with neoprene "Bulb Seal" to NEMA 3R and shall have the same finish as the exterior of the building. Doors insulated with 5" mineral wool (R20) lined with 22 gauge perforated galvanized steel sheets mechanically fastened to the framing members.
- F. Support Baseframe:
 - 1. The generator sets and all ancillaries shall be supported on the prefabricated steel baseframe designed to withstand the forces of damage fatigue as a result of transportation and placement at site.
 - 2. All frame structural material shall be in accordance with ASTM A36. Galvanized steel shall be Grade 30 in accordance with ASTM A653. Tolerances shall be +/- 1/8".
 - 3. There shall be two longitudinal wide flange beams provided as the main support positioned inward of the perimeter and to provide skidding as required. Additional thermal break between the rails and the enclosure shall be provided.
 - 4. Floor plate shall consist of 3/16" diamond plate galvanized steel properly braced and stiffened to prevent "oil canning." All seams shall be stitch welded. At the Contractor's option an epoxy coated floor system may be used in lieu of the diamond plate.

5. Four lifting eyes shall be provided in relation to the center of gravity.

G. Enclosure Access Stairs:

1. Provide stair access and landing at building entrance(s). Provide number of steps as required to meet IBC requirements and suitable for site conditions. Stairs and landing shall be manufactured from structural grade aluminum or stainless steel grip strut. Provide aluminum or stainless steel handrails as required per the IBC.

H. Electrical:

1. The following electrical components shall be supplied and installed in accordance with the applicable project Specification Sections, the National Electric Code (NEC), and as shown on the Drawings.
2. 225 amp, 120/208V, 3-phase, 4W lighting and service panel complete with 225AF/100AT main breaker and required branch circuit breakers. Reference Section 26 2416 Panelboards.
3. Provide interior LED fixtures, Lithonia #FEM L48 or equal, to provide an average lighting level of 30 footcandles throughout the module. Reference Section 26 5000 Lighting. Provide light switch at entries to module to control interior lights. Reference Section 26 2726 Wiring Devices.
4. Provide interior emergency lighting via LED dual lamp emergency fixtures with integral battery backup, Lithonia ELM4L or equal. Reference Section 26 5000 Lighting.
5. Provide exterior LED fixtures with integral photocell at each door, Lithonia TWR1 LED P2 40K PE DDBTXD or equal. Reference Section 26 5000 Lighting. Provide one light switch at an entry for manual control exterior lights. Reference Section 26 2726 Wiring Devices.
6. A minimum of three interior duplex receptacles in addition to those required to operate the battery charger and engine block heater. A minimum of one GFCI protected exterior duplex receptacle with an "In-Use" listed weatherproof cover. Reference Section 26 2726 Wiring Devices.
7. All components shall be installed, wired, and tested in accordance with the applicable Division 26 Specifications and the NEC.
8. Providing labeling on all equipment as required by Section 26 0553 Identification for Electrical Systems.

I. Ventilation:

1. All motor operated dampers and motors shall be provided and pre-wired to a relay panel with controls.
2. All openings shall include weatherhoods and birdscreens. Coordinate hood locations and configuration with site and building layout. Intake openings shall be a minimum of 72" Above finished grade.
3. Ventilation and Combustion Air:
 - a. One (1) Fixed, 4" insulated and lined horizontal intake hood with integral duct silencers and fixed louvers with galvanized bird screen.
 - b. One (1) Insulated Aluminum Volume Control Damper with four (4) Belimo AFB24-MFT-S modulating actuators (Fail open – power close).
4. Radiator Air Discharge:
 - a. One (1) Flex connector between radiator and damper.
 - b. One (1) Aluminum insulated volume control damper with two (2) Belimo AFB24-MFT-S modulating actuators (Fail open / power close).
 - c. One (1) 4" Insulated and lined vertical discharge hood with removable duct silencer with integral duct silencers and galvanized bird screen.

5. One (1) Thermostatically controlled 1,640 CFM exhaust fan with gravity backdraft damper. Fan to be interlocked with the intake damper.

6. One (1) PLC Based Ventilation Control Panel based on room temperature only.

J. Heating:

1. Two (2) 4.8kW Electric Fan Forced unit heaters shall be provided with built-in thermostats to heat generator enclosure.

K. Temperature Control System:

1. Temperature controls shall be provided to operate electric unit heaters and generator dampers.

L. Insulation:

1. Insulate all ductwork, engine exhaust piping and muffler.

2.05 ACCESSORIES

A. Sub-Base Tanks: Double-wall, all-welded construction, base-mounted fuel tank with a minimum capacity for 36-hour runtime. The tank outside dimensions shall not exceed the dimensions of the generator enclosure framework. The tank the structural integrity to support the engine-generator set, shall be supplied by the engine-generator set distributor, and shall be installed before shipment. The tank shall be UL 142 listed for both primary and secondary containment and shall meet all of the requirements of NFPA for the intended use. The tank shall have the following features:

1. 2,330 useable gallons capacity providing 36 hours of generator run time at 100% nameplate rating

2. Five (5) Internal generator supports with ten (10) mounting pads.

3. 2" perimeter containment

4. Exterior 4" UL Listed 5-gallon spill bucket with 2" lockable manual fill cap with 2" cam lock and ULC overflow prevention valve.

