



## .1 General

- .1 New buildings are to be provided with an indoor unit substation designed to accept 15kV and 25kV primary voltages, however, the primary voltage connected will be 15kV.
- .2 Indoor unit substations are to be provided with:
  - .1 Primary switchgear including two incoming 25kV and one 25kV outgoing SF6 gas filled switches.
  - .2 Dual bumpless transfer primary switching controls including uninterrupted power supply, programmable logic controller, HMI control interface and outlet jack.
  - .3 Primary switch contact lights with manual momentary switch located on the primary switch enclosure.
  - .4 Power Transformer.
  - .5 Secondary switchgear.
  - .6 Digital information metering
- .3 The unit substation is suitable for use on a 12.47kV/25kV, 3-phase, 3-wire, 60 Hz grounded system with a 3-phase fault level of 5,000 A.
- .4 The high voltage unit substation consists of an assembly of high voltage switchgear, transformer, bus bar, and all equipment and connections necessary to make a complete installation.
- .5 Provide DANGER – HIGH VOLTAGE signs for all high voltage switchgear cubicle doors and transformer enclosures.
- .6 Provide adequate lifting lugs for transformer as well as all cubicle sections.
- .7 Install all unit substation components and auxiliary equipment in sheet steel cubicles.
- .8 Cubicles shall be of formed code-gauge sheet steel construction with all panel edges turned into the framework. All panels (including side panels) not installed against walls or adjacent cubicles shall be hinged with “hold down” bolts. All other panels shall be welded in place. Enclosure panels shall be well braced and reinforced to prevent vibration.
- .9 Provide keyless porcelain lamps in HV fused disconnect switch and transformer cubicles complete with a labelled flush-mounted switch on the cubicle door of the main switch.
- .10 All panels on which relays, meters, meter switches, metering test blocks, controls, and other similar apparatus are mounted shall be hinged to give ready access to equipment wiring when the door is opened. These panels shall be completely barriered from high voltage cubicles.
- .11 The unit substation shall be assembled by a single manufacturer regularly engaged in the fabrication of such equipment and shall be completely shop assembled and tested prior to delivery to the site.
- .12 Interlocks shall be provided as shown on the drawings.
- .13 Provide continuous lamicoid or neatly painted mimic single line diagram fastened to the front of switchgear and extending from cubicle to cubicle.
- .14 A, B, and C phase designation shall be made obvious in the back of each cell.

## .2 Quality Assurance

- .1 Submit ten (10) copies of production test results to [Departmental Representative] [Consultant]. Do not ship equipment until test results have been accepted by [Departmental Representative] [Consultant].



**.3 Extra Materials**

- .1 Include three (3) fuse refills for primary switched.

**.4 Indoor Unit Substation**

- .1 Primary switchgear: indoor, 25 kV, 600 A, 3 phase, 4 wire, interrupting capacity 250 MVA, symmetrical, BIL 95 kV.
- .2 Interior mounted metal-enclosed unit substation.
- .3 Provide a 15kV class interior mounted metal-enclosed unit substation, c/w provision for dual radial feeders.
- .4 All sections, high voltage and low voltage, when bolted together shall present a unified aesthetic appearance.
- .5 The unit substation shall be adequately and naturally ventilated (louvers on the substation roof are not permitted). Louver sizes for the core and coil assembly shall be as recommended by the transformer manufacturer.

**.5 High Voltage Switchgear Cubicles**

- .1 The high voltage switchgear cubicles shall include a fixed disconnect switch and accessory components, all completely factory assembled and type tested.
- .2 The cubicles shall be complete with appropriately sized, CSA-approved, split support for high voltage cables and shall be suitable for the installation of stress cone cable terminations specified elsewhere. Details of the terminations shall be provided on submission of shop drawings. Terminals shall be pre-drilled holes to accept one-hole crimp-on type compression lugs.
- .3 Service entrance cubicle shall have provision for padlocking by Owner.
- .4 The minimum rating of the integrated assembly shall be as follows:
  - .1 Voltage Class: 12.47/25 kV
  - .2 BIL: 95 kV
  - .3 Minimum short circuit capacity: 250 MVA at 25kV (symmetrical for all current carrying components)
  - .4 60 Hz withstand 55 kV for circuit breakers
  - .5 Main bus, continuous current: 600 A
- .5 Bus bar supports shall be NEMA BIL rated epoxy or porcelain insulators. All bus bars shall be designed to withstand thermal and electromagnetic stresses at the specified ratings and shall be tin-plated copper construction.
- .6 Nameplates shall be permanently fixed to the exterior of each enclosure indicating:
  - .1 Manufacturer's name
  - .2 Switchgear kV
  - .3 Switchgear BIL
  - .4 Switchgear maximum short circuit MVA
  - .5 Switchgear momentary amperes
  - .6 Switchgear fault closing amperes
  - .7 Switchgear continuous bus amperes
  - .8 Switchgear year of manufacture
  - .9 Switchgear drawing numbers
  - .10 Circuit breaker catalogue number



