APPENDIX 4.10

WEST CAMPUS MEDIUM VOLTAGE INFRASTRUCTURE ELECTRICAL TESTING AND MAINTENANCE SERVICES

Specification For Testing

1. GENERAL SCOPE

1.1. These specifications cover the field tests and inspections that are required to assess the suitability for the energized electrical power equipment and systems located on the Portland State University Campus. The inspection and test procedures described below may not be complete and the Contractor shall ensure that all equipment on the Portland State University Campus is tested, verified, energized and in-service using industry acceptable methods and procedures. The Contractor may recommend in their proposal additional tests and procedures not listed below.

1.2. The purpose of these specifications is to assure that tested electrical equipment and systems are operational, are within applicable standards and manufacturer's tolerances, and are installed in accordance with design specifications.

1.3. The work specified in these specifications may involve hazardous voltages, materials, operations, and equipment. These specifications do not purport to address the safety issues associated with their use. It is the responsibility of the user to review all applicable regulatory limitations prior to the use of these specifications.

1.4. The Contractor shall submit a method of procedure (MOP) for completing each task, prior to starting work on any task, for review and approval by Portland State University-Capital Projects and Constriction (CPC) Department.

1.5. The Contractor shall submit a separate emergency contingency plan (in & out and duration for equipment back in service) method of procedure (MOP), prior to starting work on any task, for review and approval by Portland State University-Capital Projects and Constriction (CPC) Department.

1.6. The Prime contractor shall be an electrical contractor and will lead this project with a NETA accredited testing organization supporting the testing needs of the project.

1.7. The testing organization is responsible for coordinating with other onsite entities, including Portland State University-Capital Projects and Constriction (CPC) Department, to be sure all equipment and functions are accounted for.

1.8. Refer to Section 1.2 for the identified critical and non-critical loads and standby generator requirements. Standby generator(s) and cabling shall be sized, provided and connected by the electrical contractor.

1.9. PSU West Campus Medium Voltage Infrastructure Electrical Testing and Maintenance Services Request for Proposals front end documents and all appendices apply to this Section.

2. APPLICABLE REFERENCES

Codes, Standards, and Specifications

All inspections and field tests shall be in accordance with the latest edition of the following codes, standards, and specifications except as provided otherwise herein.

2.1. American National Standards Institute – ANSI
2.2. ASTM International – ASTM
2.3. Association of Edison Illuminating Companies – AEIC
2.4. Electrical Apparatus Service Association - EASA
2.5. Institute of Electrical and Electronic Engineers – IEEE
2.6. Insulated Cable Engineers Association – ICEA
2.7. InterNational Electrical Testing Association – NETA
2.8. National Electrical Manufacturers Association – NEMA
2.9. National Fire Protection Association – NFPA
2.10. Occupational Safety and Health Administration – OSHA
2.11. State and local codes and ordinances
2.12. Underwriters Laboratories, Inc. – UL

Other Publications

Manufacturer's instruction manuals for the equipment to be tested.

3. QUALIFICATIONS OF TESTING ORGANIZATION & PERSONNEL

3.1. Testing Organization

3.1.1. The testing organization shall be a NETA accredited, independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated.

3.1.2. The testing organization shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

3.1.3. The testing organization shall use technicians who are regularly employed for testing services.

3.1.4. At the request of the Owner, the testing organization shall submit appropriate documentation to demonstrate that it satisfactorily complies with these requirements. This documentation shall include as a minimum the following:

3.1.4.1. NETA certificate of accreditation.

3.1.4.2. Statement of independence and no-conflict-of-interest with manufacturers, suppliers, and installers of equipment or systems being evaluated.

3.1.4.3. Experience summaries of the organization on at least five similar testing projects.

3.1.4.4. Experience summaries, NETA certifications, and expected role and/or function of the testing personnel who will participate on the project.

3.1.4.5. Examples of test data forms to be used.

3.2. Testing Personnel

3.2.1. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.

3.2.2. Technicians shall be certified in accordance with ANSI/NETA ETT-2000, Standard for Certification of Electrical Testing Personnel. Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.

4. DIVISION OF RESPONSIBILITY

4.1. The Owner & Owner's Representative

The owner and/or owner's representative shall provide the testing organization with the following:

4.1.1. Existing electrical drawings that are available. Not all scenario's have existing electrical drawings.

4.1.2. Site-specific hazard notification and safety training.

4.2. The Testing Organization

The testing organization shall provide the following and all requirements in PSU front end documents:

4.2.1. All field technical services, tooling, equipment, instrumentation, and technical supervision to perform such tests and inspections.

4.2.2. Specific power requirements for test equipment.

4.2.3. Notification to the owner's representative prior to commencement of any testing.

4.2.4. A complete project schedule for the full duration of the project, as outlined in Section 1.4 of the PSU RFP document, including a 2-week look ahead schedule that includes a logistics plan which accounts for generator power, contingencies, outages, etc.

4.2.5. Photos of equipment being maintained.

4.2.6. A timely notification of any system, material, or workmanship that is found deficient based on the results of the acceptance tests.

4.2.7. A written record of all tests and a final report, including required photos and documentation of any pertinent as-built conditions.

4.2.8. Prior to energization the Contractor will provide 3 sets of drawings as described below:

4.2.8.1. Master Construction or "RED STICK" set, reflecting the current as-left condition of the Portland State University Facilities with red and green lines. Must reside in the Portland State University-Capital Projects and Constriction (CPC) Department Office or Building Electrical rooms.

4.2.8.2. Commissioning "GREEN STICK" set, documenting the checkout of all equipment circuitry which must be handed over to Portland State University-Capital Projects and Constriction (CPC) Department Office System Protection representative.

4.2.8.3. The "AS-BUILT STICK" set, consisting of only the drawings that contain markups, which will be returned to the Portland State University-Capital Projects and Constriction (CPC) Department Office.

4.2.9. A complete project schedule for the full duration of the project, as outlined in Section 1.4 of the PSU RFP document, including a 2-week look ahead schedule that includes a logistics plan which accounts for generator power, contingencies, outages, etc.