5. One (1) Mechanical Fuel Level Gauge

6. ULC Listed High (90%), low (30%) and critical low (10%) level switches

7. One (1) Supply fitting with dip tube, foot valve

8. One (1) Return fitting with dip tube

9. One (1) Stub-up under both generator circuit breakers with 2" containment

10. One (1) Stub-up under the distribution panel with 2" containment

11. ULC listed stainless steel flexible fuel lines provided from the sub-base tank to the engine

12. Venting per B139

13. One (1) Normal vent (2") with vent extended

14. Two (2) Emergency vents

15. Four (4) Spare 2" Fittings
16. One (1) Spare 4" Fitting
- B. Exhaust Silencers: One (1) Interior, Hospital Plus Grade, mild steel, rectangular silencer with 90 degree elbow. Two (2) 18" stainless steel exhaust flexible connections. One (1) 40" Exterior exhaust stack with heavy-duty rain cap. Nut, bolt, and gasket kits shall be provided for all flanged exhaust connections with all bolts double-nutted. Removable insulation blankets shall be provided and installed for the interior silencer, exhaust flexes, and exhaust elbow.
- C. Batteries: Shall be heavy duty Kohler part 10702002501-KA1 Absorbent glass mat (AGM), no exceptions.
- D. Battery Trays: Non-metallic battery boxes with covers and hold-downs, treated for electrolyte resistance and constructed to contain spillage of electrolyte. Provide with seismic restraints to secure batteries during earthquakes. The battery housing shall be accessible for maintenance.
- E. Battery Charger: Provide Kohler 10702000502-KA1 Industrial 20A Battery Charger. Battery charger shall comply with UL1236 for Category BBHH. Battery charger operation shall be current-limited, constant-voltage, automatic-boost-type charger designed for AGM maintenance-free batteries, with the following features:
 - a. Automatic three-stage charge cycle for up to three independent batteries simultaneously per charger.
 - b. Output Voltage Regulation: Charger regulates output to within plus or minus 0.5 percent of manufacturer-provided voltage settings despite variations of input voltage, input frequency, and output current.
 - c. Battery Thermal Compensation: Battery temperature compensation with adjustable slope, factory set at minus 0.18 percent per degree C, and equipped for sensing battery temperature.
 - d. AC Input: Charger operates from any 45- to 65-Hz ac source with voltage ranging from 105- to 264-V rms.
 - e. LCD Digital Display: AC input voltmeter, DC output voltmeter, and ammeter (1 percent accuracy).
 - f. LED Lamp Indicators: Current limit, AC ON, and charger fail.
 - g. Charger Fail Alarm Contact: Voltage-free (dry type) form "C" output.
 - h. Filtered output for type VRLA AGM batteries.
 - i. Charger Enclosure: NEMA 250, Type 1 (IP20), wall mounted and rated for generator duty with charger enclosure vibration resistance.
- F. Line Circuit Breaker: NEMA AB 1 molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole; sized in accordance with ANSI/NFPA 70. Include battery-voltage operated shunt trip, connection to open circuit breaker on engine failure. Mount unit in enclosure to meet ANSI/NEMA 250, Type 1 requirements.
- G. Engine-Generator Control Panel: Shall be Kohler APM603 and provide the following equipment and features:
 1. Digital engine generator controller with integrated graphical touch screen TFT display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
 2. Controller Face Ingress Protection: IP 65.
 3. Operating Temperature: Minus 40 to plus 70 deg F (Minus 40 to plus 21 deg C).
 4. Maximum Operating Humidity: 95 percent non-condensing.
 5. Corrosion Resistant: Tested in accordance with ASTM B117 (salt spray test).
 6. Controller Features:

- a. Mode Selector: Allowing selection of one of the following modes:
 - 1) Off/Reset: Prohibits the generator from starting and resets shutdowns. In this mode the controller does not respond to remote start and stop commands.
 - 2) Manual: Allows user to locally start and stop to operate the generator. In this mode the controller does not respond to remote start and stop commands.
 - 3) Auto: Allows generator to start and stop based on remote commands. In this mode the generator does not respond to manual start and stop commands.
- b. Emergency Stop Switch: Latch-type remote stop switch, red in color with mushroom-type head. Depressing the stop button will immediately stop the generator set and lock out any automatic remote starting.
- c. Audible Alarm: Horn sounds for specific warning and shutdown conditions.
- d. Alarm Silence/Lamp Test Pushbutton: Silences audible alarm when depressed. All controller indicating lights are simultaneously illuminated while actuated.
- e. Fault Light: LED indicating abnormal conditions:
 - 1) Yellow: Active warning condition or mode selector switch not in automatic.
 - 2) Red: Active shutdown condition.
- f. Real-time clock and calendar for time stamping events.
- g. Load Management:
 - 1) Programmable outputs to command the connect and disconnect of loads based on system state:
 - a) Loads connected based on available capacity.
 - b) Loads disconnected at system startup.
 - c) Loads disconnected based on a maximum kW setting or under frequency setting.
 - 2) Support up to 16 load steps.
- h. Engine Control Features:
 - 1) Programmable engine start delay.
 - 2) Programmable engine cool-down delay.
 - 3) Programmable warm-up delay based on time or engine temperature.
 - 4) Programmable idle speed.
 - 5) Programmable cyclic cranking with adjustable on time, off time, and number of cycles.
- i. Event Logging:
 - 1) Maintain record of a minimum of 1,000 events with date and time locally for warning and shutdown faults.
 - 2) Event log easily available for download onto USB storage device or PC.
 - 3) Event Snapshot: Capture 15 seconds of critical data around the time of a fault or warning. Data to be viewable on the controller and downloadable.
- j. Data Logging: Capable of time-based recording of customized parameters.
 - 1) Parameters selectable from all monitored parameters.

- 2) Sample period configurable from one second to one day.
- 3) Collected data stored on USB storage device plugged into the control panel.

