

SECTION 26 23 00

LOW-VOLTAGE SWITCHGEAR
05/15

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS) or Japan Electrical Safety Inspection Associations for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2023) National Electrical Safety Code

ELECTRICAL SAFETY INSPECTION ASSOCIATIONS

Denki Hoan Kyokai Japan Standard for Acceptance Testing and Inspections

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS B 1048	(2007) Fasteners - Hot Dip Galvanized Coatings
JIS C 0365	(2007) Protection Against Electric Shock - Common Aspects for Installation and Equipment
JIS C 1210	(1979) General Rules for Electricity Meters
JIS C 1731-1	(1998) Instrument Transformers for Testing Purpose and Used with General Instrument Part 1: Current Transformer
JIS C 2110-1	(2016) Solid electrical insulation materials-Test methods for strength of dielectric breakdown-Part 1: Tests by applying commercial frequency alternating voltage
JIS C 5381-11	(2014; R 2019) Low-voltage surge protective devices -- Part 11: Surge protective devices connected to low-voltage power systems -- Requirements and test methods
JIS C 8201-1	(2020) Low-voltage switchgear and control unit-Part 1: General rules
JIS C 8201-2-1	(2021) Low-Voltage Switchgear and Control Gear - Part 2-1: Circuit-Breakers

JIS C 8201-2-2	(2021) Low-Voltage Switchgear And Control Gear - Part 2-2: Circuit-Breakers Incorporating Residual Current Protection
JIS C 8462-1	(2021) Boxes and enclosures for electrical accessories for household and similar fixed electrical installations -- Part 1: General requirements
JIS C 8480	(R2020) Box-Type Switchgear Assemblies for Low-Voltage Distribution Purpose
JIS C 60364-5-54	(2006; R 2015) Building Electrical Equipment-Part 5-54: Selection Of Electrical Equipment and Contruction-Grounding Equipment, Protective Conductor and Protective Bonding Conductor
JIS C 60364-6	(2010; R 2019) Low-voltage electrical installations -- Part 6: Verification
JIS C 61558-1	(2019) Safety of transformers, reactors, power supply units and combinations thereof -- Part 1: General requirements and tests
JIS C 61000-4-5	(2018) Electromagnetic compatibility-Part 4-5: Test and measurement techniques-Surge immunity test
JIS K 6911	(2006; R 2021) Thermosetting plastic general test method
JIS K 6912	(1995; R 2006) Laminated Thermosetting Sheets
JIS G 3352	(2014) Deck Plate
JIS G 4304	(2021) Hot-Rolled Stainless Steel Plate, Sheet and Strip
JIS H 8641	(2021) Hot Dip Galvanized Coatings
JIS Z 2371	(2015) Methods of Salt Spray Testing
JIS Z 9101	(2018) Graphical symbols -- Safety colours and safety signs -- Part 1: Design principles for safety signs and safety markings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70E	(2024) Standard for Electrical Safety in the Workplace
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1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section,

with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor QC approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29, SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings; G[, [_____]]

SD-03 Product Data

Switchgear; G[, [_____]]

SD-06 Test Reports

Acceptance Checks and Tests;

SD-10 Operation and Maintenance Data

Switchgear Operation and Maintenance, Data Package 5;

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals;

Equipment Test Schedule;

[Request for Settings;

][Required Settings;

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[Service Entrance Available Fault Current Label;

1.5 QUALITY ASSURANCE

1.5.1 Product Data

Include manufacturer's information on each submittal for each component, device and accessory provided with the switchgear including:

- a. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- b. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device.

1.5.2 Switchgear Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity on submittal. Also include applicable federal, military, industry, and technical society publication references on submittals. Include the following:

- a. One-line diagram including breakers[, fuses][, current transformers, and meters].
- b. Outline drawings including front elevation, section views, footprint, and overall dimensions.
- c. Bus configuration including dimensions and ampere ratings of bus bars.
- d. Markings and NEMA nameplate data[, including fuse information (manufacturer's name, catalog number, and ratings)].
- e. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- f. Wiring diagrams and elementary diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.
- g. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device. Use this information (designer of record) to provide breaker settings that ensures protection and coordination are achieved. [For Navy installations, provide electronic format curves using SKM's Power Tools for Windows device library electronic format or EasyPower device library format depending on installation modeling software requirements.]
- [h. Provisions for future expansion by adding switchgear sections.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of applicable codes and standards unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal

material, design and workmanship, and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.2 Assembled Operation and Maintenance Manuals

