

1.0 GENERAL

1.1 Coordination Requirements

- .1 UBC Energy & Water Services. Refer to <https://energy.ubc.ca>.

1.2 Description

- .1 UBC requirements for Indoor and Outdoor Unit Substations.

2.0 MATERIAL AND DESIGN REQUIREMENTS – INDOOR UNIT SUBSTATIONS

2.1 Indoor Unit Substations General Requirements

- .1 The unit substation assembly shall be CSA approved 15 KV rated and be a completely unitized assembly of components as described in the next section.
- .2 Outdoor fluid filled padmount unit substations are acceptable to UBC and shall meet the minimum requirements in sub-section 3.0 and only in coordination with Energy & Water Services - Electrical Technical Services.
- .3 Switchgear located in sprinklered rooms, or rooms where the likelihood of water ingress could occur from above, shall have drip hoods installed on all cubicles. Openings for ventilation shall have suitable sprinkler protection. Where multiple cubicles are joined to form a single unit, individual drip hoods shall form a single continuous water barrier by means of factory provided upturned flanges or approved caulking methods.
- .4 Air conditioning units located within electrical rooms shall not have evaporator coils, drains, condensers or any powered equipment located directly above unit substations.
- .5 Unit Substation Components shall consist of:
 - .1 15 KV switchgear.
 - .2 Main feeder and standby feeder cable entrance sections.
 - .3 Drawout, 15KV vacuum circuit breakers and protection relay.
 - .4 Cast coil transformer, (aluminum shall not be specified).
 - .5 Metering.
 - .6 Secondary Distribution (if applicable).
- .6 Characteristics of the unit substation shall be:
 - .1 Primary voltage
 - .1 12,480 volts.
 - .2 Secondary voltage
 - .1 347/600 volts or 120/208 volts.
- .7 Transformer KV Rating
 - .1 KVA rating as required.
 - .2 Fan cooling to provide 50% additional capacity.
- .8 High voltage equipment shall be rated.
 - .1 3 phase 60 hertz.
 - .2 95 KV BIL.
 - .3 300 MVA interrupting capacity at 12.5 KV.

- .9 Primary service connections shall be nominal 3 phase 3 wire 12.5 KV.
- .10 Secondary voltage shall be 347/600 volts 3 phase, 4 wire, or 120/208 volts 3 phase, 4 wire.
- .11 Maximum allowable Arc Flash Hazard/Risk Category within any part of the unit substation between primary cable entrances and main secondary bus shall not exceed level 2 (8 cal/cm²).
- .12 All equipment shall be housed in factory assembled enclosed cubicles. Adjacent cubicles shall be separated by metal barriers.
- .13 Where it is necessary to construct the components in separate enclosures these, when mounted and bolted together, shall present a unified appearance as to height, form and color.
- .14 All exterior surfaces shall be free from projections. Cubicle construction shall be rigid with formed metal corner posts and with all metal edges returned.
- .15 Access to all individual components must be readily obtainable. All cubicles shall have hinged doors to allow for easy infrared scanning. Doors shall be maximum 1200 mm wide with a minimum 90 degree opening. All panels on which relays, meters, or instruments are mounted shall have a barriered compartment with hinged door. All hinges shall be concealed.
- .16 Cubicles shall have heavy duty locks with common key or inter-lock.
- .17 Access doors shall have two vault-type handles with padlocking feature or be secured with bolt(s) where required. This will allow easy infrared scanning.
- .18 Interlocking shall be to Canadian Electrical Code and UBC Utility Requirements.
- .19 Inside of cubicles shall be painted white or ASA 61 grey. Exterior shall be ASA 61 grey, two coats of high gloss enamel.
- .20 All power connections shall be rigid bussing adequately supported for available fault currents. All equipment shall be wired at manufacturer's plant and required field connections wired to accessible load terminals. Grounding ball studs shall be affixed to bus at each cable entrance compartment and on the high voltage bus within the transformer section.
- .21 All ground conductors including equipment ground shall be copper.
- .22 A flat copper bonding strip of 0.50 sq. in. (1.3 sq. cm) minimum cross sectional area shall extend the length of the unit substation and be extended to all non-current carrying metal parts of the unit substation and the neutral grounding bus. Grounding ball studs shall be located for easy access during maintenance and shall be located within easy access of all door openings.
- .23 All control fuses mounted in substation shall have downstream long life LED indicating lights, with nameplates, to indicate circuits are energized. Supply one set of spare fuses for all fuses locations.
- .24 Provide wiring terminal box with terminal block for all outgoing control circuits and spare contacts. Terminal block shall be located where access is possible without de-energizing.

