1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 *Division 16*
.3 *Division 17*

1.2 Co-ordination Requirements

.1 UBC Utilities
.2 UBC Building Operations
.3 *UBC Information Technology (IT)*

1.3 Description

.1 General requirements for all Division 16.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

.1 The contractor is responsible for and keeps one complete set of white prints, including revision drawings in the job site, office.

.2 Construction Power
- .1 The temporary power service includes a consumption meter. The connection point and voltage for the construction power will be determined by UBC Utilities.
- .2 The Contractor shall pay for all materials and installation of equipment for the provision of construction power.
- .3 The Contractor shall pay for all utility consumption until the building is turned over to UBC.
- .4 *The Contractor must contact UBC Information Technology for coordination and installation of temporary telecommunications cabling.*

  UBC Information Technology,
  IT Plant Coordinator,
  Phone: 604-822-8659.

2.2 High Voltage Vaults

.1 All high voltage vaults shall have a floor drain and containment curbs.

2.3 Project Record Drawing Requirements

.1 The contractor shall be responsible for and keep one complete set of white prints, including revision drawings at the job site.

.2 The contractor shall deliver to the consultant at “substantial performance” one complete set of white prints, showing by colored lines and suitable notation all work as installed, together with sizes and routes of electrical service lines installed, relocated or adapted under this project. The contractor shall maintain a current record, as the job progresses, of any deviations from contract drawings. Manholes, pulling pits, etc. shall be located at the center

lines, by co-ordinates, on a grid system shown on the site plan. Locations and levels shown on plans must be accurate to within 12 mm.

.3 Approval for backfilling of underground services will not be given before the UBC Utilities, is satisfied that the exact location of the underground service has been surveyed and recorded. The contractor must employ a qualified surveyor to record the horizontal and vertical location of underground services. This survey information is to be shown on the project record drawings and must indicate the location of all buried services, as well as, those capped or exposed by the work of this contract.

.4 The Project Record drawing must show the following, where applicable:

.1 All conduit or duct work located below ground level and in or below a building slab.

.2 All service, sub-service and main riser conduits, all spare conduits stubbed in concealed spaces, and location of all electrical equipment essential for safe system operation (such as end of line resistors, etc.).

.3 All service ducts and cables for voltages above 750 volts and for main communications cables.

.4 Project Record White prints shall be delivered to the consultant at "substantial performance" in accordance with Division One - General Requirements.

2.4 Electrical Operating and Maintenance Manuals

.1 *One (1) copy* of operating and maintenance manuals shall be prepared in suitably labeled hardback post binders and one (1) digital CD copy.

.2 These manuals shall be turned over to the owner no later than the time of substantial completion, and shall include complete sets of maintenance and operating instructions for all equipment provided under the contract and specifically as called for below:

.1 Manufacturer's maintenance instructions shall include all equipment as designated in the equipment list. Instructions shall be complete with installation, operation and maintenance drawings and shall include:
- .1 One corrected copy of all shop drawings.
- .2 Catalogue details of all lighting fixtures actually installed, including lenses.
- .3 Schematic drawings and maintenance data on the fire alarm system, emergency lighting system and clock systems as applicable.

.3 These manuals shall be compiled by the contractor or an independent agency specializing in this type of activity. In the latter case, the manual shall be thoroughly vetted by the consulting engineer and recommended by letter to owner as being complete and accurate.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 16, Section 02800
.3 Division 17

1.2 Coordination Requirements:

.1 UBC Building Operations
.2 UBC Utilities
.3 UBC Information Technology

1.3 Description

.1 UBC requirements for the Design Development Brief for Division 16.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General Requirements

.1 Engaged Consultants supplies the University at the preliminary stage of the building project, a Development Brief which contains information listed below:

.1 Preliminary drawings clearly defining scope of work and equipment details.
.2 Specifications of all electrical systems and equipment.
.3 Power Riser Diagram.
.4 One Line Diagram.

2.2 Off Site and Site Services

.1 Through discussion with UBC Utilities the Design Development Brief shall include:

.1 Underground duct system tie-in to existing duct or manhole.
.2 Expected peak demand, in KVA.
.3 Manhole size and approximate location, drainage provision.
.4 Number, size and type of power cables and neutral.
.5 Number of ducts in each duct bank.

