
26 10 00 Medium and High Voltage Electrical Distribution

1. Source of Power and Substation

- 1.1. All new buildings will require a unit substation fed at 4160V from the existing campus grid. This substation shall be indoors unless special permission given by PPS Engineering.
- 1.2. All new building 4160V feeds shall be designed in loops within the existing campus grid for power reliability. No radial feeds on the 4160V system allowed. As a result, all new buildings will require at least two 4160V feeders (1 primary, 1 backup). Connection points of these feeders within the existing campus grid will be provided in association with PPS Engineering.
- 1.3. Only in exceptional cases will the power be supplied at secondary voltage from an adjacent building. Special permission must be given by PPS Engineering.
- 1.4. Flexibility shall be maintained through the use of network switches, multiple 4160V feeds to each building and cross connections of the feeds through network switches.
- 1.5. Phasing is marked from left to right or top to bottom Red-Yellow-Blue, Red-White-Blue, or A-B-C.

2. Buried Services and Duct Banks

- 2.1. Location of all 4160V cables in duct shall be marked with brass markers either supplied by Queen's or to Queen's Standard Design. A sufficient number of these markers is to be arranged to allow the cable route to be easily determined.
- 2.2. All 4160V cables will be installed within concrete-encased duct banks. All concrete-encased buried electrical power duct banks shall contain 5" ducts and shall be installed according to the latest Ontario Electrical Safety Code and Ontario Provincial Standard Drawings (whichever is more severe). Direct buried cables are not acceptable.
- 2.3. New or changed underground services shall be recorded on the digital campus map and on the 5kV operating diagram as well as on the design drawings associated with the project (if applicable).
- 2.4. New duct banks shall be constructed with spare ducts to allow for future campus expansion and to enable cable replacement. In other words, duct banks serving one building will have capacity for the maximum number of feeders to that building plus minimum one spare. (i.e. A building containing a 4-position 4160V network switch has the capacity for 3 feeders from other locations. As a result, the number of ducts

to that building will be 4 ducts (minimum).) For duct banks serving more than one building, multiple spare ducts shall be required for future expansion. In this case, the total number of ducts shall be determined in association with PPS Engineering.

- 2.5. Building incoming and outgoing loop feeds are to be located in separate duct banks whenever possible. Feeders which form backup pairs are to be in separate duct banks whenever possible.

3. Transformers – Dry Type 5kV

- 3.1. Transformers shall be three phase, indoor, dry type with copper windings and have 220 insulation class and 115°C temperature rise. Transformers may be liquid-filled if to be located outside and will require approval by Queen's PPS Engineering.
- 3.2. The primary shall be delta-connected, rated 4,160V and a Basic Impulse Level (BIL) of 60kV minimum. Four taps shall be provided; 2 at 2 ½ % full current above nominal (FCAN), 2 at 2 ½% full current below nominal (FCBN). Normally the primary taps will be set at 97 ½%.
- 3.3. For a newly-constructed/renovated building the secondary voltage shall be wye-connected at 600/347V, three phase, four wire, and grounded neutral. The transformer shall have 10 kV BIL on the secondary. 208/120V distribution shall be provided by a single main 600-208/120V transformer or distributed via smaller transformers as required throughout the building. This will depend on the type/layout of the building. For partial renovations, the secondary voltage of the 5KV transformer can also be 208/120 V. System design shall be reviewed and approved by PPS Engineering.
- 3.4. The transformer capacities shall be double the designed operating load (not connected load) and shall include for the installation for at least four vehicle chargers.
- 3.5. Transformers shall be provided with Qualitrol winding temperature indicators complete with remote terminals and shall be connected to a remote monitoring system (in most cases, the building automation system).
- 3.6. Infrared window (minimum 4" diameter) shall be provided and adequately positioned on transformer enclosure to allow thermal inspection on transformer key components and cable terminations.
- 3.7. PPS Engineering shall be provided with appropriate data for updating the 5kV operating diagram and the 5kV computer model.