- .7 The high voltage switchgear shall be designed, manufactured and tested in accordance with CSA 22.2 No. 31 and shall bear CSA approval label and meet the requirements of the local Inspection Authority.

**.6 Bus Bars**

- .1 Three phase and full capacity neutral bare busbars, continuous current rating 600 A extending full width of multi-cubicle switchboard suitably supported on insulators.
- .2 Main connections between busbars, major switching components of continuous current rating to match major switching components.
- .3 High conductivity copper for busbars and main connections.
- .4 Brace busbar system to withstand stresses resulting from short circuit currents specified.
- .5 Tin surfaced joints, secured with non-corrosive bolts and washers, tightened with torque wrench in accordance with manufacturer's recommendations.
- .6 Identify phases of busbars by suitable marking.
- .7 Busbar connectors when switchgear shipped in more than one section.

**.7 Grounding**

- .1 Copper ground bus not smaller than 50 x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.
- .2 Lugs at each end for size 4/0 AWG grounding cable.
- .3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

**.8 Dual Primary Load Interrupter Switches**

- .1 15k/25V, 600A continuous, 3-pole, gang-operated, SF6 gas filled, non-automatic type. All arcing accompanying interruption shall be contained within completely enclosed interrupting units. The units shall be mechanically operated by and interlocked with the interrupter blades so as not to open until the blades have cleared the main contacts by a distance greater than the external flash over distance across the interrupting unit. Manual remote operating HMI interface permitting operation of switches from a safe distance is required.
- .2 Interrupting rating to match that of switchgear.
- .3 Inspection windows shall be of wired safety glass or laminated heat-tempered safety-plate glass, gasket mounted at the front. Windows shall be so located that the open and closed position of the switches can be readily seen from the exterior of the enclosure.
- .4 Live-line neon-type indicating lights shall be connected on each phase of the incoming cubicles. Indicating lights shall be connected to the line side of the disconnect switch and shall be visible through the inspection window.
- .5 Operating handles shall be externally mounted and non-removable and shall provide for latching and padlocking in open positions. They shall swing in a vertical plane normal to the front face of the switchgear.
- .6 Provide two Form C contacts on each load break switch. Wire from one contact on each switch to two status inputs on the digital metering system (two separate status points for each contact). The contacts will be wired to indicate which feeder is currently energized and in conjunction with primary parallel transfer system.
- .7 Provide Kirk key type interlocking as shown on the drawings with two keys and three locks as shown. Provide full operating instructions as indicated on drawings inscribed on lamicoid labels and installed at the operating handle location of each load break switch.



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- .8 Provide inspection luminaires to observe the open/closed status of load break switch contacts. Luminaires shall have keyless porcelain lamp holders, complete with 100W rough service lamp and a labelled flushmounted switch on the cubicle door of the load break switch.