- k. Minimum of three user access levels.
- l. Password protection to prevent unauthorized modification to system parameters.
- m. Customizable Interface:
 - 1) Overview Screen: Dedicated screen allowing user to display up to 16 parameters for immediate access.
 - 2) Favorites: User customizable menu set up for enhanced usability.

- 7. Monitoring Instruments: Accessible through the digital engine generator controller and viewable during operation.
 - a. Engine-coolant temperature.
 - b. Battery voltage.
 - c. Running-time meter.
 - d. Engine speed.
 - e. Oil pressure.
 - f. Fuel level (with optional sensor).
 - g. Fuel pressure.
 - h. Fuel consumption rate.
 - i. Crankcase pressure.
 - j. Oil temperature.
 - k. Coolant level.
 - l. Coolant pressure.
 - m. Common rail fuel pressure.
 - n. Fuel temperature.
 - o. Intake air temperature.
 - p. Exhaust temperature (with optional sensor).
 - q. Charge air pressure.
 - r. Charge air temperature.
 - s. Ambient temperature.
 - t. AC output voltage including all phase-to-phase quantities, 0.25 percent accuracy.
 - u. AC output current for each phase, 0.25 percent accuracy.
 - v. AC frequency, 0.25 percent accuracy.
 - w. Power factor total and per phase with leading/lagging indication.
 - x. kW total and per phase, 0.5 percent accuracy.
 - y. kVARS total and per phase, 0.5 percent accuracy.
 - z. kVA total and per phase, 0.5 percent accuracy.
 - aa. kW hours.
 - bb. Generator duty level (actual kW loading divided by kW nameplate).

- 8. Service Data: Stored in the controller and available for display.
 - a. Generator model number and serial number.
 - b. ECM serial number.
 - c. Alternator part number.
 - d. Engine model number and serial number.
 - e. Controller serial number and firmware version.

- 9. Operational Records: Stored in controller beginning at system startup.

- a. Total run-time hours.
 - b. Total loaded hours.
 - c. Total unloaded hours.
 - d. Total kW hours.
 - e. Controller hours.
 - f. Controller run-time hours.
 - g. ECM run-time hours.
 - h. Number of starts.
 - i. Number of crank attempts.
 - j. Last crank duration.
 - k. Last start runtime duration.
 - l. Last start date and time.
 - m. Last stop date and time.
10. Maintenance Records: Stored in controller beginning at system startup, user resettable to zero.
- a. Total run-time hours since last maintenance.
 - b. Total loaded hours since last maintenance.
 - c. Total unloaded hours since last maintenance.
 - d. Total kW hours since last maintenance.
11. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:
- a. Mode selector switch not in automatic position.
 - b. Overcrank shutdown.
 - c. Low lubricating-oil pressure warning.
 - d. Low lubricating-oil pressure shutdown.
 - e. Low coolant temperature warning.
 - f. High engine temperature warning.
 - g. High engine temperature shutdown.
 - h. Overspeed shutdown.
 - i. High fuel level warning.
 - j. Low fuel main tank.
 - 1) Low-fuel-level alarm to be initiated when the level falls below that required for operation for duration required
 - 2) Critically low-fuel-level warning.
 - k. Coolant low-level shutdown device.
 - l. Coolant high-temperature warning.
 - m. Coolant high-temperature shutdown.
 - n. ECM Digital Trouble Codes warnings.
 - o. ECM Digital Trouble Codes shutdown.
 - p. Loss of ECM Communications shutdown.
 - q. ECM mismatch shutdown.
 - r. Battery high-voltage warning.
 - s. Battery-charger malfunction warning.
 - t. Battery low-voltage warning.
 - u. Remote manual stop shutdown.
 - v. Local manual stop shutdown.
 - w. Alternator protection shutdown.
 - x. Overcurrent warning.

- y. Overcurrent shutdown.
- z. Under frequency warning.
- aa. Under frequency shutdown.
- bb. Over frequency warning.
- cc. Over frequency shutdown.
- dd. Over power warning.
- ee. Over power shutdown.
- ff. Under voltage warning.
- gg. Under voltage shutdown.
- hh. Over voltage warning.
- ii. Over voltage shutdown.
- jj. User-defined input warning.
- kk. User-defined input shutdown.
- ll. No oil pressure signal shutdown.
- mm. No speed sensor signal shutdown.
- nn. Fail-to-start shutdown.

H. Remote Annunciator Panels: Provide flush mounted 20-light LED type remote alarm annunciator panels with brushed stainless steel finish and alarm horn, located as shown on the Drawings. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 2 systems for the local generator control panel. Annunciator shall be labeled with the specified functions. Alarm silence and lamp test switches shall be provided. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel. Provide alarm horn, and indicators and alarms as follows:

Condition	Lamp Color	Audible Alarm
Genset Running	Green	No
Not in Auto	Red (Flashing)	Yes
High Battery Voltage	Red	Yes
Low Battery Voltage	Red	Yes
Charger AC Failure	Red	Yes
Fail to Start	Red	Yes
Low Engine Temperature	Amber	Yes
Pre-High Engine Temperature	Amber	Yes
High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Amber	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
Overcrank	Red	Yes
Emergency Stop	Red	Yes
Low Coolant Level	Amber	Yes

Low Fuel Level	Amber	Yes
Loss of Generator Control Wiring	Red	Yes
Network OK	Green	Yes
(4) Spares	Configurable	Configurable