2.3 Building Service

.1 The Design Development Brief shall include the following Building Service information:

.1 Size and location of main electrical and sub electrical rooms and distribution centers.
.2 Power switching components.
.3 Power transformer types and sizes.
.4 Secondary voltages.
.5 One line diagram including secondary distribution board, sub distribution centers, motor control centers, and risers.

2.4 Other Services

.1 The Design Development Brief shall include the following other information:

.1 Fire alarm and building alarm components and supervisory equipment.
.2 Communication rooms size and location.
.3 Other services to be provided such as clocks, bells, telephone/data outlets, TV outlets, closed circuit television system, P/A system, emergency lighting and standby generator.
.4 Type of interior, exterior lighting fixtures and poles.

2.5 Construction Power

.1 The Consultant obtains from UBC Utilities, the location and voltage level for construction power.

.2 The Design Development Brief shall include the following construction power information:

.1 The Consultant provides in his design, a drawing showing the basic equipment and wiring for the service.

.3 Construction power consumption and all associated equipment and installation material and labour shall be paid for by the project.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Section 02800

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations

1.3 Description

.1 UBC requirements for Duct Banks and Manholes.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Design Standards

.1 Work shall comply with requirements of:
  .1 WorkSafe BC.
  .2 BC Safety Authority.

.2 All civil work including duct banks, manholes and cast-in-place and precast concrete shall comply with UBC Technical Guidelines, BC Hydro Standards, or Master Municipal Construction Documents (MMCD) as applicable.

2.2 Trenching

.1 Prior to any trenching the duct runs shall be surveyed and staked out. Approval of the staked runs shall be obtained from the Consultant.

.2 All trenching, excavating, and backfill shall be done to MMCD specifications. Backfill and bedding materials shall be supplied by the Contractor. Trench bottom shall be continuous, firm and shall provide uniform support to the ducts.

.3 Backfill materials shall be free of rocks larger that 75mm diameter, wood, cinders, ash, and frozen materials. Top surface shall be landscaped to match the existing ground and any road surfaces shall be made good to match existing conditions.

2.3 Other Services

.1 There are existing services and may be additional runs of other services such as electrical, telephone, water, sewers, gas, oil, drainage, etc. Exercise the maximum care to avoid interference or damages to these. Refer to Underground Utility Services.

2.4 Requirements for Ducts

.1 Ducts shall be rigid PVC, encased burial type duct conforming to the specific of CSA standard C22.2 No. 211.1 “Rigid Types EB1 and EB2 / ES2 PVC Conduit”. Ducts shall be 125mm (5") for all ducts between manholes.

.2 Ducts shall be:
.1 Power services: minimum: 6 – 125 mm (5") between manholes and 4 – 100 mm (4") into buildings. Larger size may be required by CSA or UBC Utilities.

.2 Communication services: minimum 4 - 125 mm (5") between manholes and 4 -100 mm (4") into buildings.

.3 Ducts shall be sized on the drawings.

.4 Ducts shall be buried at a minimum depth of 900 mm. Duct runs shall be evenly sloped toward duct terminations for drainage.

.5 Ducts shall terminate with bell mouth ends. A 10 mm (¼") pulling line shall be installed in all ducts.

.6 All duct bends shall be long sweep "Utility" bends manufactured to utility pulling specifications.

.7 At building entry seal duct openings with an approved non-hardening putty material for all conduits or ducts entering building to prevent migration of gases into the building.

2.5 Requirements for Manholes

.1 Manholes shall be 1830 mm x 3300 mm x 2000 mm high inside dimensions.

.2 Manhole shall be complete with cast manhole cover, frame and brick assembly between manhole and manhole lid.

.3 Materials shall include:
.1 Pre-cast Manhole Assembly.
.2 Manhole Frame.
.3 Manhole Cover.
.4 Spacer Rings.
.5 Pulling Irons.
.6 Ground Rods.
.7 Sump Cover.

.4 Manholes shall be constructed to the following UBC Utility Standards:
.1 E 3-1 Standard Electrical Precast Manhole.
.2 E 3-2 Standard Electrical Manhole Pour in Place.
.3 E 3-3 Additional Reinforcing for Pour in Place Electrical Manhole.
.4 E 3-4 Standard Electrical Manhole Cover & Riser Details.
.5 E 3-5 Standard Electrical Manhole Sump Detail.
.6 E 3-6 Typical Manhole Grounding & Details.
.7 E 3-7 Typical Manhole Separation.

