16400 SERVICE AND MAIN SECONDARY DISTRIBUTION

PART 1 GENERAL

1.01 POLICY

A. The following standard applies to both retrofit and new work. This standard applies to the electric services for new buildings and upgrades to the electrical gear associated with existing buildings. This standard applies to buildings served by Cornell utilities as well as buildings served by public utilities (i.e., NYSEG, National Grid, etc.).

B. This Standard pertains to primary switches, transformers, main secondary switchgear, and associated metering.

C. In an effort to provide safe and reliable electric distribution service to the Cornell campus, and to provide for a safe working environment, NFPA 70E - Standard for Electrical Safety Requirements for Employee Workplaces, shall be an integral part of any design strategy. Short circuit current, voltage, time curves, and working distance shall all be factors to limiting arc fault energies within levels set forth by this standard.

D. The arc flash hazard/risk levels as defined by NFPA 70E shall be no greater than:

1. Category 4 at the line side of the main secondary disconnect device.
2. Category 3 between the load side of the main secondary disconnect device and the line side of the secondary feeder breakers.
3. Category 2 at the load side of the secondary feeder breakers.
4. Category 1 at MCC’s and branch panelboards which only have access by qualified personnel.
5. Category 0 at any location accessible by unqualified personnel.
6. No device shall be greater than category 4 at any point in the system.

E. Definitions:

1. “Critical Use” – Facility where loss of power would result in immediate concern (i.e., health, life safety, loss of research).
2. “Non-Critical Use” - Facility where loss of power would not result in immediate concern (i.e., classroom or office building).
3. “Qualified personnel” – as defined by NFPA 70 (NEC).
4. One-Line Diagram – drawing consisting of, at minimum, equipment location/room number, equipment voltage/short circuit ratings, conduit and conductor sizes, device overcurrent protection rating(s), bonding and grounding location(s), specific equipment identification labels.
1.02 SYSTEM DESCRIPTION

A. New electric services are recommended to be connected to the campus 13.2kV distribution system.

B. Existing buildings connected to the campus 2.4kV distribution system undergoing a service upgrade are recommended to be converted to the 13.2kV distribution system.

C. Buildings with areas exceeding 25,000 gross sq. ft., or connected loads exceeding 250 kW are recommended to have a main secondary voltage of 480Y/277V.
   1. Mechanical equipment and lighting panels should be 480Y/277V.
   2. Distribution step down transformers should provide 208Y/120V to panels serving convenience power and receptacle loads.

D. Buildings less than 25,000 gross sq. ft. and connected loads less than 250 kW may have a main secondary voltage of 208Y/120V.

1.03 QUALITY ASSURANCE

A. Current with the date of submittal, the NFPA, NEC, and UL codes, standards, and guidelines shall be applied herein.

B. The Engineer of Record shall provide the following information for review:
   1. “Basis of Design” statement describing the system objectives and measures to limit arc fault levels and protect from short circuit interruption.
   2. Building load calculations with connected and demand loads, including a percent breakdown of the lighting, mechanical, and plug loads at the design development level.
   3. Building power distribution one-line diagram.
   4. Computer generated fault study conforming to IEEE 1584 Standard (indicating both short circuit and arc flash levels) and a device coordination study. Existing arc flash hazard and short circuit data may be used if available; otherwise, include this assessment in the design development. Following this, the Engineer shall provide the circuit breaker settings in the specification and be responsible for compliance of this specification.

C. Information provided by owner:
   1. Available short circuit fault current at connection point to the Cornell medium voltage distribution system.
   2. Medium voltage fuse data and relay settings immediately upstream from the new service being designed.
D. Reviews and Approvals: Depending upon the scope and location of a project, review and approval may be required from multiple Cornell departments. This includes, but is not limited to:

1. Facilities Engineering (FE), Electrical Section
2. Energy & Sustainability, Utilities & Infrastructure Operations
3. Facilities Management (FM), Maintenance Management

PART 2 SYSTEM REQUIREMENTS

2.01 MANUFACTURERS

A. Square D, GE, and Eaton shall be standard for all equipment unless a specific or additional manufacturer(s) is identified below.

B. The contractor shall perform a coordination and arc-flash study, using a professional engineer or approved subcontractor, on the actual equipment submitted. If the equipment submitted is different than specified by the Engineer of Record, the study and field settings of the equipment shall also be submitted for review and approval by the engineer of record prior to the release of equipment for manufacture.

2.02 PRIMARY ELECTRIC SERVICE ENTRANCE ROOM

A. All new gear should be located in one room. If a medium voltage network switch is required, it should be separated by a full height chain link fence and a padlockable personnel access gate sized to allow for equipment removal. Access to the network switch shall be by the Cornell FM Electric Shop Line Crew only.

B. The primary switch, transformer, and secondary switchgear should be close-coupled in one line-up and be installed on a 4-inch concrete housekeeping pad. Provide minimum 24” clearance between distribution equipment and any adjacent wall for access and maintenance.

C. Primary Electric Service Entrance Room shall have a minimum 2-hour fire rating.

D. No sprinklers or dry chemical for fire protection shall be installed in the primary electric service entrance room unless specifically required by Code. Provide fire alarm smoke detection and visual notification devices as required per NFPA 72.