Assemble and securely bind manuals in durable, hard covered, water resistant binders. Assemble and index the manuals in the following order with a table of contents:

- a. Manufacturer's O&M information required by the paragraph SD-10, OPERATION AND MAINTENANCE DATA.
- b. Catalog data required by the paragraph SD-03, PRODUCT DATA.
- c. Drawings required by the paragraph SD-02, SHOP DRAWINGS.
- d. Prices for spare parts and supply list.
- [e. Information on metering.
-] f. Design test reports.
- g. Production test reports.

1.7 WARRANTY

Provide equipment items that are supported by service organizations reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis

during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchgear and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SWITCHGEAR

JIS C 8201-1.

2.2.1 Ratings

Provide equipment with the following ratings:

- a. Voltage rating:
[480Y/277][440/254][420/242][208Y/120][220][210Y/105][_____] volts AC,
[50][60] hertz, [3][4]-wire [three-phase, [3][4]-wire][as indicated].
- b. Continuous current rating of the main bus: [_____] amperes][as indicated].
- c. Short-circuit current rating: [_____] rms symmetrical amperes][as indicated].
- d. UL listed and labeled[for its intended use][as service entrance equipment].

2.2.2 Construction

Provide the following:

- a. Switchgear: consisting of vertical sections bolted together to form a rigid assembly and [rear][front and rear] aligned[as indicated].
- b. All circuit breakers: [front accessible with rear load connections][as indicated].
- c. Compartmentalized switchgear: vertical insulating barriers between the front device section, the main bus section, and the cable compartment[with full front to rear vertical insulating barriers between adjacent sections].
- d. Where indicated, "space for future" or "space" means to include all necessary components and hardware to be fully equipped for racking in a circuit breaker element.
- e. Insulating barriers: provided in accordance with JIS K 6912 6.35 mm minimum thickness.
- [f. Moisture resistant coating: applied to all rough-cut edges of barriers.
-]g. Switchgear: Arc-resistant, tested in accordance with manufacturer's requirements.

]2.2.2.1 Enclosure

Provide the following:

- a. Enclosure: [outdoor][indoor][weatherproof] IP rated [as indicated] per JIS C 8462-1 [fabricated entirely of 12 gauge, type 304 or 304L stainless steel] per JIS G 4304.
- b. Enclosure: bolted together with removable bolt-on side and[hinged] rear covers[, and sloping roof downward toward rear].
- [c. Front[and rear] doors: provided with[stainless steel] padlockable vault handles with a three point catch.
-]d. Bases, frames and channels of enclosure: corrosion resistant and fabricated of[type 304 or 304L stainless steel][or][galvanized steel]JIS G 4304.
-] e. Base: includes any part of enclosure that is within 75 mm of concrete pad.
- [f. Galvanized steel: coating per JIS H 8641 and JIS G 3352, and JIS B 1048, as applicable. Galvanize after fabrication where practicable.
-] g. Paint color: light gray over rust inhibitor.
- [h. Paint coating system: comply with[JIS C 8480 for galvanized steel][and][JIS Z 2371 for stainless steel].
-]i. Infrared viewing windows: install to allow the use of an infrared camera or thermal imager direct line of site to inspect electrical connections without requiring the opening of panels and doors. These windows are intended to allow thermographers the ability to inspect the electrical equipment without directly exposing themselves to live electrical components and energized devices.

]2.2.2.2 Bus Bars

Provide the following:

- a. Bus bars: [copper with silver-plated contact surfaces][or][aluminum with tin-plated contact surfaces].
 - (1) Phase bus bars: [uninsulated][insulated with an epoxy finish coating powder or insulating sleeve providing a minimum breakdown voltage in accordance with JIS C 2110-1].
 - (2) Neutral bus: rated [100][_____] percent of the main bus continuous current rating[as indicated].
- b. Make bus connections and joints with hardened steel bolts.
- c. Main-bus (through bus): rated at the full ampacity of the main throughout the switchgear.
- d. Minimum 6.35 mm by 50.8 mm copper ground bus secured to each vertical section along the entire length of the switchgear.