- I. Low battery voltage lamp shall also be lighted for low cranking voltage or weak battery alarm.
- J. Heaters: Provide manufacturer's recommended heaters with thermostatic controls to keep engine oil pan, engine block, generator controls, and generator windings within manufacturer's recommended temperature at 30°F. Provide immersion type coolant heater in remote radiator to keep radiator within manufacturer's recommended temperature at -20°F.
- K. Mounting: The complete engine/generator package shall be mounted on a common, self-supporting, low profile, structural steel skid base with rubber in shear vibration isolators between the engine and base and spring type vibration isolators with seismic snubbers between the base and the module. The base shall extend from the rear end of the generator to the most forward point of the engine and shall be predrilled to accept a #2 AWG - 250 kCMIL copper grounding conductor.
- L. Resistive Load banks:
 - 1. UL listed, free-standing, air-cooled, resistive load bank:
 - a. The load bank shall be Simplex MARS 900 and supplied by the generator supplier.
 - b. The load bank shall be designed for continuous duty have a total capacity at unity power factor or +/-5% of the value shown on the drawings.
 - c. The load bank shall be constructed of heavy gauge aluminized steel per ASTM A463 or galvanized steel with marine grade, baked polyester powder coated finish and exterior stainless steel fasteners.
 - d. Load elements shall be helically wound chromium alloy wire rated to operate at approximately ½ of maximum continuous rating of the wire. Elements shall be fully supported across the entire length of the air stream by segmented ceramic insulators on stainless steel rods. Element supports shall be designed to prevent a short circuit to adjacent elements or ground.
 - e. The load bank shall have a unit mounted control panel
 - f. The load bank shall have automatic load stepping capability with a step resolution nominally 20% of the load bank rating.
 - g. Protective Devices:
 - 1) A differential pressure switch shall be provided to detect air loss. The switch shall be electrically interlocked with the load application controls to prevent load from being applied if cooling air is not present.
 - 2) An over-temperature switch shall be provided to sense the load bank exhaust. The switch shall be electrically interlocked with the load application controls to prevent load from being applied in the event of an over temperature condition.
 - 3) Branch fuses shall be provided on all three phases of switched load steps above 50KW. Branch fuses shall be current limiting type with an interrupting rating of 200K A.I.C

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work and field dimensions are as shown on Drawings.
- B. Verify that required utilities are available in proper location and ready for use.

- C. Beginning of installation means installer accepts existing conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Ground and bond generator and other electrical system components in accordance with NEC requirements.

3.03 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01.
- B. Generator system on-site testing shall be performed in accordance with NFPA 110 requirements for Level 1 Systems, namely Part 7.13. Coordinate scheduling of testing with Owner and Authority Having Jurisdiction a minimum of seven (7) days prior to testing.
- C. Perform an initial 1.5 hour minimum on-site acceptance test utilizing all loads that are served by the EPSS, per NFPA 110 7.13.4.1. Simulate power failure by opening the normal source to all transfer switches. Observe, verify and record the following:
 - 1. Time delay on start up.
 - 2. Cranking time until the prime mover starts and runs.
 - 3. Time to reach operating speed.
 - 4. Verify engine start function by verifying operation of the initiating circuit on all transfer switches supplying EPSS loads.
 - 5. Time to achieve a steady-state generator condition after all transfer switches have transferred to the emergency position.
 - 6. Record real power, apparent power, voltage, frequency, amperage, oil pressure, and coolant temperature at 15 minute intervals throughout the test.
 - 7. Time delay on retransfer to normal power for all transfer switches.
 - 8. Time delay on generator cooldown and shutdown.
- D. Upon completion of the initial acceptance test, allow the generator to cool for a minimum of 5 minutes before beginning the full load test below.
- E. Provide a two (2) hour full-load test utilizing the integrated load bank,. Building loads may be utilized during this full load test if approved by the Owner prior to testing. Simulate power failure including operation of each transfer switch. Full-load testing shall be done as follows:
 - 1. 30 minutes at 50% rated load.
 - 2. 30 minutes at 75% rated load.
 - 3. 1 hour at 100% rated load.
 - 4. Record real power, apparent power, voltage, frequency, amperage, oil pressure, and coolant temperature at 15 minute intervals throughout the test.
- F. Upon completion of the full-load test test alarm and shutdown circuits by simulating conditions. Demonstrate all automatic features as directed by the Owner's Representative.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Prepare, start, test, and adjust systems under provisions of Division 01.

3.05 ADJUSTING

- A. Adjust work under provisions of Division 01.
- B. Adjust generator output voltage and engine speed.

3.06 CLEANING

Southcentral Foundation - Benteh Nuutah Valley Native Primary Care Center
1001 S Knik Goose Bay Rd, Wasilla, AK 99654
22007.01 VNPCC New Generator

- A. Clean work under provisions of Division 01.
- B. Clean engine and generator surfaces. Replace oil and fuel filters.

3.07 DEMONSTRATION

- A. Provide systems demonstration under provisions of Division 01.
- B. Describe loads connected to standby system and restrictions for future load additions.
- C. Simulate power outage by interrupting normal source and demonstrate that system operates to provide standby power.

END OF SECTION

**SECTION 26 3623
AUTOMATIC TRANSFER SWITCHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Complete factory assembled Automatic Transfer Switch (ATS).

1.02 RELATED SECTIONS

- A. Section 26 0553 - Identification for Electrical Systems: Engraved Nameplates.
- B. Section 26 3200 – Packaged Generator Assemblies.

1.03 REFERENCES

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements and Section 26 0500 – Common Work Results for Electrical.
- B. NFPA 70 - National Electrical Code.
- C. NFPA 110 – Emergency and Standby Power Systems.
- D. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- E. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
- F. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- G. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
- H. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- J. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Transfer Switching Equipment.
- K. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- L. UL 508 - Industrial Control Equipment.
- M. UL1008 - Standard for Transfer Switch Equipment.