E. Provide minimum horizontal illumination level of 50 foot-candles in front of all electrical equipment (measured at the floor). All lighting shall be fed from an emergency generator source, if available. Supplemental emergency lighting shall be provided via battery powered wall packs.

F. Provide an Ethernet source where required by Owner.
G. Safety grounding shall consist of, but not be limited to, a fully exposed ground ring around the interior space of the room. Visibly bond all equipment, room door frame(s), etc. to the ground ring.

H. A double door for access will be required. Crash bars shall be installed on the interior side of all access doors. Doors shall swing in the outward direction for egress.

I. The design development process shall minimize the risk of water entering the switchgear room (i.e., no mechanical water system shall be located over the electric gear, the room shall have proper drainage, consider conduit routing from primary electric manhole, etc.).

J. The electric room shall have proper ventilation, thermostatically controlled, to remove excess heat.

2.03 MEDIUM VOLTAGE NETWORK SWITCH

A. Ratings: 15kV, 600 amp, SF6 insulated, 20k AIC.

B. Acceptable Manufacturers:

1. G&W, RAM series (non-fused) or VPNI (vacuum interrupter) series, depending on primary protection scheme.
2. S&C, PME series (non-fused) or Vista series (vacuum interrupter) depending upon primary protection scheme.

C. A vacuum interrupter for transformer protection shall be required when determined through an arc flash analysis to be the optimal method to reduce arc flash hazards to acceptable levels.

D. The specific style of switch will need to be determined based on discussion with Facilities Engineering and Energy & Sustainability Departments.

2.04 PRIMARY SWITCH

A. A primary switch will be required for every installation. Primary switch shall be fused when no vacuum interrupter is provided, or non-fused when a vacuum interrupter is provided in the medium voltage network switch.

B. Switch manufacturer and style:

1. Indoor: S&C, 15kV, air-break, mini-rupter.
2. Outdoor: Integral to outdoor compartmental type transformer.
C. Fuse manufacturer: S&C, SM5, standard speed, power fuse only. An S&C SM4 fuse is not acceptable due to the lower interrupting rating.

D. The SM-5 fuse will be the smallest size that meets the following criteria:

1. The transformer inrush will not intrude into the fuse melt curve with a cold fuse.
2. The fuses will be sized such that the continuous hot fuse rating (S&C technical application manual) is under the forced air (if applicable) full load amperage of the transformer.
3. The fuse should coordinate with the main and feeder breakers. Loss of coordination between the primary fuse and main secondary breaker is allowable if a drop in fuse size results in a significant drop on arc flash energy, or a change in the flash hazard classification.
4. Loss of coordination with the main breaker, especially the short time element, is not a significant concern. Loss of coordination with a feeder breaker will not be allowed.
5. Upsizing to the next higher fuse size requires clear documentation of the coordination issues and arc flash impact, or a proven situation of regularly blowing fuses. If a fuse is resized, the arc flash hazard categories as listed in paragraph 1.01.D above still need to be met.
6. Fuses larger than 80E (>2000kVA transformer) at 13.2kV are not allowed due to the greater than one second clearing time at 400A (13.2kV high impedance ground fault).
7. Services with transformers 1500kVA or larger, using fuses for primary protection, shall also have secondary loss of phase protection or blown fuse protection tripping the secondary main breaker.

2.05 SERVICE ENTRANCE TRANSFORMERS

A. For large research and “critical use” facilities, a double-ended service entrance is recommended to minimize power disruptions.

B. Maximum transformer size at 480V:

1. 1500 kVA with fan cooling.
2. 2000 kVA will require special permission from owner and will still need to meet arc flash hazard classifications listed in paragraph 1.01.D.
3. The transformer shall be sized to carry double ended loads without fans and single ended loads with fans.

C. Maximum transformer size at 208V shall be 500 kVA.
D. Construction type:
   1. Indoor: Vacuum Pressure Impregnated (VPI), pad-mount, dry type.
   2. Outdoor: Compartmental type, pad-mount, oil filled, dead front.

E. Bonding between the electrical system neutral and ground shall be performed at the service entrance transformer neutral \((X_0)\) connection.

### 2.06 SERVICE ENTRANCE METERING

A. Primary metering is not allowed.

B. Revenue grade metering: CT’s shall be provided for every service entrance greater than 200 amps and shall be located within the secondary switchgear, downstream from the main secondary device (cold sequence). All CT’s shall conform to the ANSI Standard accuracy class for metering service of 0.3 or better.

C. Meter Device types:
   1. Allen Bradley (Rockwell Automation), Powermonitor 3000, 1404-M6, with Ethernet communications and Powermonitor II display module. Device shall be located in the electric switchgear line-up. Ethernet connected for remote monitoring via the campus system.
   2. GE, KV series, S-Base, form 9S, Fitzall. Device shall be mounted in an accessible location 48-65” AFF with a meter box as manufactured by Hialeah, part no. “4-MS-G13T20SHO-M,” remotely from the electric switchgear line-up. Meter shall have a KYZ output sized for one (1) pulse per kilowatt hour.