2.2.2.3 Main Section

Provide the main section consisting of[main lugs only][an individually mounted][air power circuit breaker[with current-limiting fuses]][and utility transformer compartment].

2.2.2.4 Distribution Sections

Provide the distribution section[s] consisting of[[individually mounted,]][air power circuit breakers[with current-limiting fuses]][and utility transformer compartments] as indicated.

[2.2.2.5 Auxiliary Sections

Provide auxiliary sections consisting of indicated[instruments,][metering equipment,][control equipment,][transformer,][and][current transformer compartments] as indicated.

]2.2.2.6 Handles

Provide handles for individually mounted devices of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

]2.2.3 Protective Device

Provide[main and] branch protective devices as indicated.

Provide the following:

- a. JIS C 8201-2-1 and JIS C 8201-2-2. [105 Vac][120 Vac][electrically][manually] operated, [unfused][fused], low-voltage power circuit breaker with a short-circuit current rating[of [_____] rms amperes symmetrical][as indicated] at [_____] volts.
- b. Breaker frame size: [as indicated][[_____] amperes].
- [c. Equip electrically operated breakers with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing the handle.

]2.2.4 Electronic Trip Units

Equip[main and][distribution] breakers[as indicated] with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that provides true rms sensing adjustable time-current circuit protection. Include the following:

- a. Current sensors ampere rating: [as indicated][[_____] amperes][the same as the breaker frame rating].
- b. Trip unit ampere rating: [as indicated][[_____] amperes].
- [c. Ground fault protection: [as indicated][zero sequence sensing][residual type sensing].
-]d. Electronic trip units: provide additional features[as indicated]:

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- [(1) [Indicated]Breakers: include long delay pick-up and time settings, and indication of cause of circuit breaker trip.
-][(2) Main breakers: include[short delay pick-up and time settings][and][, instantaneous settings][and][ground fault settings][as indicated].
-][(3) Distribution breakers: include[short delay pick-up and time settings][, instantaneous settings][, and ground fault settings][as indicated].
-][(4) [Main]Breakers: include a digital display for phase and ground current.
-][(5) [Main]Breakers: include a digital display for watts, vars, VA, kWh, kvarh, and kVAh.
-][(6) [Main]Breakers: include a digital display for phase voltage, and percent THD voltage and current.
-][(7) [Main]Breakers: include provisions for communication via a network twisted pair cable for remote monitoring and control. Provide the following communications protocol:[DNP3][Modbus][IEC 61850].
-][(8) For electronic trip units that are rated for or can be adjusted to 1,200 amperes or higher, provide arc energy reduction capability with an energy-reducing maintenance switch with local status indicator.

][2.2.5 Metering

[2.2.5.1 Digital Meters

[JIS C 5381-11 and JIS C 61000-4-5 for surge withstand. [Metering shall be compliant with the current Advanced Meter Reading System (AMRS) specification.] Provide true rms, plus/minus one percent accuracy, programmable, microprocessor-based meter enclosed in a sealed case with the following features.]

[Provide meter(s) and connect the meter(s) to the existing Advanced Meter Infrastructure Data Acquisition System (AMI DAS). The contractor shall use the existing government laptop computers to configure the meter using existing software loaded on the computer. The contractor will not be allowed to modify any software or add any additional software to the computer. Alternatively, the government will configure the meter(s), which must be compatible with the existing system, using existing software. Contract shall insure that the meter(s) will transmit the specified data to the DAS. Meters shall be compatible with the Base AMI DAS per NAVFAC Far East requirements.]

a. Display capability:

- [(1) Multi-Function Meter: Display a selected phase to neutral voltage, phase to phase voltage, percent phase to neutral voltage THD, percent phase to phase voltage THD; a selected phase current, neutral current, percent phase current THD, percent neutral current; selected total PF, kW, KVA, kVAR, FREQ, kVAh, kWh.

Detected alarm conditions include over/under current, over/under voltage, over/under KVA, over/under frequency, over/under selected PF/kVAR, voltage phase reversal, voltage imbalance, reverse power, over percent THD. Include a Form C KYZ pulse output relay on the meter.