1.04 SUBMITTALS

- A. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching devices, operating logic, short circuit ratings, dimensions, enclosure details and all option provided.
- B. Factory Test Report: Provide copy of factory operational test on the transfer switch prior to shipping from the factory. A certified test report shall be included in the packing list with the transfer switch. The test process shall include calibration of voltage sensors.

1.05 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Indicate actual locations and mounting heights of transfer switches on the project record drawings. Submit under Section 26 0500.
- B. O&M Manuals:
 - 1. Provide project adjusted shop drawings indicating the final wiring and terminations with the O&M manuals.
 - 2. Provide printout or spreadsheet indicating final settings and adjusted values of the transfer switch.

3. Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions when engine generator is running.
4. Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience. Manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service in accordance with ISO 9001.
- B. Supplier: Must be supplied by the generator supplier to be part of a complete system. Authorized distributor of specified manufacturer with minimum three years documented experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 110 for a Level 2 system.
- C. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.09 FIELD MEASUREMENTS

- A. Verify that field measurements are as instructed by manufacturer.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.11 WARRANTY

- A. Provide three-year manufacturer warranty of all components, parts, and assemblies against defects in materials and workmanship, with no deductible for all components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton (Basis of Design)
- B. Kohler.
- C. Substitutions: Under provisions of Division 01.

2.02 AUTOMATIC TRANSFER SWITCH

- A. Description: NEMA ICS 2, UL 1008 listed automatic transfer switch.
- B. Configuration: Double throw, electrically operated, electrically and mechanically interlocked and mechanically held transfer switch. The transfer switch shall be specifically designed so that it cannot stop in a neutral position.
- C. Closed Transition type:
 1. The CTTS shall transfer the load without interruption (closed transition) by momentarily connecting both sources of power only when both sources are present and acceptable. The maximum interconnection time is 100 milliseconds. The CTTS shall operate as a conventional break-before-make (open transition) switch when the power source serving the load fails.

2. Source differential sensing shall be provided for the closed transition operating mode. The sensor shall enable transfer/re-transfer between live sources in the closed transition mode only when the two sources have a maximum voltage differential of 5%, frequency differential of 0.2 Hz and are within 5 electrical degrees.
3. Closed transition transfer shall be accomplished with no power interruption and without altering or actively controlling standby generator set.

2.03 SERVICE CONDITIONS

- A. Service Conditions: NEMA ICS 1.
- B. Operating Temperature: minus 4°F to plus 140°F.
- C. Altitude: 1,000 feet.

2.04 RATINGS

- A. Furnish and install Automatic Transfer Switches with voltage, amperage, and number of switched poles as shown on project one-line drawing.
- B. Load Inrush Rating: Combination load.
- C. Continuous Rating: As noted on the Drawings.
- D. Interrupting Capacity: 250 percent of continuous rating.
- E. Withstand Current Rating: The switch shall be rated to withstand the fault current as shown on the Drawings. Transfer switch withstand ratings shall be applicable for ANY manufacturer's breakers. Withstand ratings utilizing specific manufacturer's breakers will only be accepted if coordinated in advance by the Contractor to ensure the existing/new breaker upstream of the transfer switch complies with the "specific breaker" listing.

2.05 PRODUCT OPTIONS AND FEATURES

- A. ATS Controls: Microprocessor controls with digital display for status information.
- B. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
- C. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s) to allow the control system to be disconnected and service without disconnecting power from the transfer switch mechanism.
- D. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- E. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch or the number and size of conductors shown on the drawings, whichever is larger.
- F. Operator Panel: Provide with a control panel to allow the operator to view the status and control the operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities:
 1. High intensity LED lamps to indicate the source that the load is connected to and which sources are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
 2. High intensity LED lamps or control panel display to indicate that the transfer switch in "Not in Auto" and "Test/Exercise Active" to indicate that the control system is testing or exercising the generator set.
 3. "OVERIDE" pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.

4. "TEST" pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
5. Security key switch or controller password protection to allow the user to inhibit adjustments, manual operation or testing of the transfer switch unless the key is in place and operated.
6. Alphanumeric display panel with pushbutton navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The alphanumeric display panel shall be capable of providing the following functions and capabilities:
 - a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen.
 - b. Display source status to indicate source is connected or not connected.
 - c. The display panel shall allow the operator to view and make the following adjustments in the control system after entering an access code:
 - 1) Set nominal voltage and frequency for the transfer switch.
 - 2) Adjust voltage and frequency sensor operation set points.
 - 3) Set up time clock functions.
 - 4) Set up load sequence functions.
 - 5) Enable or disable control functions in the transfer switch, including program transition.
 - 6) Set up exercise and load test operation conditions, normal system time delays for transfer time, time delay for start, stop transfer and retransfer.
 - d. Display real time clock data, including date, and time in hours, minutes and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
 - e. Display service history for the transfer switch. Display source connected hours to indicate the total number of hours connected to each source. Display number of times transferred and total number of times each source has failed.
- G. Provide RMS voltage sensing and metering that is accurate to within plus or minimum 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site.
- H. Transfer switch voltage sensors shall be close differential type providing source availability information to the control system based on the following functions:
 1. Monitoring all phases of the normal source for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage leave and dropout in a range of 75 to 98% of normal voltage level).
 2. Monitoring all phases of the standby source for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage leave and dropout in a range of 75 to 98% of pickup voltage level).
 3. Monitoring all phases of the normal and standby sources for voltage imbalance.
 4. Monitoring all phases of the normal and standby sources for loss of a single phase.
 5. Monitoring all phases of the normal and standby sources for phase rotation.