.5 Pre-cast Manhole using AE Concrete # 331822 Chamber to same dimensions may be substituted as an alternate.

.6 Concrete shall not be placed in foundations until the soil breaking has been reviewed by the Engineer.

.7 All manholes shall have a sump with positive drainage. *Manhole drains shall be connected to the storm water system.*

.8 Testing costs for compaction and concrete tests shall be paid for by the UBC.

2.6 Requirements for Concrete Encased Duct Bank

.1 All Service Ducts shall be concrete encased.

.2 All Civil Work associated with Duct Bank shall be to MMCD Specifications.

.3 Duct Banks shall be constructed in accordance with UBC Standards Drawings:
- .1 E2-1 Standard Concrete encased Electrical Duct.
- .2 E2-3 Standard Electrical Duct Bank.
- .3 E2-4 Electrical Ductbank Clearances to Steam Distribution Lines.

.4 Forms must be used on the walls of the duct bank.

.5 Duct connectors shall be staggered so they are never adjacent to another coupling. Manufactured intermediate spacers shall be used throughout the length of the duct run every 2 meters.

.6 Concrete shall have maximum 200 mm (3/4") aggregate, minimum 20 MPA strength at 28 days, and shall contain “Anti-Hydro” mixed as recommended by the additive Manufacturer.

.7 Immediately after installation, ducts shall be tested for blockages and cleaned as necessary. Prior to completion the ducts shall be swabbed and mandrel led.

2.7 Requirements for Warning Tape During Construction

.1 During construction a warning tape (yellow) imprinted “CAUTION BURIED ELECTRICAL LINE” shall be installed at all duct banks and buried conduit.

.2 Warning tape shall be laid in the trench midway between duct bank and finished grade.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 16
.3 Division 17 (17120)

1.2 Coordination Requirements

.1 UBC Utilities.
.2 UBC Information Technology

1.3 Description

.1 UBC requirements for Electrical Grounding.

2.0 MATERIALS DESIGN REQUIREMENTS

2.1 Ground Wires

.1 Grounding conductors shall be installed as required by the Code.
.2 From the neutral ground position of each transformer, a grounding conductor shall be extended to the UBC system ground bus.
.3 Ground wire for ground electrodes shall be # 4/0 copper.
.4 All ground wire shall be tested for continuity. Record each continuity test and include in ground system report.

2.2 Ground Wires

.1 Unit substation and pad mounted transformers shall have a ground grid.

2.3 Ground Rods

.1 Ground rods shall be 3/4" x 10' copper clad ground rods.

2.4 Ground Fittings

.1 Ground connections shall be made with compression fittings that are CSA approved for grounding.

.2 Ground grid connections for buried ground grid splices shall be Cad welded or CSA approved compression connected.

2.5 Telecommunications Bonding

.1 Please refer to Division 17 Section 17120 for specialized telecommunications bonding requirements.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 Performance Standards

.1 High Voltage Cable shall comply with the requirements of the most recent edition of:
  .1 I.P.C.E.A. S-66-524/NEMA WC7.
  .2 CSA C68.3.

2.2 U.B.C. Power System Characteristics

Voltage	12480V
Phases	3
Wires	3
Frequency	60 Hz
System Neutral	Low resistance grounded 100A, 10 sec, 7.2 KV, 72 ohms
Available short circuit capacity	Maximum 300 MVA

2.3 Detailed Cable Specifications

Insulation	Unfilled cross linked polyethylene (XLPE) 90º C temperature rating, 133% insulation level *or Ethylene-Propylene Rubber (EPR) 105º C temperature rating, 133% insulation level.*
Shield	Metallic: bare copper tape with 100% coverage and a minimum of 10% overlap.
Conductor	ASTM Class B soft bare copper, stranded.
Size	Building Services: 1 Conductor - 4/0 AWG per phase
	Feeders: 1 Cond. 500 KCM per phase
Construction	Solid plastic
Jacket, Outer	PVC
Rated Voltage	15 KV

2.4 Applicable Manufacturers

.1 Aetna Insulated Wire Company.
.2 Phillips Cable.
.3 Pirelli Cable.
.4 Alcatel.
.5 Okonite
.6 Southwire
.7 All substitutes shall be pre-approved by UBC Utilities.