5. GENERAL SAFETY AND PRECAUTIONS

5.1. Safety and Precautions

All parties involved must be cognizant of industry-standard safety procedures. This document does not contain any procedures including specific safety procedures. It is recognized that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Individuals performing these tests shall be qualified and capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved.

5.1.1. Safety practices shall include, but are not limited to, the following requirements:

5.1.1.1. All applicable provisions of the Occupational Safety and Health Act, particularly OSHA 29 CFR Part 1910 and 29 CFR Part 1926.

5.1.1.2. ANSI/NFPA 70E, Standard for Electrical Safety in the Workplace.

5.1.1.3. The Electrical Safety Program Book, Kenneth G. Mastrullo, Ray A. Jones, Jane G. Jones, NFPA.

5.1.1.4. Applicable state and local safety operating procedures.

5.1.1.5. Owner's safety, health and environmental practices including provisions currently in place at the site.

5.1.2. A safety lead person shall be identified prior to the commencement of work.

5.1.3. A safety briefing shall be conducted prior to the commencement of work.

5.1.4. All tests shall be performed with the apparatus de-energized and grounded except where otherwise specifically required to be ungrounded or energized for certain tests.

5.1.5. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety. This individual may be the same person described in 5.1.2.

5.2. Suitability of Test Equipment

5.2.1. All test equipment shall meet the requirements in Section 5.3 and be in good mechanical and electrical condition.

5.2.2. Field test metering used to check power system meter calibration must be more accurate than the instrument being tested.

5.2.3. Accuracy of metering in test equipment shall be appropriate for the test being performed.

5.2.4. Wave shape and frequency of test equipment output waveforms shall be appropriate for the test to be performed and the equipment to be tested.

5.3. Test Instrument Calibration

5.3.1. The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

5.3.2. The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

5.3.3. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).

5.3.4. Instruments shall be calibrated in accordance with the following frequency schedule:

5.3.4.1. 1 Field instruments: Analog and Digital, 12 months maximum.

5.3.4.2. Laboratory instruments: 12 months maximum.

5.3.4.3. Leased specialty equipment: 12 months maximum.

5.3.5. Dated calibration labels shall be visible on all test equipment.

5.3.6. Records that show date and results of instruments calibrated or tested must be kept up to date and be made available for review prior to the commencement of work.

5.3.7. Calibrating standard shall be of better accuracy than that of the instrument tested.

5.4. Test Report

5.4.1. The test report shall include the following:

5.4.1.1. Summary of project.

5.4.1.2. 2 Description of equipment tested.

5.4.1.3. Equipment nameplate data.

5.4.1.4. Description of tests.

5.4.1.5. Test data.

5.4.1.6. 5.4.1.6 Analysis and recommendations.

5.4.2. Test data records shall include the following minimum requirements:

5.4.2.1. Identification of the testing organization.

5.4.2.2. Equipment identification and equipment nameplate data.

5.4.2.3. Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.

5.4.2.4. Date of inspections, tests, maintenance, and/or calibrations.

5.4.2.5. Identification of the testing technician.

5.4.2.6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

5.4.2.7. Indication of expected results when calibrations are to be performed.

5.4.2.8. Indication of as-found and as-left results, as applicable.

5.4.2.9. Traceable identification and calibration due date of test equipment used to perform testing.

5.4.2.10. Sufficient spaces to allow all results and comments to be indicated.

5.4.2.11. The testing organization shall make available for review preliminary test data and results for each apparatus and system test within twenty-four hours of completion of testing of that apparatus or system.

5.4.2.12. The testing organization shall furnish one digital copy and two hardbound copies of the complete report to the owner's representative within fifteen business days of completion of testing.

6. INSPECTION AND TEST PROCEDURES

NOTES: The testing organization shall perform the following on all electrical equipment being tested:

1. Verify tightness of all accessible secondary screw terminations using the proper screw or nut drivers.

2. Verify the use of PSU approved compression type lugs and crimps on screw terminations.

3. Record complete nameplate data of all electrical equipment including protective relays, meters, etc.

4. The contractor shall thoroughly clean and vacuum all equipment to be tested.

6.1. Transformers, Liquid-Filled

6.1.1. Visual and Mechanical Inspection

6.1.1.1. Compare equipment nameplate data with drawings and specifications.

6.1.1.2. Inspect physical and mechanical condition**.**

6.1.1.3. Inspect impact recorder prior to unloading.

6.1.1.4. Test dew point of tank gases, if applicable.

6.1.1.5. Inspect anchorage, alignment, and grounding.

6.1.1.6. Verify the presence of PCB content labeling.

6.1.1.7. Verify removal of any shipping bracing after placement.

6.1.1.8. Verify the bushings are clean.

6.1.1.9. Verify that alarm, control, and trip settings on temperature and level indicators are as specified.

6.1.1.10. Verify operation of alarm, control, and trip circuits from temperature and level indicators, pressure relief device, gas accumulator, and fault pressure relay, if applicable.

6.1.1.11. Verify that cooling fans and pumps operate correctly and have appropriate overcurrent protection.

6.1.1.12. Inspect bolted electrical connections for high resistance using one or more of the following methods:

6.1.1.12.1. Use of a low-resistance ohmmeter.

6.1.1.12.2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

6.1.1.13. Verify correct liquid level in tanks and bushings.

6.1.1.14. Verify that positive pressure is maintained on gas-blanketed transformers.

6.1.1.15. Perform inspections and mechanical tests as recommended by the manufacturer.

6.1.1.16. Test load tap-changer, if applicable.

6.1.1.17. Verify presence of transformer surge arresters.

6.1.1.18. Verify de-energized tap-changer position is left as specified.

6.1.1.19. 19 Verify tightness of all accessible secondary screw terminations, using the proper screw or nut drivers, located in the Main and LTC cabinets as well as the junction boxes and devices throughout the transformer.

6.1.1.20. Verify the use of PSU approved compression type lugs and crimps on screw terminations.

6.1.1.21. Identify all auxiliary seal-in packages using PSU methods.

6.1.2. Electrical Tests

6.1.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.1.2.2. Perform insulation-resistance tests, winding-to-winding and each winding-to ground. Apply in accordance with manufacturer's published data. In the absence of manufacturer's published data, use ANSI/NETA ATS-2013. Calculate polarization index.