6. Monitoring all phases of the normal and standby sources for over voltage conditions (adjustable for dropout over a range of 105 to 135% or normal voltage and pickup at 95 – 99% of dropout voltage level).
 7. Monitoring of all phases of the normal and standby sources for over or under frequency conditions.
- I. Communications Module: Provide remote interface module to support monitoring of vendor's transfer switch, controller and optional power meter. Module shall provide status, analog parameters, event logs, equipment settings & configurations over embedded webpage and open protocol. Module shall allow for the initiating of transfers, retransfers, bypassing of active timers and the activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor's monitoring equipment. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0 – 6 seconds, set at 5 seconds); transfer (adjustable in a range from 0 – 120 seconds, set at 2 seconds); retransfer (adjustable in a range from 0 – 30 minutes, set at 5 minutes); and generator stop (cool down) (adjustable in a range of 0 – 30 minutes, set at 5 minutes).
 - J. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs to provide optimum protection from line voltage surges, RFI and EMI.
 - K. The transfer switch shall provide an isolated relay contact for starting of the generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C.
 - L. Provide one set of Form C auxiliary contacts on both sides operated by transfer switch position, rated 10 Amps, 250 VAC.
 - M. Generator set exercise (test) with load mode: The control system shall be configurable to test the generator set under load. In this mode the transfer switch shall control the generator set in the following sequence:
 1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program or when manually initiated by the operator.
 2. When the control system senses the generator set at rated voltage and frequency it shall operate to connect the load to the generator set.
 3. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period the transfer switch shall automatically reconnect the load to the normal source.
 4. At the completion of the exercise period the transfer switch shall operate to connect the load to the normal source.
 5. The transfer switch shall operate the generator set unloaded for the programmed cool down period and then remove the start signal from the generator set. If the normal source fails at any time when the generator set is running the transfer switch shall immediately connect the load to the generator set.
 - N. Generator set exercise (test) without load mode: The control system shall be configurable to test the generator set without transfer switch load connected. In this mode the transfer switch shall control the generator set in the following sequence:
 1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program or when manually initiated by the operator.
 2. When the control system senses the generator set at rated voltage and frequency it shall operate the generator set unloaded for the duration of the exercise period.
 3. At the completion of the exercise period the transfer switch shall remove the start signal from the generator set and shut the generator down. If the normal source fails at any time when

the generator set is running the transfer switch shall immediately connect the load to the generator set.

- O. Elevator Pre-Transfer Delay Relay: Provide relay and NO/NC contact outputs to delay transfer or retransfer for a specified time to give warning to an elevator controller that a transfer or retransfer is about to occur. This time delay shall be adjustable over a range of 0 to 60 seconds, set to 20 seconds or as recommended by elevator manufacturer.
- P. Generator Control Wiring Monitoring Device: Provide means to monitor the integrity of the generator start signal. The device, upon loss of control wire integrity, shall issue visual and audible annunciation at the generator and remote annunciator locations, and start the generator.

2.06 ENCLOSURE

- A. Enclosure shall be ICS 10 and UL listed NEMA 3R. The enclosure shall provide wire bend space in compliance to the latest version of NFPA 70. The cabinet door shall include permanently mounted key type latches.
- B. Enclosure shall be configured to require front access only front access for maintenance.
- C. For NEMA 3R outdoor installations, provide transfer switch with 125W strip heater properly designed and sized to prevent condensation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface is suitable for transfer switch installation.

3.02 INSTALLATION

- A. Install transfer switches in accordance with manufacturer's instructions.
- B. Provide engraved plastic nameplates under the provisions of Section 26 0553.
- C. Provide start-up control signal wiring between transfer switch and standby diesel generator system to start generator upon local loss of power.
- D. Provide reinforced concrete pad(s) for pad mounted transfer switch.
- E. All transfer switches shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment. At a minimum the signage shall state the following:

Warning
Arc Flash and Shock Hazard
Appropriate PPE Required

3.03 MANUFACTURER'S SERVICES

- A. The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be included in the packing list with the transfer switch. The test process shall include calibration of voltage sensors.

3.04 DEMONSTRATION

- A. Visual and Mechanical Inspection:
 - 1. Compare equipment nameplate data with drawings and specifications.
 - 2. Inspect physical and mechanical condition.
 - 3. Verify manual transfer warnings are attached and visible.
 - 4. Verify tightness of control connections.
 - 5. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

6. Perform manual transfer operation.
 7. Verify positive mechanical interlocking between normal and alternative sources.
 8. Inspect anchorage, alignment, grounding and required clearances.
- B. Electrical Tests:
1. Measure contact-resistance.
 2. Perform insulation-resistance tests, phase-to-phase and phase-to-ground, with switch in both source positions. Test duration shall be one minute. Use a test voltage in accordance with manufacturer's published data. For control devices that cannot tolerate test voltage follow manufacturer's recommendation.
 3. Verify settings and operation of control devices.
 4. Calibrate and set relays and timers in accordance with manufacturer's published data.
 5. Verify phase rotation, phasing and synchronized operation as required by the application.
 6. Perform automatic transfer tests:
 - a. Simulate loss of normal power.
 - b. Return to normal power.
 - c. Simulate loss of emergency power.
 - d. Simulate all forms of single-phase conditions.
 7. Verify correct operation and timing of following functions:
 - a. Normal source voltage-sensing relays.
 - b. Engine start sequence.
 - c. Time delay upon transfer.
 - d. Alternate source voltage-sensing relays.
 - e. Automatic transfer operation.
 - f. Interlocks and limit switch function.
 - g. Time delay and retransfer upon normal power restoration.
 - h. Engine cool down and shutdown feature.