2.5 UBC Underground Duct System Consideration

.1 All cables will be pulled into underground duct systems constructed to UBC Standards.

.2 The duct system is not waterproof and the cables may be immersed in water for long periods of time.

.3 Ducts are to be constructed as per UBC Standard Drawings E2-1, E2-2 and E2-3.

2.6 Ground Wires

.1 Grounding conductors shall be installed to UBC standards and as required by the Code. Specify wire size 4/0 and 500 kCM.

2.7 High Voltage Cable Termination

.1 High voltage cable terminations shall be Elastimold #K656 BLR 600 amp series only, unless otherwise specified.

.2 Termination cable kit shall match conductor insulation diameter for 500 kCM or 4/0 conductors.

.3 Refer to UBC Standards Drawing # E4-2.

2.8 Interruption of Services

.1 Shut down for any 12 KV circuits must be requested 4 weeks in advance of the actual shutdown date.

.2 At any time no more than one 12 KV circuit can be shut down.

2.9 Manhole Access

.1 Permission to access any utility manhole must be coordinated and approved by UBC Utility Department. A Manhole Entry Permit must be approved before entry.

.2 Entry into any manhole must be made in the company of UBC Utility personnel.

2.10 Safety Standards

.1 All work within a utility manhole shall comply with WCB confined space access requirements.

2.11 Labeling

.1 Feeder labels to be installed around feeders at cable heads, stress cones, manholes, pull pits, etc. Refer to UBC Standard Drawing E4-1.

.2 Feeders revised from existing circuit arrangements shall be relabeled at all “downstream” locations such as manholes, pull pits and building switchgear.

2.12 Testing

.1 Tests to be performed using qualified personnel. Provide necessary instruments and equipment.

.2 Perform Hi-pot testing of cable at a voltage level not exceeding cable rating on the original reel at the UBC site. Failure to comply will void the factory warranty and the installation will be at the Contractor's risk.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check insulation resistance after each splice and/or termination to ensure that the cable system is ready for acceptance testing.

.5 Acceptance Testing

.1 Ensure terminations and accessory equipment is disconnected including ground shields, ground wires, metallic amour and conductors not under test.

.2 UBC Utilities shall perform installed cable acceptance tests on all new cable installations using VLF testing equipment. All tests performed to NETA specifications.

.3 Review test with the Engineer before proceeding.

.4 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

.5 Remove and replace entire length if cable fails to meet the test criteria. Contractor will be responsible for the cable and installation costs to replace damaged cable.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 15, 16 & 17

1.2 Coordination Requirements

.1 UBC Building Operations

1.3 Description

.1 UBC Requirements for Wire and Cables (0-1000 V).

2.0 MATERIALS AND DESIGN REQUIREMENTS

.1 Wires shall be copper throughout with R90 X-Link insulation. Minimum wire size shall be #12 AWG except for control wire. Wires #12 AWG and larger shall be stranded.

.2 Power wiring shall be color coded red, blue and black with white for neutral and green for ground.

.3 Color shall be impregnated in the insulation for wire #8 and smaller, and clearly identified with colored vinyl tape at both ends and at all splices for large wire.

.4 Control wiring shall be clearly identified if AC or DC.

.5 Color coding for motor control wiring shall reflect accepted industry standards, but be sized no smaller than #18.

.6 Wiring installed in underground ducts or conduits shall be copper, 1000V insulation, XLPE.

.7 Electrical wiring shall be installed in conduit. Use metallic surface raceway equal to wire mold in finished areas for renovation projects.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 16

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations

1.3 Description

.1 UBC seismic requirements for Electrical Equipment.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General

.1 Submit a detailed and sealed report from Structural Engineer of record who shall also ensure the specified restraint system has been installed.

.2 All electrical equipment shall be seismically secured in compliance with BC Building Code.

2.2 Transformer and Unit Substation Seismic Support

.1 The Substation Manufacturer shall have a Seismic Engineer design and select, the seismic restraint system to suit post disaster earthquake requirements.

.2 Structural Engineer of record shall ensure the floor is sufficiently thick for the required bolting and that the specified restraint system has been installed.

