SECTION 26 2413 - SWITCHBOARDS

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. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

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 "Grounding and Bonding for Electrical Systems".

1.3 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, surge suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detailed short-circuits current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
8. Include diagram and details of proposed mimic bus.
9. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
4. Circuit directories with load descriptions in electronic format.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials 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 size and type.
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 switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by UL and marked for intended location and application.

C. Use of series rated equipment is prohibited.

D. Comply with NEMA PB 2.

E. Comply with NFPA 70.

F. Comply with UL 891.

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

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 electric service.
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 access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

C. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

D. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards, including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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 switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Six** years from date of Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corp. Electrical Group.
2. Siemens Industry Inc.
3. Gus Berthold Electric.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: [**Draw-out**] [**Fixed, individually mounted, *insulated case***].
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Front- and Rear-Accessible Switchboards:

1. Main Devices: [**Drawout**] [**Fixed, individually mounted insulated case**].
2. Branch Devices: Panel and fixed, individually mounted.
3. Sections front and rear aligned.

D. Nominal System Voltage: [**480Y/277 V**] [**208Y/120 V**].

E. Main-Bus Continuous: <**Insert ampere rating**> A. [Note: **2000 A maximum**]

F. Factory certified 30 cycle rating.

G. Indoor Enclosures: 12 gauge Steel, NEMA 250, and Type 1.

H. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

I. Barriers: Between adjacent switchboard sections.

J. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

L. Rear Accessible Switchboards: Hinged Rear Doors and Compartment Covers to allow access to rear interior of Switchboard with Corbin #4T3142 key lock as approved by NU Electric Shop. Lock type shall be the same for both campuses.

M. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments, held with knurled thumb screw retainers.

N. Provide IR scanning windows in switchboard dead front to allow scan of line and load side lugs, and bolted connections.

O. Buses and Connections: Three-phase, four-wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with tin-plated copper feeder circuit-breaker line connections.
2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position, plug-in, finger type bus connections are not acceptable.
3. Make all bus connections using a minimum of two (2) Grade 5 bolts with conical washers.
4. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
5. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
6. Neutral Buses: Tin-plated, 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables.
7. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

P. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

Q. ***Optional*** [**Furnish switchboard with all provisions necessary for future extension of buswork and enclosure, if not double ended equipment**.]

R. ***Optional*** [**Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C**.]

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Surge Protection Device Description: IEEE C62.41-compliant externally mounted, UL 1449 3rd edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Comply with Division 26 Section “Surge Protective Devices”.
2. Provide a dedicated three pole circuit breaker for the SPD in the switchboard.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corp. Electrical Group.
2. Siemens Industry Inc.
3. Gus Berthold Electric with Eaton Corp. or Siemens Industry Inc. components

B. Molded-Case Circuit Breaker (MCCB) Up To 1600 A: Comply with UL 489, fully rated to meet available fault currents. Use of series rated equipment is prohibited.

1. Circuit breakers 600 Amps and greater shall be insulated molded case.
2. Minimum frame size shall be 400 Amps for feeders and 800 Amps for Mains or Tie.
3. Circuit breakers 400 Amps and greater shall be rated to carry 100% of nameplate rating continuously.
4. Thermal-Magnetic Circuit Breaker Trips Less Than 225 A: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
5. Electronic trip circuit breakers 225 A and larger shall have RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

6. Molded-Case Circuit-Breaker (MCCB) Features and Options:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, rated Copper only, suitable for number, size, and trip ratings.
    (Edit For Project Requirements)
    c. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    d. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    e. Communication Capability: Communication modules with functions and features compatible with the University’s SCADA system.

f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage. Provide for source breakers for Closed Transition Transfer Switches.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.4 CIRCUIT BREAKERS – *MAIN DEVICES 1600A THROUGH 2000A*

A. Description: Comply with IEEE C37.13 and .16 and UL 1066.

1. *Eaton "Magnum SB" or equal by Siemens, draw out type insulated case power circuit breaker*.

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.

1. Minimum frame size shall be 1600 A.

C. 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: [**Electrically charged, with optional manual charging (*For 'Main-Tie-Main' Arrangements*)**].
4. Position status reports through University's SCADA system.
5. Operation counter.

D. 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. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 deg C.
4. Field-adjustable, time-current characteristics.
5. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
6. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
7. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I^2t operation.
8. Pickup Points: Five minimum, for instantaneous-trip functions.
9. 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.

10. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking phase and ground-fault protection function.
12. Maintenance mode switched trip units: The trip unit shall utilize Arc Flash Reduction Maintenance System (ARMS) 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.

E. 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.

F. 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. Reports through University's SCADA system.

G. 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 disconnecting devices disengaged and secondary disconnect devices and ground contact engaged.
b. Disconnected Position: Primary and secondary devices and ground contact disengaged.

H. 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.

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

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

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

L. ***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**.]

M. Undervoltage Trip Devices: Where indicated, adjustable time-delay and pickup voltage.

N. Shunt-Trip Devices: Where indicated.

O. 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.

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

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

R. Provide fused shorting blocks for maintenance.

2.5 INSTRUMENTATION

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: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 Amp, 60 Hz, secondary and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

C. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for 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 values with maximum accuracy tolerances as indicated:

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.
k. Contact devices to operate remote impulse-totalizing demand meter.

4. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.6 NETWORK COMMUNICATIONS

A. Coordinate remote metering and communication module package with the University's SCADA system for successful transmission and remote readout of monitoring data.

B. Connect remote metering and 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 switchboard, including electronic meters with the same protocol and wire to a set of easily accessible terminal blocks.

2.7 CONTROL POWER

A. Control Circuits: 120-VAC, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

2.9 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic nameplate.

B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

C. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components complete with lettered designations.

D. Service Equipment Label: UL labeled for use as service equipment where required.

E. Each vertical section is to be labeled with the vertical bus voltage, amperage, phase, and fault current bracing rating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged. Scratches and small dents shall be repaired as approved by NU Chief Electrician.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete bases, 4-inch (100-mm) nominal thickness (Evanston: 6” east of Sheridan Rd.). Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of switchboards unless otherwise indicated. Comply with requirements specified in Division 03 Concrete Sections.

1. Install dowel rods to connect concrete base to concrete floor on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor, install to elevations required for proper attachment to switchboards
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. 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.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

H. Install externally mounted Surge Protection Devices. Lead length not to exceed 36 inches.

I. Verify tightness and torque all accessible bolted electrical connections to manufacturer's specified values using a calibrated torque wrench.

J. Double lugging on one protective device to feed two (2) separate loads is not permitted.

K. Comply with NECA 1.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. 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.

D. 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 SCADA network requirements.

3.4 IDENTIFICATION

A. 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."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. 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."

D. Arc Flash Labels: provide as specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Submit to NU Chief Electrician.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 90 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
b. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear line-up 11 months after date of Substantial Completion.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
5. Submit reports to NU Electric Shop.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection report, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.6 CLEANING

A. Vacuum dirt and debris from switchboard compartments; do not use compressed air to assist in cleaning.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in the "Overcurrent Protective Device Coordination Study." Provide list of “as left” settings and submit to Electric Shop.

3.8 TRAINING

A. Engage a factory-authorized service representative to train the University’s maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units. Provide eight (8) hours of classroom and hands-on training.

END OF SECTION 26 2413