6.1.2.3. Perform turns-ratio tests at all tap positions.

6.1.2.4. Perform insulation power-factor or dissipation-factor tests on all windings in accordance with test equipment manufacturer's published data.

6.1.2.5. Perform power-factor or dissipation-factor tests on each bushing equipped with a power-factor/ capacitance tap. In the absence of a power-factor/ capacitance tap, perform hot-collar tests. These tests shall be in accordance with the test equipment manufacturer's published data.

6.1.2.6. Perform excitation-current tests in accordance with test equipment manufacturer's published data.

6.1.2.7. Measure the resistance of each high-voltage winding in each de-energized tap changer position. Measure the resistance of each low-voltage winding in each deenergized tap-changer position, if applicable.

6.1.2.8. If core ground strap is accessible, remove and measure core insulation resistance at 500 volts dc.

6.1.2.9. Measure the percentage of oxygen in the gas blanket, if applicable.

6.1.2.10. Remove a sample of insulating liquid in accordance with ASTM D 923. Sample shall be tested for the following.

6.1.2.10.1. Dielectric breakdown voltage: ASTM D 877 and/or ASTM D 1816

6.1.2.10.2. Acid neutralization number: ANSI/ASTM D 974

6.1.2.10.3. Specific gravity: ANSI/ASTM D 1298

6.1.2.10.4. Interfacial tension: ANSI/ASTM D 971 or ANSI/ASTM D 2285

6.1.2.10.5. Color: ANSI/ASTM D 1500

6.1.2.10.6. Visual Condition: ASTM D 1524

6.1.2.10.7. Water in insulating liquids: ASTM D 1533. (Required on 25kV or higher voltages and on all silicone-filled units.)

6.1.2.10.8. Power factor or dissipation factor in accordance with ASTM D 924.

6.1.2.11. Remove a sample of insulating liquid in accordance with ASTM D 3613 and perform dissolved-gas analysis (DGA) in accordance with ANSI/IEEE C57.104 or ASTM D3612.

6.1.2.12. Test instrument transformers. Use secondary current and voltage injection tests to verify proper connectivity throughout the secondary circuits

6.2. Switches, Air, High-Voltage, Open

6.2.1. Visual and Mechanical Inspection

6.2.1.1. Compare equipment nameplate data with drawings and specifications.

6.2.1.2. Inspect physical and mechanical condition.

6.2.1.3. Inspect anchorage, alignment, grounding, and required clearances.

6.2.1.4. Verify the unit is clean.

6.2.1.5. Perform mechanical operator tests in accordance with manufacturer's published data, if applicable.

6.2.1.6. Verify correct operation and adjustment of motor operator limit switches and mechanical interlocks, if applicable.

6.2.1.7. Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.

6.2.1.8. Verify operation and sequencing of interlocking systems.

6.2.1.9. Verify that each fuse has adequate mechanical support and contact integrity, if applicable.

6.2.1.10. Verify that fuse sizes and types are in accordance with drawings, short-circuit study, and coordination study.

6.2.1.11. Inspect bolted electrical connections for high resistance using one or more of the following methods:

6.2.1.12. Use of low-resistance ohmmeter.

6.2.1.13. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

6.2.1.14. Verify correct operation of all indicating and control devices, if applicable.

6.2.1.15. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

6.2.1.16. Record as-found and as-left operation counter readings.

6.2.1.17. Verify tightness of all accessible screw terminations using the proper screw or nut drivers.

6.2.1.18. Verify the adjustment of the 33 switch “a” & “b” contacts so that they make approximately five full turns before the primary is at full stop position.

6.2.2. Electrical Tests

6.2.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.2.2.2. Perform contact-resistance test across each switchblade and fuse holder.

6.2.2.3. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer’s published data. In the absence of manufacturer’s published data, use ANSI/NETA ATS-2013.

6.2.2.4. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components or control devices that cannot tolerate the applied voltage, follow manufacturer’s recommendation.

6.2.2.5. Perform a dielectric withstand voltage test on each pole with switch closed. Test each pole-ground with all other poles grounded. Test voltage shall be in accordance with manufacturer’s published data. In the absence of manufacturer’s published data, use ANSI/NETA ATS-2013.

6.2.2.6. Perform complete functional tests including electrical interlocking logic.

6.3. Instrument Transformers

6.3.1. Visual and Mechanical Inspection

6.3.1.1. Compare equipment nameplate data with drawings and specifications.

6.3.1.2. Inspect physical and mechanical condition.

6.3.1.3. Verify correct connection of transformers with system requirements.

6.3.1.4. Verify that adequate clearances exist between primary and secondary circuit wiring.

6.3.1.5. Verify the unit is clean.

6.3.1.6. Inspect bolted electrical connections for high resistance using one or more of the following methods:

6.3.1.6.1. Use of low-resistance ohmmeter.

6.3.1.6.2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

6.3.1.7. Verify that all required grounding and shorting connections provide contact.

6.3.1.8. Verify correct operation of transformer withdrawal mechanism and grounding operation.

6.3.1.9. Verify correct primary and secondary fuse sizes for voltage transformers.

6.3.1.10. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

6.3.1.11. Verify tightness of all accessible secondary screw terminations using the proper screw or nut drivers.

6.3.2. Electrical Tests - Current Transformers

6.3.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.3.2.2. Perform insulation-resistance test of each current transformer and its secondary wiring with respect to ground at 500 volts dc for one minute. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's recommendations.

6.3.2.3. 3 Perform a polarity test of each current transformer in accordance with ANSI/IEEE C57.13.1. Verify CT primary polarity orientation matches drawings.

6.3.2.4. Perform a ratio-verification test using the voltage or current method in accordance with ANSI/IEEE C57.13.1.

6.3.2.5. Perform an excitation test on transformers used for relaying applications in accordance with ANSI/IEEE C57.13.1.

6.3.2.6. Measure current circuit burdens at transformer terminals in accordance with ANSI/IEEE C57.13.1.

6.3.2.7. When applicable, perform insulation-resistance tests on the primary winding with the secondary grounded. Test voltages shall be in accordance with ANSI/NETA ATS-2013.