.3 For substations located on grade on slab, mount core and coil assembly on bridge bearing neoprene Super 'W' pads, and provide hemi grommets for each bolting location designed to suit system. Alternatively, if substation is located on a suspended floor above grade, mount core and coil assembly on Lo-Rez spring isolators designed to suit system and provide separate seismic snubbers for use with springs.

.4 Supply chemical bolts for securing the transformer.

.5 Submit bolting requirements for all substation cubicles.

.6 Acceptable manufacture of seismic restrain system is Mason Industries.

.7 Provide flexible braid connections at transformer line and load connections. Cable connections are not acceptable.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Section 16999

1.2 Coordination Requirements

.1 UBC Building Operations

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 Labeling Requirements

.1 Feeder labels to be installed around feeders at cable heads, stress cones, manholes, pull pits, etc. Refer to Standard Drawing E4-1.

.2 Feeders revised from existing circuit arrangements shall be relabeled at all 'downstream' locations such as manholes, pull pits and building switchgear.

.3 Engraved lamicoid nameplates with the name of the load shall be installed on breakers or switches at the switchgear cubicles and elsewhere where called for on the drawings.

.4 Nameplates shall be securely fastened and screwed or riveted.

.5 Exterior cubicle nameplate dimensions shall be engraved brass 4" x 1 ½" black lettering.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines

1.2 Coordination Requirements

.1 UBC Building Operations
.2 UBC Utilities

1.3 Description

.1 The University owns and operates the power system consisting of 60 KV and 12 KV overhead and underground lines. Two 60 KV lines feed two substations: one located in the South Campus, and one in the Main Campus. The Main Substation supplies a 12 KV indoor and outdoor switching station.

.2 The 12 KV systems are distributed underground in a combined duct and manhole system which serves throughout Main and South campuses. The 12 KV systems are nominally rated at 12,480 volts, 3 phase Wye System, low resistance grounded. The design limits are Basic Impulse Level 95 KV and Design Fault 300 MVA Symmetrical.

.3 The power distribution is a Dual Radial System with 500 KCM 15 KV single conductor crosslink polyethylene cable for 12 KV System. For a General Distribution diagram of the 12 KV feeders, refer to Standard Drawing No. E1-1.

2.0 MATERIAL AND DESIGN REQUIREMENTS

.1 All new buildings, *UBC Renew projects* and any major additions to existing buildings shall be supplied from the 12 KV systems. *12KV main feeds shall NOT be fed as an interconnection from other buildings ("daisy-chaining"). Interconnection might compromise the research in both buildings, should a problem occur.*

.2 *It is vital* that any major renovation of an existing building that will require a change to the building's electrical supply *must* be discussed with UBC Utilities prior to design submission. *There are no exceptions.*

.3 *Any request for variance, such as where small buildings are concerned, must be reviewed with the University's Electrical Engineer, Technical Services. Call 604-822-0852.*

.4 Refer to Standard Drawing No. El-I attached as Appendix "A" in regard to the supply feeders into each building.

.5 Note that a ground of equivalent size (in general a 4/0) shall be installed to each building switch room. This ground conductor shall tie into the existing ground system and also be connected to an accessible ground bus on which all equipment and service grounds are to be terminated. Provisions shall be made for at least two spare connecting points for additional grounding, other than for the Telephone Company, fire alarm, etc.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines

1.2 Coordination Requirements

.1 UBC Utilities. Refer to http://www.buildingoperations.ubc.ca/engineering/utilities/

1.3 Description

.1 UBC requirements for Unit Substation.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 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 Unit Substation Components shall consist of:
- .1 15 KV switchgear.
- .2 Main feeder and standby feeder load break switches.
- .3 Main vacuum circuit breaker and protection relays.
- .4 Cast coil transformer, (aluminum shall not be specified).
- .5 Metering.
- .6 Secondary Distribution (if applicable).

.3 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.

.4 Transformer KV Rating
- .1 KVA rating as required.
- .2 Fan cooling to provide 50% additional capacity.

.5 High voltage equipment shall be rated.
- .1 3 phase 60 hertz.
- .2 95 KV BIL.
- .3 300 MVA interrupting capacity at 15 KV.

.6 Primary service connections shall be nominal 3 phase 3 wire 12.5 KV.

.7 Secondary voltage shall be 347/600 volts 3 phase, 4 wire, or 120/208 volts 3 phase, 4 wire.