END OF SECTION

**SECTION 26 5000
LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior and Exterior Luminaires and Accessories.
- B. Lamp Modules.
- C. Drivers.
- D. Emergency Lighting Units.

1.02 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 0500 – Common Work Results for Electrical.
- B. Division 09 – Finishes: Painting and Ceilings.
- C. Section 26 0519 – Low Voltage Electrical Power Conductors and Cables.
- D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- E. Section 26 0529 - Hangers and Supports for Electrical Systems: General Supports for Luminaires.
- F. Section 26 0533 – Raceway and Boxes for Electrical Systems.
- G. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems: Seismic Supports for Luminaires.
- H. Section 26 0553 – Identification for Electrical Systems.
- I. Section 26 2726 – Wiring Devices.

1.03 DEFINITIONS

- A. CCT: Correlated Color Temperature.
- B. CRI: Color Rendering Index.
- C. Driver: LED Power Supply.
- D. Fixture: See "Luminaire."
- E. IES: Illuminating Engineering Society of North America
- F. IP: International Protection or Ingress Protection Rating.
- G. Lamp Module: Replaceable LED board array/light engine including a plug-in connector.
- H. LED: Light-emitting diode.
- I. Lumen: Measured output of lamp and luminaire, or both.
- J. Luminaire: Complete lighting unit, including lamp or lamp module, driver, reflector, and housing.
- K. THD: Total Harmonic Distortion.

1.04 REFERENCE STANDARDS

- A. NECA/IESNA 500 – Recommended Practice for Installation Indoor Commercial Lighting System.
- B. IES TM-21-11 Projecting Long Term Lumen Maintenance of LED Light Sources.
- C. IES LM-80 IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.

- D. UL 924 - Emergency Lighting and Power Equipment.

1.05 SUBMITTALS

- A. Product Data: Submit the following:

1. Luminaires: Include manufacturer's product data sheets and/or shop drawings including outline drawings showing support points, weights, and accessory information for each luminaire type. Clearly indicate all options being provided. Arrange data for luminaires in the order of fixture designation.
2. Prior to preparing submittals, coordinate with the reflected ceiling plan for ceiling finishes and provide all necessary kits, brackets, stems, trim, etc. to install the specified fixtures in the ceilings provided. Clearly note these configurations on the product data sheets.

- B. Shop Drawings: Provide detailed shop drawings for specialty luminaires as required by the manufacturer.

- C. Warranty: Provide copies of manufacturer's warranty information for each luminaire. If warranty information is the same for a group of manufacturer's luminaires, provide a letter or schedule clearly indicating what warranty applies to each fixture.

- D. LED Luminaire Substitutions: Due to the constantly evolving technology, it is difficult to evaluate a true "equal" LED luminaire since the wattage, LED life, lumen output, etc. vary significantly from fixture to fixture, even for luminaires that have a similar shape and style. The luminaires shown on the Plans in the Fixture Schedule are not intended to be sole sourced but are considered a Basis of Design. If a substitution is proposed by the contractor, it will be evaluated based on the following criteria:

1. Does it have the same basic shape/style and characteristics? Note that there may be space constraints above the ceiling.
2. Does the luminaire have the same (or superior) light output and distribution? If not, would it still produce enough light to illuminate the space per minimum IES recommendations or other project specific lighting levels? Note that the Engineer may request .ies files or lighting calculations be provided by the Contractor to evaluate substitution requests.
3. Does it use the same (or less) wattage than the specified fixture? If it uses slightly more power, does it provide enough value to the Owner by adding additional light to offset the additional power used? Is that appropriate for the project compliance requirements. (LEED, ASHRAE 90.1, etc.)
4. Does it have the same nominal color temperature and CRI values? Note that for certain luminaires this may be more important where artwork or merchandise is illuminated.
5. Does it have an equal or better lamp life as calculated in accordance with IES TM-21 and LM-80?
6. Does the manufacturer offer an equal or better warranty than the specified fixture?
7. Are the LED lamps modules and LED boards field changeable? What guarantees does the manufacturer have that replacement parts will be available in the future?

1.06 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Indicate actual locations and mounting heights of all lighting fixtures and accessories on the project record drawings. Update part numbers and description on the Lighting Fixture Schedule to match the actual luminaires installed. Submit under Section 26 05 00.

- B. Operation and Maintenance Manuals:

1. Provide recommended luminaire cleaning and re-lamping schedule. If any luminaire lenses require special lubricants for cleaning, include this in the schedule.

2. Provide detailed bill of materials for all items purchased in this section including distributor's contact name, phone number and pertinent information.
3. Provide luminaire manufacturer's installation instructions.
4. Provide manufacturer's step-by-step installation instructions showing how to replace the LED lamp modules and drivers for each luminaire.
5. Include any specific warranty information provided by the manufacturer for luminaires, LED boards and drivers.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect in a clean, dry environment under provisions of General Conditions of the Contract.

1.08 EXTRA MATERIALS

- A. Provide spare parts under provisions of Division 01.
- B. Lenses: One of each size and type.
- C. Drivers: One of each size and type installed.
- D. LED Lamp Modules: Provide a minimum of 2 of each unique type of lamp module used on the project. Ship LED lamp modules (i.e. LED board) in protective packaging and label each lamp module to indicate the fixture type that it may be installed in. (i.e. Type A or Type D1).
- E. LED Luminaire: Where the specified or substitute luminaire does not have a replaceable lamp or lamp module, provide one spare luminaire per size and type installed.