6.3.2.8. When applicable, perform dielectric withstand tests on the primary winding with the secondary grounded. Test voltages shall be in accordance with ANSI/NETA ATS-2013.

6.3.2.9. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data.

6.3.2.10. Verify that current transformer secondary circuits are grounded and have only one grounding point in accordance with ANSI/IEEE C57.13.3. That grounding point should be located as specified by the engineer in the project drawings and identified with a piece of red tape at the end of the compression lug and identified using PSU's methods

6.3.2.11. All used current circuits must undergo a "secondary current injection" check using known quantities and verification by measuring and recording those magnitudes, phase angle relationships at each pluggable point, and relay meter display. Results must match 3-line drawings. Test connection must begin at CT secondary terminals or first terminal point from CT.

6.3.3. Electrical Tests - Voltage Transformers

6.3.3.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.3.3.2. Perform insulation-resistance tests winding-to-winding and each winding-to ground. Test voltages shall be applied for one minute in accordance with ANSI/NETA ATS-2013. For units with solid-state components that cannot tolerate the applied voltage, follow manufacturer's recommendations.

6.3.3.3. Perform a polarity test on each transformer to verify the polarity marks or H1- X1 relationship as applicable and verify primary polarity orientation matches drawings.

6.3.3.4. Perform a turns-ratio test on all tap positions.

6.3.3.5. Measure voltage circuit burdens at transformer terminals.

6.3.3.6. Perform a dielectric withstand test on the primary windings with the secondary windings connected to ground. The dielectric voltage shall be in accordance with ANSI/NETA ATS-2013. The test voltage shall be applied for one minute.

6.3.3.7. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data.

6.3.3.8. Verify that voltage transformer secondary circuits are grounded and have only one grounding point in accordance with ANSI/IEEE C57.13.3. The grounding point should be located as specified by the engineer in the project drawings and/or use of the "bonding" screw in the secondary disconnect

6.3.3.9. All used potential circuits must undergo a "secondary potential injection" check using known quantities and verification by measuring and recording those magnitudes and phase angle relationships at each terminal point beyond the secondary disconnect. Results must match the 3-line drawings.

6.4. Metering Devices

6.4.1. Visual and Mechanical Inspection

6.4.1.1. 1 Compare equipment nameplate data with drawings and specifications.

6.4.1.2. Inspect physical and mechanical condition.

6.4.1.3. Verify tightness of accessible bolted electrical connections.

6.4.1.4. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case-shorting contacts, as applicable.

6.4.1.5. Verify the unit is clean.

6.4.1.6. Verify freedom of movement, end play, and alignment of rotating disk(s).

6.4.2. Electrical Tests

6.4.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.4.2.2. Verify accuracy of meters at all cardinal points.

6.4.2.3. Calibrate meters in accordance with manufacturer's published data.

6.4.2.4. Verify all instrument multipliers.

6.4.2.5. Verify that current transformer and voltage transformer secondary circuits are intact.

6.5. Surge Arresters, High-Voltage

6.5.1. Visual and Mechanical Inspection

6.5.1.1. Compare equipment nameplate data with drawings and specifications.

6.5.1.2. Inspect physical and mechanical condition.

6.5.1.3. Inspect anchorage, alignment, grounding, and clearances.

6.5.1.4. Verify the arresters are clean.

6.5.1.5. Inspect bolted electrical connections for high resistance using one or more of the following methods:

6.5.1.5.1. Use of low-resistance ohmmeter.

6.5.1.5.2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

6.5.1.6. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

6.5.1.7. Verify that the stroke counter is correctly mounted and electrically connected, if applicable.

6.5.1.8. Record the stroke counter reading.

6.5.2. Electrical Tests

6.5.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.5.2.2. Perform an insulation-resistance test on each arrester, phase terminal-to-ground. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use ANSI/NETA ATS-2013.

6.5.2.3. Test grounding connection.

6.5.2.4. Perform a watts-loss test.

6.6. Automatic Medium Voltage Transfer Switch

6.6.1. Visual and Mechanical Inspection

6.6.1.1. Compare equipment nameplate data with drawings and specifications.

6.6.1.2. Inspect physical and mechanical condition.

6.6.1.3. Inspect anchorage, alignment, grounding, and required clearances.

6.6.1.4. Verify the unit is clean.

6.6.1.5. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

6.6.1.6. Verify that manual transfer warnings are attached and visible.

6.6.1.7. Verify tightness of all control connections.

6.6.1.8. Inspect bolted electrical connections for high resistance using one or more of the following methods:

6.6.1.8.1. Use of low-resistance ohmmeter.

6.6.1.8.2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

6.6.1.9. Perform manual transfer operation.

6.6.1.10. Verify positive mechanical interlocking between normal and alternate sources.

6.6.2. Electrical Tests

6.6.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.6.2.2. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components or for control devices that cannot tolerate the applied voltage, follow manufacturer's recommendation.

6.6.2.3. Perform a contact/pole-resistance test.

6.6.2.4. Verify settings and operation of control devices.

6.6.2.5. Calibrate and set all relays and timers as specified by PSU department standards.

6.6.2.6. Verify phase rotation, phasing, and synchronized operation as required by the application.

6.6.2.7. Perform automatic transfer tests:

6.6.2.7.1. Simulate loss of normal power.

6.6.2.7.2. Return to normal power.

6.6.2.7.3. Simulate loss of emergency power.

6.6.2.7.4. Simulate all forms of single-phase conditions.

6.6.2.8. Verify correct operation and timing of the following functions:

6.6.2.8.1. Normal source voltage-sensing and frequency-sensing relays.

6.6.2.8.2. Engine start sequence if applicable.

6.6.2.8.3. Time delay upon transfer.

6.6.2.8.4. Alternate source voltage-sensing and frequency-sensing relays.

6.6.2.8.5. Automatic transfer operation.

6.6.2.8.6. Interlocks and limit switch function.

6.6.2.8.7. Time delay and retransfer upon normal power restoration.

6.6.2.8.8. Engine cool down and shutdown feature if applicable.

6.7. Cables, Low-Voltage, 600-Volt Maximum

6.7.1. Visual and Mechanical Inspection

6.7.1.1. Compare cable data with drawings and specifications.

6.7.1.2. Inspect exposed sections of cable for physical damage and correct connection in accordance with the single-line diagram.