- .25 Corrosion resistant approved warning signs shall be securely mounted on the outside of the unit substation cubicles.
- .26 All operating control and indicating equipment shall be clearly labeled with lamacoid labels. Provide engraved brass nameplates for each section and general nameplates directed by Engineer.
- .27 All high voltage vaults must have floor drains and containment curbs.
- .28 Approved manufacturers of unit substations are as follows:
 - .1 Eaton.
 - .2 Electric Power Equipment.
 - .3 Schneider Electric.
 - .4 Unit Electrical Engineering (UEE).
 - .5 Prime Engineering.

2.2 Performance Standards

- .1 Unit substation assembly installation shall comply with:
 - .1 CSA C22.2 No. 31, current edition and CSA labeled.
 - .2 BC Hydro "Requirements for Primary Substations Supplied at 12.0 KV and 25.0 KV".
 - .3 Canadian Electrical Code.
 - .4 BC Electrical Regulations and Bulletins.
 - .5 UBC Utility Standards.

2.3 Submittals

- .1 Shop drawings shall include:
 - .1 All major electrical equipment.
 - .2 High voltage switch.
 - .3 Unit substation
 - .1 High voltage breaker.
 - .2 12 KV switchgear.
 - .3 Transformer cubicle.
 - .4 Protection and control.
 - .4 Factory Transformer Test Report – test report of no-load and load losses, winding resistance tests and impedance test.
 - .5 Co-ordination study and curves.
 - .6 Secondary distribution.
 - .7 High voltage cable.
 - .8 High voltage terminations.
 - .9 Secondary bus.
 - .10 Distribution centre.
 - .11 Revenue metering.
 - .12 Seismic restraints.
 - .13 Ground pad.
- .2 Submit the following test reports associated with the unit substation:
 - .1 Production Tests - manufacturer's standard product test as requested in Section 26 08 00 Commissioning of Electrical Systems 2.1.
 - .2 Unit Substation Test - manufacturer's factory test on supplied unit substation as specified in Section 26 08 00 Commissioning of Electrical Systems 2.1.
 - .3 Site Commissioning - test report on site commission as specified in Section 26 08 00 Commissioning of Electrical Systems 2.3.

- .4 Factory Transformer Test Report – test report of no-load and load losses, winding resistance tests and impedance test. Refer to Section 26 12 00 Medium-Voltage Transformers, sentence 2.4.4, for required loss limits for various size transformers.
- .3 Station Ground Resistance
 - .1 Submit ground resistance test as outlined in Section 26 08 00 Commissioning of Electrical Systems 2.3.6.
- .4 Cable Testing
 - .1 Submit conductor and cable test reports as outlined in Section 26 05 05 High Voltage Cables 2.12 Testing.
- .5 Voltage Calibration
 - .1 Submit voltage calibration report as outlined in Section 26 08 00 Commissioning of Electrical Systems 2.4.
- .6 Seismic Certification
 - .1 Submit certification of compliance with seismic requirements as specified in Section 26 05 48 Vibration and Seismic Controls for Electrical Systems.
- .7 Final Inspection Certificate
 - .1 Submit a copy of the final provincial electrical inspection certificate.
- .8 Operating & Maintenance Manuals
 - .1 Operating and maintenance manuals shall be submitted.
- .9 Project Record Documents
 - .1 Project record documents shall be submitted as specified and as per CCDC standards.
- .10 Shop drawings shall be submitted for review prior to construction. Shop drawings shall be AutoCAD or PDF with minimum 600 dpi resolution. Hard copies shall be on AO (841 mm x 1189 mm) sized drawings. Supply digital files with Shop Drawing submittal.
- .11 Before assembly of the unit substation, submit the following information in digital format:
 - .1 Electrical one-line diagram.
 - .2 Protective device co-ordination graph.
 - .3 Layout plan with dimensions.
 - .4 Reviewed and approved equipment cubicle drawing, including circuit breaker control wiring diagrams and key interlock scheme.
 - .5 Shop drawing information.