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- 3.8. PPS Engineering shall be provided with complete nameplate data to be entered in the 5kV transformer (TR) database and the PPS maintenance database.
 - 3.9. The transformer shall be identified according to Queen's naming convention and shall be identified with a nameplate manufactured to Section 26 05 00.
 - 3.10. A disconnecting device for the transformer shall be located within the same room unless approved by Queen's PPS Engineering.
 - 3.11. Approved manufacturers: Hammond and Delta.
 - 3.12. Documentation for transformers shall include manufacturer's catalogue cuts, recommended operating and maintenance instructions and warranty information, and shop drawings.

4. Network Switches – 15kV

- 4.1. 15kV network switches are used on campus to interconnect the 4160V grid. New switches are to be indoor, SF6 insulated and are manufactured by G&W Electric Limited. Outdoor network switches, when required, shall be of S&C Vista type. The requirement and configuration for a switch shall be determined by PPS Engineering. (15kV switches are used because 5kV switches are no longer manufactured.)
- 4.2. Network switches shall include test positions to facilitate grounding of connected cables. Each indoor network switch shall be supplied complete with three (3) Cooper Power System LPC-215 deep-well bushing insert kits and three (3) Cooper Power System LPC-215 protective caps. The inserts and caps shall be installed prior to network switch commissioning.
- 4.3. SF6 network switch shall have a valve before the SF6 pressure gauge which would allow the isolation of the gauge from rest of the SF6 chamber.
- 4.4. New added SF6 network switches shall have analog SF6 pressure sensor connected to the building automation system.
- 4.5. Network switches are assigned PPS identification numbers (NS numbers). Nameplates shall be manufactured to Queen's standard and fastened to the front of the network switch.
- 4.6. Complete nameplate data must be provided to PPS Engineering to enter in Queen's NS database.
- 4.7. Documentation shall include manufacturer's operating and maintenance instructions, specifications, data sheets and shop drawings.

5. Primary Switchgear Assembly – 5kV

- 5.1. Primary gear shall not include metering, breakers or special control equipment unless approved by PPS Engineering.
- 5.2. Switchgear shall be rated to withstand the available fault energy estimated by Utilities Kingston to be 150 MVA.
- 5.3. The insulation rating of all 5kV class primary supply equipment shall have a Basic Impulse Level (BIL) rating of 60kV minimum.
- 5.4. Each building substation transformer shall be provided with a fused, load break switch rated at 600A, 5kV minimum. Clearly visible potential indicators shall be provided on each phase of the line and load side of the switch and shall be viewable via factory-installed windows.
- 5.5. Isolation switches (IS) shall be manufactured and supplied by S&C Electric. Neither used nor reconditioned nor old stock equipment may be used without the express permission of PPS Engineering. Power fuses shall be refill type SM-5 as manufactured by S&C. The refill current, voltage and time current rating shall be specified in conjunction with PPS Engineering.
- 5.6. Isolation switches are assigned PPS identification numbers. Associated data must be provided to PPS Engineering to enter in Queen's IS database.
- 5.7. Enclosure shall be equipped with adequately positioned infrared window to allow thermal inspection on cable terminations.
- 5.8. Documentation shall include manufacturer's operating and maintenance instruction, specifications, data sheets and shop drawings.

6. Motor Starters

- 6.1. Motor starters shall be NEMA rated.
- 6.2. 5kV motor starters shall be equipped with digital electrical metering as specified in section 26 09 00.
- 6.3. All three phase motor starters must be equipped with protective devices that will disconnect the motor completely from the supply in the event of an overcurrent or sustained overload condition and prevent single phasing.
- 6.4. Solid state motor starters shall have proper temperature, overcurrent and overvoltage protection included in the design. The starters shall be shipped with proper fuses installed. The fuses selected shall be based on actual tests of fuses in

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series with the semiconductors. Overvoltage protection shall be voltage breakover clamping inherent in the starter design.

- 6.5. Motor status shall be acquired using current switches, not by using auxiliary contacts on the contactor.
- 6.6. Documentation shall include manufacturer's catalogue data, shop drawings, manufacturer's replacement parts list, operation and maintenance data.