-][(2) Power Meter: Display Watts, VARs, and selected KVA/PF. Detected alarm conditions include over/under KVA, over/under PF, over/under VARs, over/under reverse power.
-][(3) Volt Meter: Provide capability to be selectable between display of the three phases of phase to neutral voltages and simultaneous display of the three phases of the phase to phase voltages. Detected alarm conditions include over/under voltage, over/under voltage imbalance, over percent THD.
-][(4) Ammeter: Display phase A, B, and C currents. Detected alarm conditions include over/under current, over percent THD.
-][(5) Digital Watthour Meter: Provide a single selectable display for watts, total kilowatt hours (kWh) and watt demand (Wd). Include a Form C KYZ pulse output relay on the meter.
-] b. Design meters to accept[input from standard 5A secondary instrument transformers][and][direct voltage monitoring range to [300][600] volts, phase to phase].
- c. Provide programming via a front panel display and a communication interface accessible by a computer.
- d. Provide password secured programming stored in non-volatile EEPROM memory.
- e. Provide digital communications in a Modbus [RTU] protocol via a [RS232C][RS485] serial port[and an independently addressable [RS232C][RS485] serial port].
- f. Provide meter that calculates and stores average max/min demand values with time and date for all readings based on a user selectable sliding window averaging period.
- g. Provide meter with programmable hi/low set limits with two dry contact relays when exceeding alarm conditions.
- [h. Meter shall have two-way communication with the existing DAS. Provide a communications interface utilizing fiber-optic LC connection.]

][2.2.5.2 Electronic Watthour Meter

- [JIS C 1210. Provide a switchgear style electronic programmable watthour meter, semi-flush mounted, as indicated. Meter can be either programmed at the factory or programmed in the field. Turn field programming device over to the Contracting Officer at completion of project. Coordinate meter to system requirements.
- a. Design: Provide meter designed for use on a 3-phase, 4-wire, [210Y/105][208Y/120][440Y/254][420Y/242][480Y/277] volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

- b. Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.
- c. Class: 20. Accuracy: plus or minus 1.0 percent. Finish: Class II.
- d. Kilowatt-hour Register: five digit electronic programmable type.
- e. Demand Register:
 - (1) Provide solid state.
 - (2) Display actual values and readings of the metered circuit. No multipliers must be required.
 - (3) Demand interval length: programmed for [15][30][60] minutes with rolling demand up to six subintervals per interval.
- f. Meter fusing: Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.
- g. Provide meter with a communications port, RS485, with Modbus RTU serial or Ethernet, Modbus-TCP communications.

JIS C 1731-1. Provide single ratio transformers, [50][60] hertz, [_____] to 5-ampere ratio, [_____] rating factor, with a metering accuracy class of 0.3 through [_____].

[Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to voltage sensing meters. Size fuses as recommended by the meter manufacturer.

]]][2.2.5.3 Submetering

. Provide submetering for [_____] [in accordance with drawings].

]][2.2.6 Transformer

Provide transformer section in switchgear as indicated. Provide the transformer and section that is suitable for the installation. Provide a transformer conforming to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

]][2.2.7 Heaters

Provide [105][120]-volt heaters in each switchgear section. Provide heaters of sufficient capacity to control moisture condensation in the section, 250 watts minimum, and controlled by a thermostat[and humidistat] located in the section. Provide industrial type thermostat, high limit, to maintain sections within the range of 15 to 32 degrees C.[Provide humidistat with a range of 30 to 60 percent relative humidity.] Obtain supply voltage for the heaters from a control power transformer within the switchgear. If heater voltage is different than switchgear voltage, provide transformer rated to carry 125 percent of heater full load rating. Provide transformer with a 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and conforming to JIS C 61558-1.[Energize electric heaters in switchgear assemblies while the equipment is in storage or in place prior to being placed in service.

Provide method for easy connection of heater to external power source. Provide temporary, reliable external power source if commercial power at rated voltage is not available on site.]

]2.2.8 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Provide short-circuiting type terminal boards associated with current transformer. Terminate conductors for current transformers with ring-tongue lugs. Provide terminal board identification that is identical in similar units. Provide color coded external wiring that is color coded consistently for similar terminal boards.