2.4 Drawing Requirements

- .1 AutoCAD Drawings Shall Include:
 - .1 Equipment layout and overall dimensions.
 - .2 Equipment specifications.
 - .3 One line diagram.
 - .4 Relating information including relay specs; time-current graphs; wiring diagrams, and tripping system.
 - .5 Seismic support and restraints.
 - .6 Metering information.
 - .7 Terminal block wiring and labeling.
 - .8 Labels.

- .2 Electrical One-Line Diagram
 - .1 The electrical one-line diagram shall show the connection of all the service entrance equipment. It shall contain the proposed service entrance relay settings.
- .3 Protective Device Co-ordination Graph
 - .1 A standard size 4 1/2 x 5 cycle log-log graph shall be used for the co-ordination study. It is mandatory that the service entrance protective device setting be compatible and co-ordinate with UBC Energy & Water Services protective equipment. The manufacturer shall provide the required co-ordination study. Refer to Section 26 05 04 Protective Device Coordination and Arc Flash Analysis.
- .4 Equipment Drawing - Unit Substation
 - .1 The unit substation shop drawings shall be submitted for review prior to assembly.
 - .2 The drawings shall show fully dimensioned equipment assembly details and the wiring diagram of the circuit breaker control scheme.

2.5 Metering Requirements

- .1 Metering shall be supplied by Switchgear Manufacturer at the project's cost and installed by manufacturer.
- .2 Switchgear manufacturer to incorporate Schneider Electric PM8240 meter with i/o module meter into construction.

2.6 Testing & Commissioning

- .1 Factory tests shall be performed as specified in Section 26 08 00 Commissioning of Electrical Systems. Provide written report of test results prior to shipment of unit substation.
- .2 Provide written report of test results prior to energization of unit substation.
- .3 Unit substation, when fully assembled, shall be made available for inspection in the factory by the Engineer.
 - .1 Unit substation to have factory test and site and commissioning as outlined in the Specification.

2.7 Cubical Specifications

- .1 Cable Entrance and Withdrawable Breaker Cubicles
 - .1 Shall house incoming cable terminations with provision for stress cones and cable supports.
 - .2 Shall include grounding ball studs on both incoming buses.
 - .3 Shall house Capacitive Voltage Transformers (CVT).
 - .4 Shall house Current Transformers (CT).
 - .5 Shall house electrically operated withdrawable vacuum circuit breakers.
 - .6 Shall house electrical operating controls for breaker racking mechanism behind lockable door.
 - .7 Shall house electrical operating controls for breaker open/close override behind lockable door.
 - .8 Shall include viewing windows.
 - .9 Doors shall have provisions for heavy duty padlock.
- .2 Transformer Cubicle
 - .1 Shall house cast coil transformer. Aluminum transformers are not permitted.

- .2 Ventilation louvers and fan cooling shall provide adequate cooling and ventilation.
- .3 Access doors shall be interlocked with main breaker.
- .4 May house metering equipment if not located in secondary distribution.
- .5 Transformer mounting shall meet seismic requirements.

2.8 Stress Cones

- .1 Stress cones shall be Raychem "Hot Shrink" or 3M "Cold Shrink" termination kit for 4/0 XLPE 25 KV rated.

2.9 15kV Cable Entrance

- .1 All components with the 15kV cable entrance section shall be fully accessible after substation installation.
- .2 The cable entrance section shall house the 15kV Current Transformers (CT) and Capacitive Voltage Transformers (CVT).
- .3 Grounding ball studs shall be installed on all incoming feeder connections and shall be positioned to allow access after the equipment is installed.
- .4 Cable support blocks shall be installed such that they do not interfere with cable terminations or cause undue mechanical stress to cable or connections. Supports blocks shall be constructed of electrically insulating material rated for the application. Support blocks shall utilize a clamping method to secure cables. Cable ties are not permitted.

2.10 Primary Bussing

- .1 15 KV primary copper bussing, minimum 600 Amp capacity.