6.7.1.3. Verify tightness of accessible bolted electrical connections.

6.7.1.4. Inspect compression-applied connectors for correct cable match and indentation.

6.7.1.5. Inspect for correct identification and arrangements.

6.7.1.6. Inspect cable jacket insulation and condition.

6.7.1.7. Verify tightness of all accessible screw terminations using the proper screw or nut drivers.

6.7.2. Electrical Tests

6.7.2.1. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute.

6.7.2.2. Perform continuity tests to insure correct cable connection.

6.7.2.3. Verify uniform resistance of parallel conductors.

6.8. Cables, Medium- and High-Voltage

6.8.1. Visual and Mechanical Inspection

6.8.1.1. Compare cable data with drawings and specifications.

6.8.1.2. Inspect exposed sections of cables for physical damage.

6.8.1.3. Inspect bolted electrical connections for high resistance using one or more of the following methods:

6.8.1.4. Use of a low-resistance ohmmeter.

6.8.1.5. Verify tightness of accessible bolted electrical connections by calibrated torque wrench method.

6.8.1.6. Inspect compression-applied connectors for correct cable match and indentation.

6.8.1.7. Inspect shield grounding, cable supports, and terminations.

6.8.1.8. Verify that visible cable bends meet or exceed ICEA and manufacturer’s minimum published bending radius.

6.8.1.9. Inspect fireproofing in common cable areas.

6.8.1.10. If cables are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

6.8.1.11. Inspect for correct identification and arrangements.

6.8.1.12. Inspect cable jacket and insulation condition.

6.8.2. Electrical Tests

6.8.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.8.2.2. 2 Perform an insulation-resistance test individually on each conductor with all other conductors and shields grounded. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use ANSI/NETA ATS-2013.

6.8.2.3. Perform a shield-continuity test on each power cable.

6.8.2.4. In accordance with ICEA, IEC, IEEE and other power cable consensus standards, testing can be performed by means of direct current, power frequency alternating current, or very low frequency alternating current. These sources may be used to perform insulation-withstand tests, and baseline diagnostic tests such as partial discharge analysis, and power factor or dissipation factor. The selection shall be made after an evaluation of the available test methods and a review of the installed cable system. Some of the available test methods are listed below.

6.8.3. Baseline Diagnostic Tests

6.8.3.1. On-line partial discharge monitor test for seven consecutive days.

6.9. Panel Board/Switchboard Assemblies

6.9.1. Visual and Mechanical Inspection

6.9.1.1. Compare equipment nameplate data with drawings and specifications.

6.9.1.2. Inspect physical and mechanical condition.

6.9.1.3. Inspect anchorage, alignment, grounding, and required area clearances.

6.9.1.4. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.

6.9.1.5. Verify that fuse and breaker sizes and types correspond to drawings.

6.9.1.6. Verify that current and voltage transformer ratios correspond to drawings.

6.9.1.7. Verify tightness of accessible bolted electrical connections.

6.9.1.8. Confirm correct operation and sequencing of electrical and mechanical interlock systems.

6.9.1.9. Exercise all active components.

6.9.1.10. Inspect mechanical indicating devices for correct operation.

6.9.1.11. Identify all panels and their devices per the drawings and PSU methods.

6.9.1.12. Verify tightness of all accessible secondary screw terminations using the proper screw or nut drivers.

6.9.1.13. Verify the use of PSU approved compression type lugs and crimps on screw terminations.

6.9.1.14. Verify all FT-1 or FT19-R or similar type isolation switches function according to its designed application (e.g. current cutouts short before opens, all blades are tight and fit snugly in the jaws, etc.)

6.9.1.15. Test all auxiliary relays such as lockout and tripping relays for proper manufacturer pickup and timing tolerances.

6.9.2. Electrical Tests

6.9.2.1. Perform ground-resistance tests.

6.9.2.2. Determine accuracy of all meters.

6.9.2.3. Perform system function tests.

6.10. Grounding Systems

6.10.1. Visual and Mechanical Inspection

6.10.1.1. Verify ground system is in compliance with drawings, specifications, and NFPA 70 National Electrical Code Article 250.

6.10.1.2. Inspect physical and mechanical condition.

6.10.1.3. Inspect bolted electrical connections for high resistance using one or more of the following methods:

6.10.1.3.1. Use of low-resistance ohmmeter.

6.10.1.3.2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

6.10.1.4. Inspect anchorage.

6.10.2. Electrical Tests

6.10.2.1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable.

6.10.2.2. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points.

6.11. THERMOGRAPHIC SURVEY

6.11.1. Visual and Mechanical Inspection

6.11.1.1. Perform thermographic survey when load is applied to the system.

6.11.1.2. Remove all necessary covers prior to thermographic inspection. Use appropriate caution, safety devices, and personal protective equipment.

6.11.2. Report

6.11.2.1. Provide a report which includes the following:

6.11.2.2. Description of equipment to be tested.

6.11.2.3. Discrepancies.

6.11.2.4. Temperature difference between the area of concern and the reference area.

6.11.2.5. Probable cause of temperature difference.

6.11.2.6. 6 Areas inspected. Identify inaccessible and unobservable areas and equipment.

6.11.2.7. Identify load conditions at time of inspection.

6.11.2.8. Provide photographs and/or thermograms of the deficient area.

6.11.2.9. Recommended action.

6.11.3. Test Parameters

6.11.3.1. Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1° C at 30° C.

6.11.3.2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

6.11.3.3. Thermographic surveys should be performed during periods of maximum possible loading.

7. PROJECT TASK DESCRIPTIONS

Provide all labor, materials, equipment, and tools to perform electrical testing on the Portland State University Campus in accordance with PSU West Campus Medium Voltage Infrastructure Electrical Testing and Maintenance Services RFP Front End, Appendices and Specifications PSU West Campus Electrical Infrastructure Electrical System Cable Testing 12.47KV dated 2012-09-26.

