

SECTION 26 2300 - LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes metal-enclosed, low-voltage power circuit-breaker switchgear rated 1000 V and less for use in AC systems.
- B. Related Sections include the following:
 - 1. Division 26 Section "Surge Protective Devices for Low-Voltage Electrical Power Circuits" for transient voltage surge suppressors for low-voltage power, control, and communication equipment located in the switchgear.
 - 2. Division 26 Section "Low Voltage Electrical Power Conductors and Cables".
 - 3. Division 26 Section "Electricity Metering."
 - 4. Division 26 Section "Grounding and Bonding for Electrical Systems".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each type of switchgear and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
 - a. Tabulation of installed devices with features and ratings.
 - b. Enclosure types and details.
 - c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
 - d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
 - e. Current rating of buses.
 - f. Short-time and short-circuit current rating of switchgear assembly.
 - g. Nameplate legends.
 - h. Mimic-bus diagram.
 - i. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

- C. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipe and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- B. Field quality-control test reports.
- C. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Six of each type and rating used. Include spares for potential transformer fuses and control power fuses.
 - 2. Indicating Lights: Two of each type installed.
 - 3. **[Two sets of spare keys for Kirk Key interlocks. Keys shall be received and signed for by the University's Chief Electrician.]**

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain switchgear through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by UL and marked for intended use.
- D. Comply with NFPA 70.
- E. Comply with UL 1558.

- F. Comply with most current edition of the Northwestern University Design Standards.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.
- B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) to prevent condensation.

1.9 PROJECT CONDITIONS

- A. ***(Delete This Paragraph If Not Required)*** [Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by The University or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. **Notify the University's Chief Electrician no fewer than [two] calendar weeks in advance of proposed interruption of electric service.**
 - 2. **Indicate method of providing temporary utilities.**
 - 3. **Do not proceed with interruption of electrical service without the University's Chief Electrician's written permission.**
 - 4. **The University Lock-out/Tag-out procedures shall be used with Contractor controlled locks and tags.**
 - 5. **Comply with NFPA 70E.]**
- B. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 40 deg C.
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.10 COORDINATION

- A. Coordinate sensor-communication module package with data network and with the University's SCADA system for successful transmission and remote readout of remote monitoring data specified in this Section.

- B. Coordinate layout and installation of switchgear and components with other construction that penetrates ceilings or is supported by them, including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- C. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

1.11 WARRANTY

- A. Comply with Division 1 requirements.
- B. Special Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **Five** years from date of Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Corp. Electrical Group.
 - 2. Siemens Industry Inc.
 - 3. Equal as approved by **University's Chief Electrician.**

2.2 RATINGS

- A. Nominal System Voltage 480/277 V, 4 wire, 60 Hz.
- B. Main-Bus Continuous: **<Insert size>** A.
- C. Short-Time and Short-Circuit Current: Match rating of highest-rated circuit breaker in switchgear assembly.

2.3 FABRICATION

- A. Factory assembled and tested and complying with ANSI/IEEE C37.20.1 and UL 1558.
- B. Indoor Enclosure Material: Steel.
- C. Finish: ANSI/IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.
- D. Section barriers between main and tie circuit-breaker compartments shall be extended to rear of section.
- E. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and tie circuit breaker.

- F. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.
- G. Fabricate enclosure with removable, hinged, rear cover panels to allow access to rear interior of switchgear with Corbin #4T3142 key lock. Lock type shall be the same for both campuses.
- H. Inspection windows, 4" diameter, in rear panels to permit thermal imaging of device terminations, with sliding cover.
- I. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
1. Bus transition sections.
 2. Incoming-line sections.
 3. Hinged front panels for access to metering, accessory, and blank compartments.
- J. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
1. Main Phase Bus: Uniform capacity the entire length of assembly.
 2. Neutral Bus: 100 percent of phase-bus ampacity, except as indicated. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors. Include braces for neutral-bus extensions for busway feeders.
 3. Vertical Section Bus Size: Comply with IEEE C37.20.1, including allowance for spare circuit breakers and spaces for future circuit breakers.
 4. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
 5. Use copper for connecting circuit-breaker line to copper bus.
 6. Contact Surfaces of Buses: Silver plated.
 7. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
 8. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches (6 by 50 mm).
 9. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
 10. Service Entrance shall comply with UL Service Entrance requirements: service entrance label, incoming line isolation barriers, neutral connection to switchgear ground for solidly grounded wye systems.
 11. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.
 12. Neutral Disconnect Link: Bolted, un-insulated, 1/4-by-2-inch (6-by-50-mm) copper bus, arranged to connect neutral bus to ground bus.
 13. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
 14. Bus-Bar Insulation: Individual bus bars wrapped with factory-applied, flame-retardant tape or spray-applied, flame-retardant insulation.
 - a. Sprayed Insulation Thickness: 3 mils (0.08 mm), minimum.
 - b. Bolted Bus Joints: Insulate with secure joint covers that can easily be removed and reinstalled.