.8 All equipment shall be housed in factory assembled enclosed cubicles. Adjacent cubicles shall be separated by metal barriers.

.9 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.

.10 All exterior surfaces shall be free from projections. Cubicle construction shall be rigid with formed metal corner posts and with all metal edges returned.

.11 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.

.12 Cubicles shall have heavy duty locks with common key or inter-lock.

.13 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.

.14 Interlocking shall be to Canadian Electrical Code and UBC Utility Requirements.

.15 Inside of cubicles shall be painted white or ASA 61 grey. Exterior shall be ASA 61 grey, two coats of high gloss enamel.

.16 Outdoor substations shall have roofs of all cubicles spray lined with flame and moisture resistant insulation.

.17 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.

.18 All ground conductors including equipment ground shall be copper.

.19 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.

.20 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.

.21 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.

.22 Corrosion resistant approved warning signs shall be securely mounted on the outside of the unit substation cubicles.

.23 All operating control and indicating equipment shall be clearly labeled with lamicoid labels. Provide engraved brass nameplates for each section and general nameplates directed by Engineer.

.24 All high voltage vaults must have floor drains and containment curbs.

.25 Approved manufacturers of unit substations are as follows:
- .1 Cutler Hammer.
- .2 Electric Power Equipment.
- .3 Schneider Electric.
- .4 Siemens Canada.

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 16010 - Electrical General Requirements.
- .2 Unit Substation Test - manufacturer’s factory test on supplied unit substation as specified in electrical general requirements and unit substation.
- .3 Site Commissioning - test report on site commission as specified in electrical general requirements.
- *.4 Factory Transformer Test Report – test report of no-load and load losses, winding resistance tests and impedance test. Refer to Section 16311, sentence 2.4.4, for required loss limits for various size transformers.*

.3 Station Ground Resistance
- .1 Submit group resistance test as outlined in Section 16010 - Electrical General Requirements.

.4 Cable Testing
- .1 Submit conductor and cable test reports as outlined in Section 16010 - Electrical General Requirements.

.5 Voltage Calibration
.1 Submit voltage calibration report as outlined in Section 16010 - Electrical General Requirements.

.6 Seismic Certification
.1 Submit certification of compliance with seismic requirements as specified in Section 16290 - Seismic Requirements.

.7 Acoustical Certification
.1 Submit site measurement report of acoustical compliance with Section 16275.

.8 Final Inspection Certificate
.1 Submit a copy of the final provincial electrical inspection certificate.

.9 Operating & Maintenance Manuals
.1 Operating and maintenance manuals shall be submitted.

.10 Project Record Documents
.1 Project record documents shall be submitted as specified and as per CCDC standards.

.11 Eight copies of shop drawings shall be submitted for review prior to construction. Shop drawing shall be AutoCAD on AO (841 mm x 1189 mm) sized drawings. Supply AutoCAD disc with Shop Drawing submittal.

.12 Before assembly of the unit substation, submit the following information:
.1 Five copies of electrical one-line diagram.
.2 Five copies of protective device co-ordination graph.
.3 Five copies of Layout plan with dimensions.
.4 Five copies of 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 ½ 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 Utilities protective equipment. The manufacturer shall provide the required co-ordination study. Refer to Pending Addendum #13: Proposed New

Electrical Section 16420 – Protective Device Coordination and Arc Flash Analysis, for more details. Please click here.

.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 to be supplied by UBC Utilities at the project's cost and installed by manufacturer.

.2 Substation manufacturer to incorporate PML 7330 meter into construction.

.3 UBC will ship the meter to manufacturer for installation.

2.6 Testing & Commissioning

.1 Factory tests shall be performed as specified in Section 16900 – Testing and Commissioning. 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 Incoming Load Break Switch Cubicles
- .1 Provide an in-coming load break switch cubicle for each incoming 12 KV feeder.
- .2 Shall house in-coming cable terminals with provisions for stress cones and cables.
- .3 Shall include grounding ball studs on all busses.
- .4 Shall house 15KV load break switch.
- .5 Viewing windows shall be provided for viewing contacts.
- .6 Door shall have provisions for heavy duty padlock.
- .7 Access door shall be interlocked.

.2 Main Breaker Cubicle
- .1 Shall house 15KV vacuum circuit breaker.
- .2 Operating controls and equipment shall be provided to perform the required function and shall be logically organized and readily accessible.
- .3 Access door shall be interlocked.