2.11 15kV Withdrawable Circuit Breakers

- .1 15kV, 3 pole, 600 Amp group operated vacuum circuit breaker with magnetic actuator.
- .2 Each vacuum interrupter shall be mounted in molded epoxy housing with a minimum pole spacing of 210 mm. Vacuum interrupters shall be designed and rated as "sealed for life".
- .3 The breaker shall be operated by an electrically operated magnetic actuator controlled by position sensors and by electronic module. The energy required for operation shall be provided by integrated capacitors capable of storing sufficient energy for a complete operating cycle: open – close – open.
- .4 The breaker shall have local control buttons for open and close with an emergency mechanical opening operation and shall include a position indicator.
- .5 Rated interrupting capacity shall be minimum 300 MVA and 16kA RMS symmetrical at 15kV. Rated current 630 Amps. Rated duty cycle: open - 0.3 sec. - close/open - 15 sec. - close/open.
- .6 Number of operations at rated current = 30,000. Number of operations under short circuit = 100.
- .7 Rated impulse withstand of 95 KV BIL.
- .8 Breaker shall be type tested in accordance with ANSI Standard C57 and/or IEC 62271-100, CEI 17-1 file 1375.

- .9 Breaker shall be withdrawable type via motorized operator and manual racking lever.
- .10 Electric operators shall be 24 or 48V DC type compatible with unit substation control voltage and be powered directly from the DC Battery System.
- .11 The breaker shall have position sensors to prevent racking out while breaker is in the closed position.
- .12 The breaker shall have an integrated lockable hasp for the provision of personal lockout with mechanical and electric interlock to prevent the breaker from being able to be racked in.
- .13 The breaker shall be able to be fully racked in and out with the doors closed.
- .14 The breaker door shall be able to be closed after applying personal padlocks to the breaker.
- .15 All doors shall have provisions for padlocks.
- .16 A window shall be provided to permit viewing of the breaker in both the open, closed and racked out position.
- .17 Approved manufacturers are:
 - .1 ABB
 - .2 Eaton
 - .3 Schneider Electric

2.12 15kV Breaker Trip

- .1 Tripping power shall be obtained from the DC battery system.
- .2 The operating voltage for breaker trip shall be either 24 or 48 V DC.
- .3 Auxiliary trip coils shall be DC operated and independent of availability of AC current.
- .4 In addition, provide a shunt trip for over temperature and ground fault trip. Power to be from the DC battery system. Provide LED lamps for monitoring of shunt trip.
- .5 Provide one set of NO and NC auxiliary contacts to indicate whether breaker is open or closed wired to a terminal block located in an outlet box at the top of the cubicle.

2.13 Relay Current Transformers and Zone of Protection

- .1 Current Transformers (CT) shall be installed within the switchgear to create a complete protection zone. The zone of protection shall include cable terminations for both incoming feeders, HV circuit breakers, main transformer and main secondary bus and distribution board.
- .2 Provide window style, 600V, relay accuracy C100 CT's, ratio XX:5, in each 15kV cable entrance section. CT window shall be sized to allow for cable to pass through without interference to cable or its termination. CT's shall be permanently and securely mounted in switchgear cable entrance section.
- .3 Provide window style, 600V, relay accuracy C100 CT's, ratio XXX:5 in the low voltage section. Locate CT's as close as possible to the secondary connections of the transformer to maximize the protection zone area. CT's shall be permanently and securely mounted in switchgear.

.4 The Arc Flash Hazard category within any area covered by the Zone of Protection shall not exceed level 2 (8 cal/cm²).

2.14 Protection Relay

- .1 Overcurrent and short circuit protection shall be provided by a single Schweitzer Engineering Laboratories (SEL) 700GT+ series relay.
- .2 The SEL relay shall also provide protection for primary and secondary ground faults.
- .3 Protection shall be of the circuit closing type with programmable current range from 0.1 to 96.0 amps.
- .4 CT inputs shall be rated for 5 amp CT secondary.
- .5 The SEL relay shall be powered directly from the DC Battery System.
- .6 The SEL relay shall be surface mounted on the switchgear.

2.15 Capacitive Voltage Transformers

- .1 Three (3) Capacitive Voltage Transformers (CVT) shall be installed in each 15kV cable entrance section.
- .2 CVT's shall be mounted on the line side of each 15kV breaker and used exclusively for the purposes of live line detection.
- .3 CVT's shall have a voltage rating of at least 22kV to permit high potential cable testing.