The following buildings/locations are part of the PSU West Campus and are identified on the existing drawings and overall campus one-line diagram. The contractor shall review all documents and ensure that testing of all electrical equipment is included in their proposal.

Task 1 – Science Research and Teaching Center (Critical)
Task 2 – Science Building One (Critical):
Task 3 – West Heating Plant (Non-Critical)
Task 4 – Peter W. Stott Center (Non-Critical)
Task 5 – Research Greenhouse (Non-Critical)
Task 6 – Millar Library (Non-Critical)
Task 7 – Extended Studies Building (XSB) (Non-Critical)
Task 8 – Lincoln Hall (Non-Critical)
Task 9 – Cramer Hall S.E. & N.W. (Critical)
Task 10 – Smith Memorial Student Union (Non-Critical)
Task 11 – Library East (Non-Critical)
Task 12 – Neuberger Hall (Non-Critical)
Task 13 – Parking Facility #1 (Non-Critical)
Task 14 – University Services Building (Non-Critical)
Task 15 – Parking Facility #2 (Non-Critical)

Refer to the following tables for existing electrical equipment descriptions.

Science Building 1 (SC1)				
SC1 - Room SB7: DWG 242-A1				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
SC1 Feeder B	12.47kV Main Serving SC1	Feeder B (ATS)	12.47kV ATS Feeder B (Local)	#1
SC1 ATS Control	12.47kV Prim. Load Center (ATS Control)	12.47kV Automatic Transfer Switch Control	12.47kV ATS (Local)	N/A
SC1 Feeder A	12.47kV Main Serving SC1 (Feeder A)	Feeder A (ATS)	12.47kV ATS Feeder A (Local)	#2
DCE Bldg	12.47kV Prim. Switch Serving XSB (Feeder A/B)	12.47kV Load Interrupter Switch (Fused)	XSB-201 Room 15	N/A
SC1 XFMR	12.47kV Prim. Switch Serving SC1 XFMR	12.47kV Load Interrupter Switch (Fused)	SC1 XFMR	N/A
Old Main Lincoln Hall	12.47kV Prim. Switch Serving Old Main L.H.	12.47kV Load Interrupter Switch (Fused)	LH Main Room 17A Disc (Unfused)	N/A
Spare Cell	N/A	N/A	N/A	N/A
Spare Cell	N/A	N/A	N/A	N/A
SC1 XFMR	SC1 XFMR	1MVA 12.47kV-208Y/120V XFMR	Distribution Switchboard	N/A
Lincoln Hall XFMR	LH Main Room 17A Disc (Unfused)	3-333kVA 12.47kV-208Y/120V Oil XFMR	LH-XFMR Under Sidewalk On SW Broadway	N/A

Science Research & Teaching Center				
SRTC (South) - Room B3-30: DWG 241-A1.2				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
R496	12.47kV Prim. Switch Serving SC2 Sub 5 - SB #5	12.47kV Load Interrupter Switch (Fused)	SC2 SB #5: XFMR (POA #11)	#9
R497	12.47kV Prim. Switch Serving WHP SW (Feeder B)	12.47kV Load Interrupter Switch (Fused)	Feeder B to WHP ATS (NO) (POA #28)	#8
R495	12.47kV Main Serving SC1 (Feeder B)	12.47kV Load Interrupter Switch (Fused)	Feeder B to SC1 ATS (NO) (POA #1)	#7
1998 PGE	N/A	12.47kV Automatic Transfer Switch	12.47kV Feeder A/B	N/A
SRTC ATS Control	12.47kV Prim. Load Center (ATS Control)	12.47kV Automatic Transfer Switch Control	12.47kV ATS (Local)	N/A
1815 PGE	12.47kV Prim. Switch Serving SC2	12.47kV Load Interrupter Switch (Fused)	SC2 Service Entrance (POA #10)	#6
R501	12.47kV Prim. Switch Serving WHP SW (Feeder A)	12.47kV Load Interrupter Switch (Fused)	Feeder A to WHP ATS (NC) (POA #29)	#5
R503	12.47kV Main Serving SC1 (Feeder A)	12.47kV Load Interrupter Switch (Fused)	Feeder A to SC1 ATS (NC) (POA #2)	#4

Science Research & Teaching Center				
SRTC (South) - Room B3-30: DWG 241-A1.2				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
R499	12.47kV Prim. Switch Serving CH (SE) Feeder B	12.47kV Load Interrupter Switch (Fused)	Feeder A to CHSE ATS (NO) (POA #22)	#12
Spare Cable Feeder B	Spare Cable Feeder B (Needs Placard)	Spare Cable	N/A	N/A
13119 PGE	13119 PGE Cable Port 1 & Port 2 Metering (Needs Placard)	PGE Cable From TX-WR2	Local R497 (POA #8)	N/A
R509	Spare ATS Fuse Holders Feeder B (Needs Placard)	Spare Fuse Holders	N/A	N/A
Spare SRTC ATS Control	Spare ATS Control (Needs Placard)	Spare 12.47kV Automatic Transfer Switch Control	Spare 12.47kV ATS (Local)	N/A
R507	Spare ATS Above (Needs Placard)	Spare 12.47kV Automatic Transfer Switch	Spare 12.47kV Feeder A/B	N/A
13118 PGE	13118 PGE Cable Feeder A (Needs Placard)	PGE Cable From TX-WR3	Local 1815PGE (POA #6)	N/A
Spare Cable Feeder A	Spare Cable Feeder A (Needs Placard)	Spare Cable Feeder A	N/A	N/A
R505	12.47kV Prim. Switch Serving CH (SE) Feeder A	12.47kV Load Interrupter Switch (Fused)	Feeder B to CHSE ATS (NC) (POA #20)	#13