D. Communication:
   1. Provide shorting blocks and cabling between CT’s and meter. Provide Cimetrics BACnet unit next to meter with surface mounted termination box. Provide raceway (i.e. 3/4” EMT) with pullstring between main electric service room and CIT telecommunications closet. Ethernet cabling, terminations, and faceplate typically provided by CIT.

E. Application:
   1. Coordinate specific meter requirements with FE and Energy & Sustainability departments during design development phase.

### 2.07 SECONDARY SWITCHGEAR/DISTRIBUTION EQUIPMENT

A. General:
   1. Secondary Switchgear/Distribution equipment shall be coordinated with the primary switch and service entrance transformer(s) to limit the arc flash hazard to levels indicated in Part 1.01 D.
2. Main Disconnect device shall be a circuit breaker with solid-state trip device.

B. “Critical Use” Facility

1. Low voltage draw-out style individually mounted power breakers shall be utilized for the main and all feeder devices.
2. Provide electronic trip functions on the main and feeder breakers.
3. Provide long time (L), short time (S), and ground fault (G) trip functions on the main breaker. Use of instantaneous (I) trip function is not permitted on the main device.
4. Manufacturer: Square D Masterpact or equal.

C. “Non-Critical Use” Facility:

1. Low voltage molded case or insulated case group mounted circuit breakers shall be utilized for the main and all feeder devices.
2. Provide electronic trip functions on the main and feeder breakers.
3. Provide long time (L), short time (S), and ground fault (G) trip functions on the main breaker. Use of instantaneous (I) trip function is not permitted on the main device.

D. Switchgear Hardware Requirements:

1. All low-voltage main secondary breakers will be equipped with shunt trip devices for protection against single phasing or load shedding purposes.
2. No closed source transitions. Sources must be interlocked.
3. Non-compartmentalized group mounted low-voltage breakers may be used when the arc-flash rating on the line side of the main secondary breaker is hazard category 2 or less.
4. Provide factory installed quartz windows for infrared thermography.
5. Status of transformer temperature and cooling fans should be monitored by the building automation system.
6. Circuit breaker status and amps should be monitored by the building automation system.

PART 3 EXECUTION

3.01 INSTALLATION

A. Prior to installation, equipment shall be properly stored and protected to prevent damage. Install equipment per manufacturer’s recommendations.

B. Primary electric service entrance room must be fully enclosed prior to a request for energization of equipment.
C. In cases where a contractor must work on medium voltage systems, the following shall apply:

1. Operation of switching equipment: Contractors shall not operate medium voltage circuit breakers, distribution switches, and other switching equipment except to de-energize a circuit in the event of an emergency. **Cornell linemen will perform all live switching operations.**

2. Work on New Systems: Contractors may perform all necessary work on new systems installed by the Contractor, without the necessity for supervision or assistance of Cornell personnel. The contractor is expected to follow standard de-energizing, lock out, tag out, testing, and grounding procedures before handling any medium voltage equipment. Any connection to existing equipment shall require the contractor and Cornell personnel to adhere to the following procedure. Once a system has been energized and put into service, it is considered to be “existing equipment.”

3. Work on Existing Systems:

   Any time a Contractor must make a connection to, or work on an existing system, the following procedures shall be used to ensure the safety of all personnel involved:

   a. Cornell linemen will operate all switching equipment as required to de-energize a circuit in preparation for work. A representative of the Contractor shall be present during all switching, and both the Contractor’s electrician and a Cornell lineman shall install locks on all switches as required to prevent accidental switch operation. Each switch shall be tagged to inform others of the work being done. **Manhole switches are never operated with personnel in the manhole.** Cornell linemen have and use remote switching devices.

   b. Cornell lineman will test a circuit to ensure that it is “dead” before any contact is made with the circuit. After testing, grounds will be installed by Cornell linemen to ensure the circuit is dead and cannot become energized. The Contractor may also install grounding equipment.

   c. A Contractor shall not work on any existing cable without first having a Cornell lineman verify that the correct cable has been selected and the cable is de-energized. **Cornell linemen will make the first cut into any existing cable system prior to Contractor splicing or terminating.** This is to ensure that the Contractor does not select and cut into an energized cable. Cornell linemen will perform the switching, locking, tagging, and testing procedure before cutting into the cable and grounding each phase. The Contractor may then proceed with work.

D. Primary equipment will only be energized after inspection by the Cornell FM Electric Shop, City or Town of Ithaca Electrical Inspector, and a representative from the Cornell Energy & Sustainability Department.
3.02 TESTING AND COMMISSIONING

A. The contractor shall perform initial system breaker settings in compliance with the equipment coordination study.

B. A third party commissioning agent shall verify the actual field electrical settings to be in accordance with the approved settings.

3.03 ARC FLASH LABELING

A. The Engineer of Record shall provide the facility arc-flash hazard data for labeling.

B. The installing contractor shall provide and install the arc-flash hazard labels at the primary switch, main secondary switchboard, motor control centers, and all locations greater than NFPA 70E hazard/risk category 1.

END OF SECTION