PART 2 PRODUCTS

2.01 INTERIOR AND EXTERIOR LUMINAIRES AND ACCESSORIES

- A. Luminaires: Provide UL listed luminaires as scheduled on the drawings or as approved equal.
- B. Listing: Luminaires shall be listed for use in the environment in which they are installed. For example, luminaires installed in return air plenums, direct contact with insulation, or in hazardous, wet, damp, or corrosive locations shall be UL listed for such application.
- C. Accessories: Provide all mounting kits, supports, interconnecting wiring, power supplies, trim kits, gaskets, etc. for a complete installation.
- D. Housing:
 1. Metal parts shall be free of burrs and sharp corners and edges. Form and support to prevent warping and sagging.
 2. Doors, Frames and Other Internal Access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
 3. Luminaires shall be factory painted and free of discoloration. Color as scheduled.

2.02 LAMP MODULES – LED

- A. All LED's shall be nominal 4000 degrees Kelvin (nominal) within a 3-step MacAdam Ellipse unless special circumstances require a different color temperature application, see Luminaire Schedule on Plans.
- B. Color Rendering: Minimum CRI as scheduled on the Plans for each fixture. Under no circumstances shall the CRI be less than 70.
- C. Lamp Life: Minimum lamp life shall be calculated in accordance with IES LM-80. Lamp life for each luminaire shall be equal or greater than scheduled on the Plans. Under no circumstances shall an interior luminaire have a minimum rated life (L70) less than 50,000 hours at 75 degrees

F average indoor ambient temperature and an outdoor luminaire less than 75,000 hours at 40 degrees F average outdoor ambient temperature.

- D. Replaceable: Unless otherwise scheduled, all LED modules shall be field replaceable with quick disconnect connections.
- E. Luminaires and lamps installed outdoors shall be rated for starting and operating at a minimum of -40F.

2.03 DRIVERS - LED

- A. LED Driver: Provide UL listed power supply as recommended by the LED fixture manufacturer for operation of the specified LED lamps. Power supply shall be integral to the luminaire unless otherwise noted on the Plans. Power supply shall be dual voltage (120/277V) where available or operate at the supply voltage indicated on the Plans.
- B. LED Dimming Driver: UL listed 0-10V dimming driver as recommended by the LED fixture manufacturer for operation of the specified LED lamps, fully compatible with the dimming system or dimming switch controlling the fixture. Driver shall be integral to the fixture and capable of dimming the luminaire down to 1% output unless otherwise scheduled on the Plans. Power supply shall be dual voltage (120/277V) where available and operate at the supply voltage indicated on the Plans.

2.04 EMERGENCY LIGHTING UNITS

- A. Luminaires: Provide UL listed emergency lighting units as scheduled on the drawings or as approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction items that penetrate ceilings or are supported by them, including luminaires, occupancy sensors, HVAC equipment, smoke detectors, fire-suppression system, IP video cameras, and partition assemblies. Adjust locations as required.
- B. Unless otherwise noted on Plans, provide drivers integral to luminaires, pre-wired and installed at the factory, suitable for use with the selected LED lamps.
- C. Support surface-mounted luminaires directly from building structure. Install level and parallel/perpendicular with ceiling or wall surfaces.
- D. Rigidly align continuous rows of lighting fixtures for true in-line appearance.
- E. Provide luminaire disconnecting means in the wiring compartment of each luminaire. Where the luminaire is fed from a multi-wire branch circuit, provide multi-pole disconnect to simultaneously break all supply conductors to the ballast, including the grounded conductor.
- F. LED Power Supplies: Install power supplies to be readily accessible. Where power supplies are installed in plenum areas, provide plenum rated listing. Where remote power supplies are used, install in concealed, accessible locations or in utility room that provides adequate sound dampening. Locate driver to allow free air movement in accordance with manufacturer's installation instructions and securely mount to structure.
- G. Tandem wiring: Provide factory harness for all tandem mounted light fixtures.
- H. Support exterior surface-mounted luminaires directly from building structure. Maintain wall waterproofing.
- I. Aim directional lampheads of emergency lighting units to illuminate the path of egress.
- J. Coordinate location of wall mounted emergency lighting units with mechanical equipment, ductwork, piping, or any other obstruction that would impact the lighting output.

- K. Wiring installed between a luminaire and an emergency lighting inverter or remote emergency driver is considered "emergency" wiring and shall be separated from the normal wiring and installed in a dedicated raceway per NEC Article 700.

3.02 RELAMPING

- A. Re-lamp or replace luminaires that have failed lamps at completion of work.

3.03 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire finish at completion of work.

3.04 FIELD QUALITY CONTROL

- A. Tests: Perform tests listed below according to manufacturer's written instructions. Test unit functions, operations, and protective features. Adjust to ensure operation complies with Specifications. Perform tests required by NFPA 70, Articles 700 and 701. Perform tests on completion of unit installation and after building circuits have been energized. Provide instruments to permit accurate observation of tests. Include the following tests:
 - 1. Simulate power outage: Verify proper operation of each individual emergency power supply.
 - 2. Verify emergency supply duration.
 - 3. Verify operation of remote test switches.
 - 4. Provide reports for load test conducted on individual batteries.
- B. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.05 ADJUSTING

- A. Aim lamps on wall-mounted emergency lighting units to obtain the following illumination of egress pathway:
 - 1. An average of 1 foot-candle.
 - 2. A minimum at any point of 0.1 foot-candle measured along the path of egress at floor level.
 - 3. Maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.
- B. Test emergency lighting equipment in accordance with the manufacturer's instructions and NECA/IESNA 500.

3.06 DEMONSTRATION

- A. Walk owner's representative through the emergency lighting system. Note how to maintain, test and troubleshoot all units. Provide maintenance schedule for NFPA required testing and note locations of remote test switches, and which units have self-diagnostic features.

END OF SECTION