Science Research & Teaching Center				
SRTC/SC2 (North) - Room B3-66: DWG 241-A1.1				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
SC2 Service Entrance	12.47kV Main	Service Entrance	SC2 Main Bus	#10
SC2-201	12.47kV Prim. Switch Serving SC2 Sub 4	12.47kV Load Interrupter Switch (Fused)	SC2 Sub 4 XFMR Main	N/A
SC2-202	12.47kV Prim. Switch Serving SC2 Sub 2	12.47kV Load Interrupter Switch (Fused)	SC2 Sub 2 XFMR Main	N/A
SC2-203	12.47kV Prim. Switch Serving SC2 Sub 3	12.47kV Load Interrupter Switch (Fused)	SC2 Sub 3 XFMR Main	N/A
SC2-204	12.47kV Prim. Switch Serving SC2 Sub 1.2	12.47kV Load Interrupter Switch (Fused)	SC2 Sub 1.2 XFMR Main (North)	N/A
SC2-205	12.47kV Prim. Switch Serving SC2 Sub 1.1	12.47kV Load Interrupter Switch (Fused)	SC2 Sub 1.1 XFMR Main (South)	N/A

Science Research & Teaching Center				
SRTC/SC2 (North) - Room B3-66: DWG 241-A1.1				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
Sub 4	Sub 4 XFMR "Chiller"	2MVA 12.47kV-4160V Dry XFMR	Switchboard #4	#10
Sub 2	Sub 2 XFMR Mech Room	750kVA 12.47kV-480Y/277V Dry XFMR	Switchboard #2	N/A
Sub 3	Sub 3 XFMR Lighting	750kVA 12.47kV-480Y/277V Dry XFMR	Switchboard #3	N/A
Sub 1.2	Sub 1.2 XFMR (North) Lab Power On	1MVA 12.47kV-208Y/120V Dry XFMR	Switchboard #1	N/A
Sub 1.1	Sub 1.1 XFMR (South) Lab Power Off	1MVA 12.47kV-208Y/120V Dry XFMR	Switchboard #1	N/A
Sub 5	Sub 5 XFMR	2MVA 12.47kV-480Y/277V Dry XFMR	Switchboard #5	N/A

Cramer Hall Southeast				
CHSE - Rooms S30, S30D, S38: DWG 201-A1				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
CHSE ATS	12.47kV Campus Transfer Switch Feeders A & B	12.47kV Automatic Transfer Switch	12.47kV Feeders A & B	N/A
CH-201	12.47kV Prim. Switch Serving CHNW Main	12.47kV Load Interrupter Switch (Fused)	CHNW Main Room S1A CHNW-201	N/A
CH-202	12.47kV Prim. Switch Serving CHSE XFMR CH-001	12.47kV Load Interrupter Switch (Fused)	CHSE XFMR CH-001	N/A
CH-203	12.47kV Prim. Switch Serving CHSE XFMR CH-003	12.47kV Load Interrupter Switch (Fused)	CHSE XFMR CH-003	N/A
CH-204	12.47kV Prim. Switch Serving USB Parking #2	12.47kV Load Interrupter Switch (Fused)	USB Parking #2 Room 309 US-201 (POA #14	#16
CH-204	12.47kV Tap to Unfused Switch serving CHSE-101	12.47kV Switch (Un-fused)	CHSE CH-207 (POA #19)	N/A
CH-205	12.47kV Prim. Switch Serving NH Block D	12.47kV Load Interrupter Switch (Fused)	Local 1815PGE (POA #6)	POA #17 Label, but no POA installed
CH-206	12.47kV Prim. Switch Serving SMSU Block C	12.47kV Load Interrupter Switch (Fused)	SMSU Room 4 Main (POA #24)	N/A
CHSE-201	12.47kV Prim. Switch Serving CHSE Chiller #1	12.47kV Load Interrupter Switch (Fused)	CHSE XFMR CH-002	#23

Cramer Hall Southeast				
CHSE - Rooms S30, S30D, S38: DWG 201-A1				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
CHSE-202	12.47kV Prim. Switch Serving CHSE Sub 4A SW	12.47kV Load Interrupter Switch (Fused)	CHSE XFMR CH-006	N/A
CHSE ATS Control	12.47kV Prim. Load Center (ATS Control)	12.47kV Automatic Transfer Switch Control	12.47kV ATS (Local)	#20, #21, #22
CH-003	XFMR CH-003	300kVA 12.47kV-208Y/120V Dry XFMR	Distribution Switchboard	N/A
CH-001	XFMR CH-001	1MVA 12.47kV-208Y/120V Dry XFMR	Distribution Switchboard	N/A
CH-002	Chiller Sub XFMR CH-002	1MVA 12.47kV-480Y/277V Dry XFMR	Chiller Substation	N/A
CH-006	12.47kV Tap to Unfused Switch serving CHSE-101	2.5MVA 12.47kV-480Y/277V Dry XFMR	Chiller Substation	N/A
CH-207	1600A, 480V Square D Main Bolt-Loc Switch	Switchgear	CHSE Main (POA #23)	#19
CHSE XFMR	CHSE XFMR	12.47kV-208Y/120V Dry XFMR	CHSE Distribution Switchboard	N/A

West Heating Plant				
WHP - DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
WHP-103	12.47kV Main Serving WHP	Feeder B (ATS)	12.47kV ATS Feeder B (Local)	#28
WHP-102	12.47kV Prim. Load Center (ATS Control)	12.47kV Automatic Transfer Switch Control	12.47kV ATS (Local)	N/A
WHP-101	12.47kV Main Serving WHP	Feeder A (ATS)	12.47kV ATS Feeder A (Local)	#29
WHP-201	N/A	Unused Meter Base	N/A	N/A
WHP-202	12.47kV Prim. Switch Serving PSC, Room 168	12.47kV Load Interrupter Switch (Fused)	12.47kV Feeder to PSC	#30
WHP-203	12.47kV Prim. Switch Serving WHP XFMR	12.47kV Load Interrupter Switch (Fused)	WHP XFMR	N/A
WHP-204	12.47kV Equipped Space	N/A	N/A	N/A
WHP-205	12.47kV Equipped Space	N/A	N/A	N/A
WHP-206	12.47kV Equipped Space	N/A	N/A	N/A
WHP-207	12.47kV Equipped Space	N/A	N/A	N/A
WHP XFMR	WHP XFMR	150kVA 12.47kV-480Y/277V Dry XFMR	Distribution Panelboard	N/A