.3 Transformer Cubicle
- .1 Shall house cast coil transformer. Aluminum transformers shall not be allowed.
- .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 Load Break Switch.

.1 15 KV 600 AMP load break switch shall be self generated air blast type with two auxiliary contacts, 1 NC, & 1 NO, to indicate whether switch is open or closed. Provide padlock hasp to permit locking of switch in open position only. Load break switch to have two tumblers key interlocks.

.2 Provide a wired-glass viewing window adequately sized to permit easy viewing of the load interrupter contacts in both open and closed position. Provide an internal 120V 100W lamp in a screened compartment with switch to illuminate the interrupter.

.3 Approved manufacturers are:
- .1 FPE Type NAL.
- .2 EPE Type CK2.
- .3 Cutler Hammer WLI.

2.10 Primary Bussing

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

2.11 Main Breaker

.1 15 KV, 3 poles, 600 amp group operated vacuum circuit breaker.
.2 Each vacuum interrupter shall be mounted in molded epoxy housing for mechanical protection and electrical isolation. Minimum pole spacing shall be 210 mm.
.3 The breaker shall be operated by a stored energy operating mechanism with manual charging lever. Flag indicators shall identify the energy condition of the springs and breaker position. Provide manual close and trip buttons.
.4 Rated interrupting capacity shall be minimum 300 MVA and 18 kA RMS symmetrical at 15 KV. Rated current 630 amps. Rated duty cycle: open - 0.3 sec. - close/open - 15 sec. - close/open.
.5 Rated number of operations at rated current - 20,000.
.6 Rated impulse withstand of 95 KV BIL.
.7 Breaker shall be type tested in accordance with ANSI Standard C57.
.8 Mount breakers on slide rail framework designed to provide easy removal and inspection. Provide guides to guarantee alignment. Provide flexible links or finger cluster connections for line and load terminals.
.9 Approved manufacturers are:
- .1 ABB Type VD4.
- .2 Cutler Hammer.
- .3 Square D VAD-3.

2.12 Breaker Trip

.1 Tripping power shall be obtained from a capacitor trip system incorporating a 12,000/120 volt 2-pole potential transformer. The capacitor trip system shall also include a fail-safe trouble monitor system to operate a form C contact (1-N/O & 1-N/C) in the event of any derangements of the capacitor trip system which would prevent it from tripping the breaker, such as opening of primary or secondary PT fuses, etc. Extend the contacts to terminal blocks in an outlet box on the roof of the circuit breaker. It shall have a ride-through ability of 30 minutes in case of brown-outs and outages.

.2 Alternately, the breaker shall have direct acting trips and interposing self saturating transformer to limit the voltage across the relay contacts to a permissible value with maximum available fault current.

.3 Trip coils shall pick up with 3 amp CT secondary current.

.4 In addition, provide a 120V shunt trip for over temperature and ground fault trip. Power to be from a suitable 12,000/120V or secondary 120V protected by HRC fuses in disconnecting type fuses holders. Provide neon 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

.1 Provide three, 15KV relay accuracy C100 current transformers ratio XX/5 with low corona discharge, 15 Pico coulombs maximum at 12.5 KV. They shall be designed for use in switchgear and have a one minute withstand rating of 36 KV and be tested at this level relays.

.2 Provide three over current relays, (very inverse over current) Basler type BE1-50/51M Model #109 with instantaneous trip. They shall be of the circuit closing type with current dial settings 0.5 to 15.9 amps with instantaneous settings of 1 to 99 amps. Over current/instantaneous relay shall be rated for 5 amp CT secondary.

.3 Provide one over current relay, Basler type BE1-50/51M Model #108 for ground fault relaying, current plug setting to be 0.1 to 3.18A. Ground relay shall be rated for one amp CT secondary.

.4 Supply relays with semi-flush vertical mounting, C1 case size with draw out construction.

2.14 Potential Transformer

.1 Provide one potential transformer, two pole, ratio 12500/125 volt, 60 Hz, 95 KV BIL revenue metering accuracy 0.6 WXY 1.2.Z.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations

1.3 Description

.1 UBC requirements for Substation Transformers.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 Primary Bussing

.1 15 KV primary copper bussing, minimum capacity 600 amps, 300 MVA bracing.