2.4 COMPONENTS

- A. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks. Meters are described in Division 26 Section "Electricity Metering".
- B. Instrument Transformers: Comply with IEEE C57.13.
1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 2. Current Transformers: Ratios as indicated; burden and accuracy class suitable for connected relays, meters, and instruments.
- C. Comply with Section 26 2713 "Electricity Metering" requirements.
- D. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Comply with Section 26 2713 "Electricity Metering" requirements.
 2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 3. Selectable digital display of the following:
 - a. Accuracy: Power meter shall meet ANSI C12.20 for Class 2 and IEC 62053-22 accuracy requirements.
 - b. Phase Currents, Each Phase.
 - c. Phase-to-Phase Voltages, Three-Phase.
 - d. Phase-to-Neutral Voltages, Three-Phase.
 - e. Three-Phase Real Power.
 - f. Three-Phase Reactive Power.
 - g. Power Factor.
 - h. Frequency.
 - i. Power demand shall be simultaneously calculated using five different averaging methods: Fixed Window (Block) Average, Sliding Window (Rolling Block) Average, Thermal Average, Predicted Average, and Cumulative Demand. Values for all averaging intervals must be available simultaneously.
 - j. Accumulated Watt-hr, VA-hr, and VAR-hr; Watt-hr received; Watt-hr delivered.
 4. Metering Compartment: Provide 6 port Ethernet switch, graphic display module, meter, gateway, RJ45 to RJ45 receptacle, 120 VAC to 12 VDC power supply. Display and control unit flush or semi-flush mounted in instrument compartment door.
- E. **[Utility metering compartment: A separate Com-Ed utility metering compartment and section with front hinged door, for indicated metering. Comply with requirements of electrical-power Utility Company.]**
- F. Programmable pulse values from customer and utility meters shall report to the University's SCADA system through a web enabled pulse data logger. Data pulses shall be captured in real time and reported via email ftp or web service.
- G. Relays: Comply with IEEE C37.90, types and settings as indicated; with test blocks and plugs.

- H. Surge Arresters: UL listed surge protective device. Comply with Section 26 4313.
- I. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
- J. Control Power Supply: Control power transformer supplying 120-V control circuits through secondary disconnect devices. Include the following features:
 - 1. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.
 - 2. **[Provide for electrically interlocked main-tie-main arrangements]** Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.
 - a. Secondary windings connected through a relay or relays to control bus to affect an automatic transfer scheme.
 - b. Secondary windings connected through an internal automatic transfer switch to switchgear control power bus.
 - 3. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.
 - 4. Fuses are specified in Division 26 Section "Fuses."
- K. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
 - 1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
 - 2. Conductors sized according to NFPA 70 for duty required.

2.5 CIRCUIT BREAKERS

- A. Description: Comply with IEEE C37.13 AND UL 1066.
 - 1. Eaton "Magnum DS" or equal by Siemens.
- B. Ratings: As indicated, fully rated, for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.
- C. Main and Tie circuit breakers shall have a minimum 3200 A frame.
- D. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
 - 1. Normal Closing Speed: Independent of both control and operator.
 - 2. Slow Closing Speed: Optional with operator for inspection and adjustment.
 - 3. Stored-Energy Mechanism: **[Manually charged] [Electrically charged, with optional manual charging (For 'Main-Tie-Main' Arrangements)].**
 - 4. Operation counter.
- E. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:

1. Eaton Digi-Trip 1150 plus or equal.
 2. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
 3. Minimum sensor size shall be 800 A which can be set at 50 percent of breaker rating.
 4. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 deg C.
 5. Field-adjustable, time-current characteristics.
 6. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
 7. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
 8. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I²t operation.
 9. Pickup Points: Five minimum, for instantaneous-trip functions.
 10. Ground-fault protection with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:
 - a. Three-wire circuit or system.
 - b. Four-wire circuit or system.
 - c. Four-wire, double-ended substation.
 11. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
 12. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking phase and ground-fault protection function with the downstream circuit breakers so that the breaker closest to the fault will clear the fault without disruption of service to other parts of the distribution system.
 13. Maintenance mode switched trip units: The trip unit shall utilize Arc Flash Reduction Maintenance System to reduce the instantaneous pickup value when activated. The ARMS shall provide a clearing time of 0.04 seconds with a minimum of settings from 2.5X to 10X of the sensor value. The ARMS shall be enabled by a switch on the trip unit with blue indicator LED. A remote communication link shall also be provided for enable/disable and confirmation.
- F. Phase rotation indicators: Bright LED lamps indicate phase live or open, correct phase sequence, with fuse protected inputs. Provide on each main.
- G. Communication Capability: Communication modules with functions and features compatible with the University's SCADA system using Modbus or Ethernet, such as power and voltage metering, power quality monitoring, access to programmable trip settings, breaker control, alarm status, and diagnostic information.
- H. Auxiliary Contacts: For interlocking or remote indication of circuit-breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit-breaker operation, quantity as indicated. Each consists of two-type "a" and two-type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.
- I. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:
1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.

2. Circuit-Breaker Positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:
 - a. Test Position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
 - b. Disconnected Position: Primary and secondary devices and ground contact disengaged.

- J. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear.

- K. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism. Provisions shall be included for padlocking the breaker in the open or closed position.

- L. Operating Handle: One for each circuit breaker capable of manual operation.

- M. Electric Close Button: One for each electrically operated circuit breaker.

- N. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.

- O. ***(Delete This Paragraph For Single Ended Switchgear)*** Key Interlocks: Arranged so keys are attached at devices indicated and requires one main circuit breaker in a double-ended unit substation to be open before the tie circuit breaker can be closed. Mountings and hardware are included where future installation of key-interlock devices is indicated. These interlocks shall keep the circuit breakers trip-free when actuated.

- P. ***(Delete If Not Required)*** [Undervoltage Trip Devices: Where indicated, adjustable time-delay and pickup voltage.]

- Q. Shunt-Trip Devices: Provide on source breakers for Closed Transition Transfer Switches.

- R. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices.

- S. Lugs: Mechanical style, rated for Copper conductors only, suitable for number, size, and trip ratings.

- T. Grounding Ball Studs: provide on incoming lug pad and outgoing lug pad.

- U. Provide shorting blocks for maintenance.

- V. ***(For Main-Tie-Main arrangements)*** [Kirk Key Interlocks: Key interlocks shall be provided as indicated on the drawings. Arrange so keys are attached at devices indicated. These interlocks shall keep the circuit breakers trip-free when actuated. Mountings and hardware are included where future installation of key-interlock devices is indicated.]

2.6 SPACE FOR FUTURE DEVICES

- A. Where indicated on the Drawings, "space" shall mean fully provisioned space ready for inserting a circuit breaker at a future date without any future modifications. Provide current transformers sized according to the breaker frame size. A blank door shall close off the front of the compartment.

2.7 TIE BREAKER CONTROL (*Delete Paragraphs A thru E If Switchgear Is Single Ended*)

- A. Provide automatic transfer control equipment to transfer a load bus from its normal source of supply to an alternate source. Voltage sensing on each source shall be three phase with loss of phase protection. All transfer scheme logic shall be incorporated into and executed by a Programmable Logic Controller (PLC). The PLC shall receive the following inputs: source voltage status as sensed by the voltage relays, breaker status (open, closed, tripped on fault) for main and bus tie breakers. Interposing relays shall be provided for interfacing the PLC outputs with the circuit breaker close and trip circuits. Additional PLC outputs shall be provided for local indication of the following: transfer scheme status (auto-blue / manual-white) and PLC fault (amber). If the control power source for the PLC is derived from within the switchgear, provide a dedicated "hold up device" for the PLC to ride through any momentary switching of control power sources. The PLC programs shall be executed without interruption during an undervoltage or loss of phase condition.
- B. Basic PLC logic features shall include: interlocking of the main and bus tie breakers to prevent paralleling sources; time delay for initiating a transfer upon an undervoltage or loss of phase condition; time delay for return to normal after the undervoltage or loss of phase condition has been corrected; and blocking transfer, if the main or bus tie breaker trips due to a fault.
- C. Description of operation - three breaker transfers (main-tie-main), delayed transfer / delayed return. Under normal conditions both main breakers are closed and the bus tie breaker is open. The transfer system selector switch is in the auto position. When an undervoltage or loss of phase condition is detected, the PLC receives an input from the voltage sensing relays. The PLC program executes, tripping the affected main breaker by its interposing trip relay after the programmed time delay. The PLC senses the open main breaker status and the program immediately closes the bus tie breaker by its interposing close relay. With the return of the affected source, the PLC trips the bus tie breaker by its interposing trip relay after the programmed time delay. The PLC senses the open tie breaker and the program immediately recloses the open main breaker by its interposing relay. Simultaneous loss of both sources shall not cause any change in breaker status. Upon return of one source, the PLC shall immediately trip the main breaker without voltage and close the bus tie breaker.
- D. Manual operation - Control switches for the main and bus tie breakers are inoperative when the transfer system control selector switch is in the auto position. Turning the transfer system control selector switch to the manual position allows the main and bus tie breakers to be manually closed and tripped via their control switches. Electrical interlocking in the breaker close circuits prevents both main breakers and the tie breaker from being closed at the same time. Redundant electrical interlocking, separate from the PLC, shall be provided for the main and tie breakers and shall be operational only when the automatic transfer system is in the manual mode. To transfer the loads from one source to the other, the affected main breaker must first be opened and then the bus tie breaker can be manually closed. To return to normal, trip the bus tie breaker and reclose the main breaker via their respective control switches.
- E. The PLC shall be able to communicate via RS-485 / Modbus RTU protocol.