2.16 Breaker Remote Operation

- .1 Both the normal and alternate breakers shall normally be operated remotely via control cabinet located in an area outside of the arc flash protection boundary.
- .2 The control cabinet shall house a single operating switch to transfer from one feeder to the other.
- .3 The control cabinet shall house operating controls to open and close individual 15kV breakers.
- .4 The control cabinet shall house pilot lamps to indicate breaker position for both 15kV feeders.
- .5 A time delay shall be incorporated of up to 15 seconds before the first action for the purposes of transferring between feeders or closing an individual breaker. This time delay will allow sufficient time for anyone that may still be within an arc flash protection zone to safely exit the area before the breakers operate. There shall be no time delay associated with opening an individual breaker.
- .6 Control wiring between the unit substation and the control cabinet may be via individual control wires, fibre optic cables or a combination of both.
- .7 All breaker operations shall be supplied from the DC Battery System.
- .8 The control cabinet shall have a hinged cover with provision for a heavy duty padlock.
- .9 The control cabinet controls shall look similar to that in UBC Standard Drawing E1-6.

2.17 Location of Auxiliary and Control Equipment

- .1 All components used for protection and control shall be housed in a separately barriered compartment from any high voltage equipment. This also applies to all auxiliary components including terminals, relays and pilot lamps.
- .2 Provide a 27mm conduit extending from the barriered control section of each feeder to a junction box on top of the substation equipment to allow for connection to external devices or monitoring equipment.

2.18 DC Battery System

- .1 Provide 24 or 48 volt DC battery system complete with heavy duty charger. Batteries shall have sufficient storage capacity to fully operate the circuit breakers (open – close – open), pilot lights and protection and control system in the event of a power failure.
- .2 Batteries shall store sufficient energy to ably maintain, monitor and control for up to 24 hours.
- .3 The DC charger shall be fed directly from the substation at 120 volts.
- .4 The DC charger shall have output relays with Form C dry contacts for the following conditions:
 - .1 AC power loss
 - .2 Charger failure
 - .3 DC power loss
- .5 The DC charger shall have an internal audible alarm that will annunciate during any of the above abnormal conditions.
- .6 The DC Battery System may be located in a separately barriered section of the switchgear or stand-alone outside of the switchgear. The system shall be designed such that any component of the system can be readily and safely accessed without shutting down the substation.

2.19 Main Secondary Breaker

- .1 A main secondary breaker, 600 or 208 volt, is not preferred.
- .2 In lieu of a secondary main breaker, provide current transformers (CT) to perform necessary overload, short circuit protection and Arc Flash Hazard Category reduction as outlined in Section 26 11 13 Primary Unit Substations, 2.1.8.
- .3 A main secondary breaker may only be provided for the purposes of derating downstream buses or as approved by UBC Energy & Water Services.

3.0 MATERIAL AND DESIGN REQUIREMENTS – OUTDOOR UNIT SUBSTATIONS

3.1 Outdoor Unit Substations General Requirements

- .1 Substation assembly shall be CSA, cUL or field (SPE-1000) certified.
- .2 15kV, 16kA rated, switchgear, solid dielectric or gas insulated with integrated high voltage main feeder and standby feeder cable entrance section.

- .3 Fluid filled transformer and integrated vacuum fault interrupter, with FR3® Envirotemp insulating fluid.
- .4 Overcurrent protection and auxiliary control components.
- .5 Low voltage distribution equipment, if required.
- .6 Outdoor transformers shall be sized not more than 3MVA.
- .7 Outdoor transformers may have a distribution panel integrated within the low voltage section rated not more than 3000 amps.
- .8 In installations requiring integrated distribution equipment, no single circuit breaker shall be rated higher than 1600 amps.
- .9 Overhead services for outdoor unit substations is not allowed.