2.2.9 Wire Marking

Mark control and metering conductors at each end. Provide factory installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Provide a single letter or number on each sleeve, elliptically shaped to securely grip the wire, and keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Indicate on each wire marker the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 MANUFACTURER'S NAMEPLATE

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

JIS K 6911. Provide laminated plastic nameplates for each switchgear, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Identify on each nameplate inscription the function and, when applicable, the position. Provide nameplates of melamine plastic, 3 mm thick, white with [black][_____] center core.[Provide red laminated plastic label with white center core where indicated.] Provide red laminated plastic label with white center core where indicated.] Provide matte finish surface. Provide square corners. Accurately align lettering and engrave into the core. Provide nameplates with minimum size of 25 by 65 mm. Provide lettering that is a minimum of 6.35 mm high normal block style.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Provide the following as part of test equipment calibration:

- a. Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- b. Accuracy: Traceable to the National Institute of Standards and Technology.
- c. Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.
- d. Dated calibration labels: visible on all test equipment.
- e. Calibrating standard: higher accuracy than that of the instrument tested.
- f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:
 - (1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.
 - (2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Switchgear Design Tests

JIS C 8201-1.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

- a. Short-circuit current test.
- b. Enclosure tests.
- c. Dielectric test.

[2.5.2.2 Additional Design Tests

In addition to normal design tests, perform the following tests on the actual equipment. Furnish reports which include results of design tests performed on the actual equipment.

- a. Temperature rise tests.
- b. Continuous current.

]2.5.3 Switchgear Production Tests

Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

- a. [50][60]-hertz dielectric tests.

- b. Mechanical operation tests.
- c. Electrical operation and control wiring tests.
- d. Ground fault sensing equipment test.

[2.6 COORDINATED POWER SYSTEM PROTECTION

Provide a power system study as specified in Section 26 28 01.00 10
COORDINATED POWER SYSTEM PROTECTION.

]2.7 ARC FLASH WARNING LABEL

Provide warning label of potential electrical arc flash hazards for
switchgear in accordance with NFPA 70E and JIS Z 9101.

[2.8 SERVICE ENTRANCE AVAILABLE FAULT CURRENT LABEL

Provide label on exterior of switchgear used as service equipment listing
the maximum available fault current at that location. Include on the
label the date that the fault calculation was performed and the contact
information for the organization that completed the calculation. Locate
this self-adhesive warning label on the outside of the switchgear.
Provide label format as indicated.

]2.9 MIMIC BUS LABELING

Provide a mimic bus on the front of the equipment to diagrammatically show
the internal bus structure of the lineup.

]PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2 and JIS C 0365 and to the requirements specified
herein. Provide new equipment and materials unless indicated or specified
otherwise.

[3.2 GROUNDING

IEEE C2 and JIS C 0365, except that grounds and grounding systems with a
resistance to solid earth ground not exceeding [25][_____] ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND
ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of
the ground rods by exothermic weld or compression connector. Provide
compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than [100 sqmm][] not less than 610
mm below grade connecting to the indicated ground rods. When work in
addition to that indicated or specified is directed to obtain the
specified ground resistance, the provision of the contract covering
"Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

JIS C 60364-5-54, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchgear

JIS C 8201-1.

3.3.2 Meters and Instrument Transformers

JIS C 1210.

3.3.3 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Galvanizing Repair

Repair damage to galvanized coatings per manufacturer's recommendations, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.5 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Mount switchgear on concrete slab as follows:

- a. Unless otherwise indicated, provide the slab with dimensions at least 200 mm thick, reinforced with a 150 by 150 mm - MW19 by MW19 (6 by 6 - W2.9 by W2.9) mesh placed uniformly 100 mm from the top of the slab.
- b. Place slab on a 150 mm thick, well-compacted gravel base.
- c. Install slab such that the top of the concrete slab is approximately 100 mm above the finished grade.