Cramer Hall Northwest				
CHNW - Rooms S1 & S1A: DWG 201-A11				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
Main CHNW-201	12.47kV Prim. Switch Serving CHNW Main	12.47kV Load Interrupter Switch (Fused)	CHNE XFMR Room S1A CH-CHNW	N/A
CHNW-202	12.47kV Prim. Switch	12.47kV Load Interrupter Switch (Fused)	Distribution Switchboard	N/A
CHNW-203	12.47kV Prim. Switch	12.47kV Load Interrupter Switch (Fused)	Distribution Switchboard	N/A
CHNW XFMR	CHNW XFMR	3-167kVA 12.47kV-208Y/120V Oil XFMR (PCB's)	Distribution Switchboard	N/A

Millar Library				
ML - Room SB50: DWG 201-A11				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
ML Main	12.47kV Switch Serving ML XFMR	12.47kV Load Interrupter Switch (Fused)	ML XFMR	#31
ML XFMR	ML XFMR	750kVA 12.47kV-480Y/277V Dry XFMR	Distribution Switchboard	N/A

Peter Scott Center				
PSC - Room 168: DWG 201-A11				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
PSC Main	12.47kV Main	Service Entrance	PSC Main Bus	#32
PSC-201	12.47kV Prim. Switch Serving MLW Main	12.47kV Load Interrupter Switch (Fused)	MLW Main Room #SB50 (POA #31)	#33
PSC-202	12.47kV Prim. Switch Serving CHSE XFMR CH-001	12.47kV Load Interrupter Switch (Fused)	CHSE XFMR CH-001	N/A
PSC XFMR	PSC XFMR	750kVA 12.47kV-480Y/277V Dry XFMR	Distribution Switchboard	N/A

University Services Building/Parking Facility #2				
US - Room 309: DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
US Main	12.47kV Switch Serving US XFMR	12.47kV Load Interrupter Switch (Fused)	US XFMR	#14
US XFMR	US XFMR	750kVA 12.47kV-480Y/277V Dry XFMR	Distribution Switchboard	N/A

Neuberger Hall				
NH - Rooms 003, 005: DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
NH-201	12.47kV Main	Service Entrance	NH Main Bus	#26
NH-201	12.47kV Prim. Switch Serving NHS SWBD	12.47kV Load Interrupter Switch (Fused)	NHS Switchboard Room 005	N/A
NH-202	12.47kV Prim. Switch Serving PF1 SWBD	12.47kV Load Interrupter Switch (Fused)	PF1 Switchboard Room 109	N/A
NH-203	12.47kV Prim. Switch Serving NH XFMR	12.47kV Load Interrupter Switch (Fused)	NH XFMR	N/A
NH SWGR XFMR	XFMR	12.47kV-208Y/120V Dry XFMR	Distribution Switchboard	N/A
NHS-201	12.47kV Prim. Switch Serving NHS XFMR	12.47kV Load Interrupter Switch (Fused)	NHS XFMR	N/A
NHS-202	12.47kV Equipped Space	N/A	N/A	N/A
NHS Main	12.47kV Main	Service Entrance	NHS Main Bus	#27

Neuberger Hall				
NH - Rooms 003, 005: DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
NH XFMR	NH-001	1MVA 12.47kV-208Y/120V Dry XFMR	NH Distribution Switchboard	N/A
NHS XFMR	NH-002	1MVA 12.47kV-208Y/120V Dry XFMR	NHS Distribution Switchboard	N/A

Parking Facility #1				
PF1 - Room 109: DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
PF1 Main	12.47kV Main	Service Entrance	PF1 Main Bus	N/A
PF1-201	12.47kV Prim. Switch Serving PF1 XFMR	12.47kV Load Interrupter Switch (Fused)	PF1 XFMR	N/A
PF1-202	12.47kV Equipped Space	N/A	N/A	N/A
PF1 XFMR	PF1 XFMR	150kVA 12.47kV-208Y/120V Dry XFMR	Distribution Switchboard	N/A

Smith Memorial Student Union Building				
SM - Room 4 & 288: DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
SM Main	12.47kV Main	Service Entrance	SM Main Bus	#24
SM-201	12.47kV Prim. Switch Serving SM XFMR	12.47kV Load Interrupter Switch (Fused)	SM XFMR	N/A
SM-202	12.47kV Prim. Switch Serving LE SWGR	12.47kV Load Interrupter Switch (Fused)	12.47kV Feeder to LE Main	N/A
SM-203	12.47kV Prim. Switch Serving College Center Bldg XFMR	12.47kV Load Interrupter Switch (Fused)	College Center Building XFMR Room 288	N/A
SM XFMR	SM XFMR	750kVA 12.47kV-208Y/120V Dry XFMR	Distribution Switchboard	N/A
College Center Building XFMR	College Center Building XFMR	500kVA 12.47kV-208Y/120V Dry XFMR	College Center Building XFMR Room 288	N/A

Library Building East				
LE - Room C1 Hallway Door: DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
LE Main	12.47kV Main	Service Entrance	LE Main Bus	N/A
LE Space	12.47kV Equipped Space	N/A	N/A	N/A
LE XFMR	12.47kV Prim. Switch Serving LE XFMR	12.47kV Load Interrupter Switch (Fused)	LE XFMR	N/A
LE XFMR	LE XFMR	500kVA 12.47kV-208Y/120V Dry XFMR	Distribution Switchboard	N/A

Extended Studies Building (D.C.E. Bldg)				
XSB - Room 15: DWG HV-100				
Cell Designation	Feeder Information	Apparatus Information	Load & Location	POA Designation
XSB 201	12.47kV Main	Service Entrance	XSB Main Bus	N/A
XSB-201	12.47kV Prim. Switch Serving XSB XFMR	12.47kV Load Interrupter Switch (Fused)	XSB XFMR	N/A
XSB Space	12.47kV Equipped Space	N/A	N/A	N/A
XSB XFMR	LE XFMR	200kVA 12.47kV-208Y/120V Dry XFMR	Distribution Switchboard	N/A