3.2 15 KV Outdoor Switchgear Minimum Requirements

- .1 16kA rated equipment maintenance free design.
- .2 Dead front cable entrance and exit sections. Cable connections shall be IEEE 386 15kV, 600 amp deadbreak type.
- .3 Cable connection bushings shall be minimum 30" from bottom of equipment.
- .4 Solid dielectric or gas insulating medium only. Air insulated equipment shall not be permitted.
- .5 2 separate high voltage 3 phase fully load break rated isolating switches (2 ways) in a loop/feed through configuration within in common tank.
- .6 Each operating switch shall have one cable entrance connection with a 3rd outgoing cable connection directly on the common bus.
- .7 Cable entrance and exit connections shall only be mounted on front, back or side walls. Cable connections shall not be permitted on top or bottom of equipment.
- .8 Load break isolating switches shall have either 2 operable positions, Closed-Open or 3 operable positions, Closed-Open-Ground.
- .9 Load break Isolating switches shall be padlockable in the Open position to meet WorkSafe BC requirements.
- .10 Ability to operate load break isolating switches independently of each other while energized.
- .11 Large viewing window(s) for load break isolating switch contact position verification.
- .12 Approved manufacturers of outdoor solid dielectric or gas insulated switchgear are:
 - .1 Eaton/Cooper
 - .2 G&W Electric
 - .3 S&C Electric
 - .4 Prime Engineering

3.3 Fluid Filled Transformer with Integrated Vacuum Fault Interrupter Minimum Requirements

- .1 XXXX kVA 3 Phase Transformer
- .2 Insulating fluid FR3® environmentally friendly fluid for transformers
- .3 Integrated single vacuum fault interrupter (VFI) device installed by transformer manufacturer fully immersed in common tank
- .4 Factory supplied external 3 phase self-powered protection controller with auxiliary shunt trip inputs in a NEMA 4 enclosure
- .5 VFI operating handle and contact position viewing window in separate section from HV or LV cable entrances.
- .6 Cooling Welded Panel Type Radiators
- .7 Coatings ANSI 61 grey 3 mil
- .8 Touch-Up Paint (aerosol cans) (Qty: 2)
- .9 Notifications Standard Aluminum Nameplate
- .10 Notifications CSA, cUL Listed & Labeled
- .11 Nitrogen Blanket Nitrogen blanket With Purge Valve
- .12 Liquid Level Gauge Liquid Level Gauge
- .13 Liquid Temp Gauge Liquid Temp Gauge with Alarm Contacts
- .14 Pressure Vacuum Gauge Pressure Vacuum Gage
- .15 Pressure Relief Cover Mounted Pressure Relief Device
- .16 Valves Upper Fill Valve (1")
- .17 Valves Drain Valve (2") with Sampler
- .18 Tank Designed to meet seismic requirements of BC Building Code, current edition
- .19 Tank Designed for Skid Mounting, Continuous Operation @ 4-5° Tilt
- .20 Tank Welded Main Cover with Handhole
- .21 Tank Manhole Cover (Qty: 1)
- .22 Tank Stainless Steel Ground Pads
- .23 Installation Location Outdoor
- .24 Temperature Rise 65
- .25 Cooling Class KNAN
- .26 Frequency 60
- .27 Impedance 5% - 7% max
- .28 Efficiency Standard CSA C802.1
- .29 Elevation Designed for operation at 1000 m (3300 ft) above sea level
- .30 High Voltage 12,480 Delta
- .31 Primary Conductor copper
- .32 Primary BIL 95 kV
- .33 Taps 2 - 2.5% taps above and 2 - 2.5% taps below nominal
- .34 High Voltage Bushings, IEEE 386, 15kV 600amp deadbreak
- .35 High Voltage Bushing location Sidewall minimum 36" AFF
- .36 600 volt donut style XX:5 C100 (C50 minimum) CT's (3) field mounted within incoming cable section
- .37 Primary Phasing H1-H2-H3 (Left to Right)
- .38 Low Voltage 600Y/347 Wye solidly grounded
- .39 Secondary Conductor copper
- .40 Secondary BIL 30 kV
- .41 Secondary Bushing Location Sidewall
- .42 Secondary Phasing X1-X2-X3-XO (Left to Right)
- .43 Integrated overcurrent protection and controls section (see item 6 below)

3.4 Secondary Cabinet Minimum Requirements

- .1 Secondary Cabinet Front access door, including either 2 padlockable handles or a single padlockable handle and 2 tamperproof pentahead bolts.

- .2 Secondary Cabinet Side access panel.
- .3 600 volt donut style XXX:5 C100 (C50 minimum) CT's (3) permanently mounted at secondary phase bushings.