- d. Provide edges above grade with 15 mm chamfer.
- e. Provide slab of adequate size to project at least 200 mm beyond the equipment.
- f. Provide conduit turnups and cable entrance space required by the equipment to be mounted.
- g. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.
- h. Cut off and bush conduits 75 mm above slab surface.
- i. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.4.2 Interior Location

Mount switchgear on concrete slab as follows:

- a. Unless otherwise indicated, provide the slab with dimensions at least 100 mm thick.
- b. Install slab such that the top of the concrete slab is approximately 100 mm above the finished floor.
- c. Provide edges above floor with 15 mm chamfer.
- d. Provide slab of adequate size to project at least [200 mm][] beyond the equipment.
- e. Provide conduit turnups and cable entrance space required by the equipment to be mounted.
- f. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.
- g. Cut off and bush conduits 75 mm above slab surface.
- h. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.
- i. Provide duct sealing in conduits after cables are installed to prevent entrance of insects and moisture.

3.5 FIELD QUALITY CONTROL

[Submit request for settings of breakers to the Contracting Officer after approval of switchgear and at least 30 days in advance of their requirement.

] [Submit Required Settings of breakers to the Contracting Officer after approval of switchgear and at least 30 days in advance of their requirement.

] 3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests,

performed in accordance with Denki Hoan Kyoukai.

3.5.1.1 Switchgear

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
 - (2) Inspect physical, electrical, and mechanical condition.
 - (3) Verify appropriate anchorage, required area clearances, and correct alignment.
 - (4) Clean switchgear and verify shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
 - (5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
 - (6) Verify that[fuse and] circuit breaker sizes and types correspond to approved shop drawings as well as to the circuit breaker's address for microprocessor-communication packages.
 - [(7) Verify that current transformer ratios correspond to approved shop drawings.
 -] (8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
 - (9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
 - (10) Confirm correct application of manufacturer's recommended lubricants.
 - (11) Inspect insulators for evidence of physical damage or contaminated surfaces.
 - (12) Verify correct barrier and shutter installation[and operation].
 - (13) Exercise all active components.
 - (14) Inspect all mechanical indicating devices for correct operation.
 - (15) Verify that filters are in place and vents are clear.
 - (16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.
 - (17) Inspect control power transformers.
- ##### b. Electrical Tests
- (1) Perform insulation-resistance tests on each bus section.
 - (2) Perform dielectric withstand voltage tests.

- (3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.
- (4) Perform control wiring performance test.
- (5) Perform primary current injection tests on the entire current circuit in each section of assembly.
- [(6) Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.
-][(7) Verify operation of switchgear heaters.

]3.5.1.2 Circuit Breakers - Low Voltage - Power

a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Inspect anchorage, alignment, and grounding.
- (4) Verify that all maintenance devices are available for servicing and operating the breaker.
- (5) Inspect arc chutes.
- (6) Inspect moving and stationary contacts for condition, wear, and alignment.
- (7) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
- (8) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.
- (9) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (10) Verify cell fit and element alignment.
- (11) Verify racking mechanism.
- (12) Confirm correct application of manufacturer's recommended lubricants.

b. Electrical Tests

- (1) Perform contact-resistance tests on each breaker.
- (2) Perform insulation-resistance tests.
- (3) Adjust Breaker(s) for final settings in accordance with Government

provided settings.

- (4) Determine long-time minimum pickup current by primary current injection.
- (5) Determine long-time delay by primary current injection.
- [(6) Determine short-time pickup and delay by primary current injection.
-][(7) Determine ground-fault pickup and delay by primary current injection.
-][(8) Determine instantaneous pickup value by primary current injection.
-][(9) Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.
-] (10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
- (11) Verify operation of charging mechanism.

3.5.1.3 Current Transformers

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify correct connection.
- (4) Verify that adequate clearances exist between primary and secondary circuit.
- (5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

- (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
- (2) Perform insulation-resistance tests.
- (3) Perform polarity tests.
- (4) Perform ratio-verification tests.

3.5.1.4 Metering and Instrumentation

a. Visual and Mechanical Inspection

- (1) Compare equipment nameplate data with specifications and approved shop drawings.
- (2) Inspect physical and mechanical condition.
- (3) Verify tightness of electrical connections.

b. Electrical Tests

- (1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.
- (2) Calibrate watthour meters according to manufacturer's published data.
- (3) Verify all instrument multipliers.
- (4) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.5 Grounding System

a. Visual and Mechanical Inspection

- (1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

- (1) JIS C 60364-6. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.
- (2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Trip circuit

breakers by operation of each protective device. Test each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, provide the Contracting Officer 5 working days advance notice of the dates and times for checks, settings, and tests.

-- End of Section --