**.9 Dual Primary Parallel Transfer System**

- .1 Provide a complete dual primary parallel transfer switch system as indicated on drawings and specified herein.
- .2 Key Interlock Synchronization Control Station
- .3 Provide control station as shown on the drawings and completely manufactured, pre-wired, and tested at the factory. Submit factory test reports to the Consultant.
- .4 The Synchronizing Check relay shall be verified by the independent testing agency for phase angle allowance, and voltage difference. This testing will be required to meet IEEE / ANSI / NETA standards. The standard of acceptance shall be the power system simulator microprocessor based relay test set known as the Doble system. Sync-check relays shall be Basler BE1-25 M1E-A6P-N4S3F.
- .5 The programmable relay shall be proven for all required functions and tested, commissioned, and witness verified, to the satisfaction of the Consultant and electrical maintenance staff. Programmable relay shall be Moeller "Easy" 618-AC-RC.
- .6 Provide solenoid operated key release designated as "K1" on the drawings, complete with 1 N.O. and 1 N.C. auxiliary contacts.
- .7 Provide test switches as shown on the drawings. Test switches shall be ABB/Westinghouse Flexitest Type FT-1 or equivalent.
- .8 Provide adjustable volume, selectable tone alarm horn, Edwards 5540B or equal.
- .9 Provide a locking handle for the control station front door. Key for the front door handle shall be identical to substation.
- .10 The manufacturing and pre-wiring of control station to be of matching quality and appearance to unit substation equipment.
- .11 Potential Transformers:
  - .1 Potential transformers (PTs) shall comply with the latest edition of CAN3-C13 and IEEE C57.13.
  - .2 Provide potential transformers of the number shown on drawings complete with heavy gauge steel draw-out assembly, disconnecting and grounding means, and primary and secondary fuses. The potential transformers shall have the following characteristics:
    - .3 Insulation: 15 kV, 95 kV BIL
    - .4 Ratio: as shown on drawings
    - .5 Continuous thermal rating (30°C rise above 55°C ambient): minimum 500VA
    - .6 CSA accuracy class: 0.3 WXYZ, 0.6 ZZ
    - .7 The steel draw-out assembly shall typically include all the standard features of the switchboard manufacturer's 15 kV class PT drawer, complete with pre-drilled mounting provision for a second PT core. The drawer shall be a compact assembly designed to fit into the switchboard cubicle.
    - .8 PT drawers shall be completely manufactured, pre-wired, and tested at the factory. Submit factory test reports to the Consultant.
    - .9 Provide warning signs on PT draw-out assemblies.
    - .10 Provide solid bus bar taps complete with bus bracing and support insulators from the switchgear main bus to the PT-1 and PT-2 high voltage stab connectors. Cable taps



are not acceptable unless factory test results are submitted for Consultant's approval, showing compliance with BIL rating of 95 kV crest.

.12 Switchboard and Control Station Wiring:

- .1 Provide the monitoring and control devices complete with all necessary wiring, fuses, fuse blocks, and terminal blocks for external and internal connections. Identify all terminals clearly with the appropriate control circuit wire numbers.
- .2 All control wiring shall be Type TBS or SIS and shall conform to CSA C22.2 No. 31. Provide wire numbering sleeves for all conductors.

.13 Relay Programming

- .1 Provide two non-volatile memory cards EASY-M-16K, for use with the Moeller programmable relay. One card will be used to load a standardized control program. The second card shall be a spare. Program the relay as follows:
  - .2 Relay starts in RUN mode when the power is switched on (to ride through momentary power interruption when switching CS-1).
  - .3 If control power to the relay is on, and I1 is not turned on within 1 minute of I2 being turned on, initiate alarm; otherwise, turn on Q1 to proceed with paralleling.
  - .4 If control power to the relay is on, and I2 is on, and I4 and I5 are both off continuously for more than 5 minutes, initiate alarm.
  - .5 If I1 is on and I2 is on, initiate alarm.
  - .6 If I2 remains on for more than 5 minutes, initiate alarm.
  - .7 Alarm: Flash Q2, turn on Q3, and turn on Q4 to sound the horn.
  - .8 Horn Silence: If I3 is turned on momentarily, turn off Q4 and check all "initiate alarm" conditions listed above. If any alarm condition remains, continue flashing Q2, even though the horn is turned off. If alarm conditions have all cleared, turn off Q2.
  - .9 Submit full program printout and ladder-type logic circuit diagram for Consultant's approval.
  - .10 Upon receiving the Consultant's approval, store the circuit diagram, as well as all the parameter settings for the circuit diagram, and all the system settings in both memory cards.
  - .11 Provide a 4 hour training session for UVic personnel in the use and programming of the relays.
  - .12 Demonstrate, during the training session, how to program the circuit diagram and how to transfer the program to relays.
  - .13 Hand over both memory cards to UVic upon completion of working session.

.14 Field Tests

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Inspect and test load break switches as follows:
  - .3 Inspect and check quick-make, quick-break operation
  - .4 Check contact resistance ("millivolt drop" test)
  - .5 Check operation of all auxiliary contacts
  - .6 Test all interlocking procedures
  - .7 Fully test the correct and safe operation of the parallel transfer system.
  - .8 The entire system and its operation shall be demonstrated with operational training of the procedures, calibrations, and safety interlocks to the electrical maintenance staff. Allow for minimum two training sessions for the staff.