3.5 Overcurrent Protection and Auxiliary Control Equipment Minimum Requirements

- .1 Provide a 3000VA 600/120-240V station service transformer with primary class CC fuses installed in a NEMA enclosure within the transformer VFI operating section.
- .2 Provide a 60 amp rated 120/240V, 8 circuit load centre within the VFI operating section.
- .3 Provide a single 20 amp, 5-20R, GFCI convenience receptacle within the VFI operating section.
- .4 Provide 120VAC - 24VDC power supply c/w sealed lead acid battery backup. Batteries shall be sufficiently sized to provide protection and control for up to 24 hours. Batteries shall be provided by UBC.
- .5 24VDC power supply shall have integrated form C relay output and local audible alarm that activate on loss of AC or general trouble.
- .6 Provide 24VDC powered SEL 700 GT+ relay for primary, secondary 50/51 and ground fault protection.
- .7 Provide 120VAC heater, thermostatically controlled, mounted in the control cabinet and the LV section (when distribution equipment is installed).
- .8 Provide 120VAC heater in the 15kV switchgear cabinet enclosure.
- .9 Heaters, lights and convenience receptacle shall be supplied directly from the load centre.
- .10 Provide 600 volt donut style CTs, field mounted, in transformer high voltage cable entrance section.
- .11 Provide (3) 15.3 kV MCOV surge arrestors with 600 amp IEEE 386 connection for installation in high voltage cable entrance section.
- .12 Provide 600 volt donut style CTs, factory mounted, on secondary transformer bushings.
- .13 All auxiliary protection and control equipment shall be powered from the station service transformer and located within the transformer primary VFI operating switch section within a separately barriered enclosure mounted into a rigid side panel but accessible with transformer doors closed.
- .14 All operating and control components shall be located behind lockable NEMA 3R or 4 rated panel covers.

3.6 Approved Manufacturers of Outdoor Transformers and Associated Enclosures

- .1 Eaton/Cooper
- .2 Vantran Industries
- .3 Partner Technologies Inc. – PTI

- .4 Prime Engineering
- .5 Schneider Electric

3.7 Relay Current Transformers and Zone of Protection

- .1 Primary and secondary Current Transformers (CTs) shall be installed within the transformer enclosure to create a complete protection zone. The zone of protection shall include all components within the entire transformer enclosure and incorporate the VFI, transformer and secondary supply cables.
- .2 The Arc Flash Hazard category within any area covered by the Zone of Protection shall not exceed level 2 (8 cal/cm²).
- .3 The SEL 700GT+ relay shall act as the main protection device for the zone of protection and programmed with the following settings:
 1. HV 50/51
 2. HV 51N
 3. LV 50/51
 4. LV 51G
- .4 All other ancillary protective devices (49, 63, etc.), if used, shall connect into the SEL 700GT relay.
- .5 The factory supplied protection controller (if provided) shall act as a backup protection device and shall effectively coordinate with the SEL 700GT+ relay.
- .6 Refer to UBC standard drawing E1-2b for Protection and Control Single Line.

3.8 Switchgear and Transformer Cable Interconnection

- .1 High Voltage cable interconnection between the switchgear and transformer shall be installed by UBC Energy & Water Services only and charged to the project.
- .2 All protection and control equipment wiring shall be installed by the contractor.

3.9 Concrete Equipment Pad and Seismic Anchoring

- .1 The contractor shall design and provide the concrete equipment pad and all interconnecting conduits.
- .2 15kV switchgear and transformer shall be physically separated by the minimum requirements of the equipment supplier and applicable codes with a minimum of 300mm clearance between equipment.
- .3 UBC Energy & Water Services shall approve all concrete pad layouts along with all protective bollard locations or architectural surrounds prior to any installation.
- .4 Refer to typical concrete pad layout in UBC standard drawing E1-2c.
- .5 UBC Energy & Water Services may refuse permanent power connection to any installation that is not installed as per approved layout design.
- .6 The contractor shall ensure all seismic anchoring requirements are met as per UBC Technical Guidelines section 26 05 48.

3.10 Grounding and Bonding

- .1 Counterpoise grounding and bonding shall be designed, installed and tested as per UBC Technical Guidelines section 26 05 26.

*****END OF SECTION*****