2.8 ACCESSORIES

- A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.
 - 1. Racking handle to manually move circuit breaker between connected and disconnected positions.
 - 2. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
 - 3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.
- B. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.
- C. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.9 NETWORK COMMUNICATIONS

- A. Coordinate remote metering communication module package with the University's SCADA system for successful transmission and remote readout of monitoring data.
- B. Connect remote metering communication modules to the University's SCADA system through appropriate network interface unit.
- C. The manufacturer shall wire between all communications capable devices within the switchgear, including electronic meters with the same protocol and wire to a set of easily accessible terminal blocks.

2.10 IDENTIFICATION

- A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchgear. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.
 - 1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
 - 2. Medium: Laminated plastic.
 - 3. Color: As selected by University, contrasting with factory-finish background to represent bus and components.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

- D. Switchgear Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- E. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- F. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:
 - 1. Frame size of each circuit breaker.
 - 2. Trip rating for each circuit breaker.
 - 3. Conduit and wire size for each feeder.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 400.
- B. Anchor switchgear assembly to concrete base and attach by bolting.
 - 1. Concrete Bases: 4 inches (100 mm) high, (Evanston: 6" high east of Sheridan Rd.) reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of switchgear unless otherwise indicated. Construct concrete bases according to Division 3 Concrete Sections.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.
- D. Provide wall mounted cabinet with lockable hinged door, to store all accessories, test equipment, small spares, operating and maintenance manuals, and maintenance ledger in same room as equipment.
- E. **[Clear working space around switchgear shall be in accordance with City of Chicago Electric Code.]**
- F. **[Install meters furnished by Utility Company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by Utility Company.]**

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Arc Flash Labels: provide as specified in Division 26 Section "Identification for Electrical Systems."
- C. Diagram and Instructions:
 - 1. Frame and mount under clear acrylic plastic on the front of switchgear or on nearest adjacent wall.
 - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
 - b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.

3.4 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Verify tightness and torque all accessible bolted electrical connections to manufacturer's specified values using a calibrated torque wrench. Provide a list of all torqued connections and values.
- E. Provide all communications wiring between remote metering and communication modules and the University's SCADA system. Verify that each circuit breaker's address for microprocessor-communication packages corresponds to data network requirements. Programmable pulse values shall report to the University's SCADA system. Include all necessary programming by factory certified technician.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect switchgear installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.

2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
3. Complete installation and startup checks according to manufacturer's written instructions.
4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
5. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
 - a. Switchgear.
 - b. Circuit breakers.
 - c. Protective relays.
 - d. Instrument transformers.
 - e. Metering and instrumentation.
 - f. Ground-fault systems.
 - g. Surge arresters.
2. Remove and replace malfunctioning units and retest as specified above.

D. Infrared Scanning: After Substantial Completion, but not more than 90 days after Final Acceptance, perform an infrared scan of each switchgear line-up. Remove front and rear panels so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
4. Submit reports to NU Electric Shop.

3.6 ADJUSTING

- A. Set field-adjustable, protective-relay trip characteristics as specified in the "Overcurrent Protective Device Coordination Study." Provide list of "as left" settings and submit to Electric Shop and include in O & M manuals.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

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3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train the University's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 26 2300

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