**.10 Fusible Load Interrupter Switch**

- .1 3-pole, gang-operated, 25kV, 600 A continual, non-automatic load interrupter switch. Operating handle externally mounted and non-removable, and provides for latching and padlocking in open position. It shall swing in a vertical plan normal to the front face of the switchgear. Provide Kirk key type interlocking as shown on the drawings. Include full operating instructions on a nameplate mounted above the opening handle of each unit.
- .2 Continuous full load rating: 600 A, interrupting rating: 20 kA symmetrical.
- .3 Voltage rating: 25 kV.
- .4 Interphase barriers.
  - .1 Inspection window mounted at the front. Window located so that the open and closed position of the switch can be readily seen from the exterior of the enclosure.
- .5 Interrupting rating that of switchgear.
- .6 Fixed operating handle.
- .7 Provide non-renewable current-limiting type fuses. Provide 3 spare fuses of the same type and rating, and install in a separate metal cabinet in the electrical room.

**.11 Load Break Switch**

- .1 Indoor load break switch with integral fuse holders.
- .2 Ratings:

Voltage:	7.2/12.5 kV
BIL:	95 kV
Continuous current rating:	600 Amps
Interrupting Capacity:	250 MVA
Fault closing (RMS):	20,000 Amps
Momentary rating (RMS):	40,000 Amps
- .2 Switches:
  - .1 Gang operated with manual actuator that can be locked in the "off" position and position indicator. Phase to phase and phase to ground insulating barriers. Energized components to be supported from the mounting frame on porcelain insulators. Provide current-limiting fuses equipped with striker pins to give blown fuse protection (failure of one fuse to open other phases). Provide three spare fuses mounted at the cubicle.
- .4 Trip Power: Provide adequate capacitor power supply for automatic tripping of the load break switch.
- .5 Trip Relays: Ground fault on secondary side of transformer. Thermal relay to trip on high transformer temperature.

**.12 Main Dry Type Transformer**

- .1 Refer to Section 26 12 16 Dry Type, Medium Voltage Transformers.

**.13 Secondary Switchgear**

- .1 Secondary switchgear: indoor, 120/208V, [ ] A, 3-phase, wye connected, maximum short circuit current [42] kA, manufactured to CSA C22.2 No. 31.
- .2 Matches primary switchgear enclosure construction and outline exactly.
- .3 Cubicles contain:
- .4 Digital metering system complete with current transformers.
- .5 Distribution circuit breakers.



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- .6 Copper bus including double capacity neutral from transformer to distribution cubicles including vertical buses. Bus ratings as per Drawings.
- .7 The switchboard has provision for all outgoing feeder cables as well as allowance for future cables.
- .8 Distribution Circuit Breakers:  
Moulded-case, fixed mount with bus extensions for rear connection.  
[42] kA 1.C. min.  
Adjustable thermal-magnetic trip elements or adjustable electronic trip units per drawings.  
Tripping characteristics shall be set per the coordination study requirements.
- .9 Digital Metering System: Refer to Section 26 09 02 Metering and Switchboard Instruments

**.14 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical General Requirements.
- .2 Nameplates: Switchgear designation: label - white plate, black letters, 30mm high lettering, engraved Main 12.5 kV Switchgear, L.R.C.

**.15 Coordination Study**

- .1 Provide a Computer Programmed System Coordination Study using ETAP software, prepared on time characteristic curves plotted on KE form 485258 log graph paper, showing the system selectivity from the main substation down to the largest low voltage breaker on the main secondary switchboard for this project. The study will be completed and stamped by a professional engineer registered in BC. The study shall include the following:
  - .2 Supply authority's relays or fuses protecting the incoming service.
  - .3 Main and feeder protective devices necessary to insure coordination.
  - .4 Main feeder cable damage curve.
  - .5 Transformer single and three phase thermal damage curve.
  - .6 Symmetrical and asymmetrical fault current calculations will be completed and recorded, verifying protection of various elements of the system.
  - .7 A summation chart showing all ratings and settings with reference to the appropriate curve.
  - .8 Recommendations and conclusions of the effectiveness of the coordination study.
  - .9 Protective devices associated with the largest motor.
  - .10 Protective devices associated with the standby emergency power plant.
  - .11 The drawings will not be hand drawn but shall be of computer graphics quality.

**.16 Acceptable Manufacturers**

- .12 Subject to full compliance with the requirements of these Specifications, equipment supplied by the following distributors/manufacturers is acceptable:
  - .1 Siemens Electric
  - .2 Schneider Group
  - .3 Cutler Hammer