2.2 Surge Arrestors

.1 Provide three 12 KV MCOV distribution class lightning arrestors. Install immediately upstream of transformer primary connection. Ground arrestors directly to ground bus with 4/0 copper.

2.3 Transformer Connection

.1 Flexible copper braid connections at both primary and secondary connections of transformer.

2.4 Cast Coil Transformer

.1 Substation transformer(s) to step down voltage from 12.48 KV to 347/600V or 120/208V shall be cast coil type, Class F insulation.

.2 Cast coil transformer with fan cooling to provide 50% additional load capacity. The transformer cubicle shall contain transformer core and cast coils, fans and controls, temperature measuring assembly, neutral/ground CT, primary and secondary busses and ground bus.

.3 The transformer shall be designed and built in accordance with the current issues of CSA Standard C9 and ANSI Standard C57.12.00.

.4 Losses shall not exceed those specified below and shall be in compliance with or exceed CSA Standard C802 requirements.

Transformer Size (KVA)	No. Load Losses (Watts)	Load Losses (Watts)
750	2,300	7,500
1000	2,900	9,000
1250	3,250	10,100
1500	3,800	12,100
2000	5,200	14,300
3000	5,700	19,500

.5 The transformer shall be a 3 phase core type with cast epoxy coils fiber glass reinforced, type AN with forced air cooling. To provide 50% additional capacity both HV and LV coils shall be cast under a hard vacuum in steel moulds and the cores shall be mitered.

.6 Insulation system shall be Class F (185 °C) but the average winding temperature rise shall be 80 °C maximum, at rated voltage and full load.

.7 Windings shall be copper. Aluminum shall not be used.

.8 Each LV winding shall be equipped with embedded temperature sensors connected to the detection system temperature relay unit with separate output dry contacts for fan operation, remote alarm and tripping corresponding to 80% and 95% and 105% of rated operating temperature.

.9 Provide a digital readout for each phase and constant memory of the highest temperature with readout on demand.

.10 Provide remote contacts for high temperature monitoring wired to outlet box at roof of transformer.

.11 Mount temperature relay unit and thermometer on a hinged panel of a barrier instrument compartment on the side of cubicle. Connect tripping contacts to trip the primary vacuum breaker. Extend 1-NO and 1-NC alarm contact to terminal blocks in a six inch outlet box on the roof of the transformer enclosure.

.12 Power supply for cooling fan shall be supplied from power source in transformer cubicle (secondary connection).

.13 Provide design data and shop drawings for all transformer characteristics for approval by the consultant before proceeding with manufacture.

.14 The core shall be protected against corrosion by a coating of epoxy resin not less than 1 mm thick. All steel parts other than the core shall be hot dip galvanized with a minimum coating thickness of 0.1 mm or epoxy painted.

.15 After manufacture, the transformer shall be partial discharge and sound level tested in addition to standard production tests list in CSA Standard C9 to verify the specified ratings. The partial discharge shall not exceed 15 pico coulombs at a corona extinction voltage of 120% of rated voltage when energized by induction from a three phase, 60 HZ or higher frequency source. A certificate issued by the Testing Engineer shall be provided verifying the results of all factory tests.

.1 Continuous (XXX) KVA rated output.
.2 (XXX) KVA fan cooled rated output.
.3 Insulation Class - F 185 °C maximum winding temperature.
.4 Temperature Rise Design - 80 °C average winding temp rise.
.5 Frequency – 60 Hz.
.6 Rated Primary voltage – 12,480V.
.7 Rated secondary voltage 347/600V or 208\120V.
.8 Connections - delta / grounded Wye.
.9 Impedance 5% min. to 7% max.
.10 Off load taps - 4 - 2 1/2%, 2 FCAN, 2 FCBN.
.11 Basic Impulse Level – 95 KV.
.12 Available fault current rating - 300 MVA sym.
.13 Number of phases is three (3).

.14 Maximum noise level 65 dBA at full load at one meter.

.16 Approved Manufacturers are:
- .1 LG Industrial Systems.
- .2 ABB Resibloc Cast Resin.
- .3 Alternate manufacturers shall be approved by UBC Utilities.

.17 Provide the Following Features for the Transformer:
- .1 Access doors key interlocked with primary circuit breaker.
- .2 Engraved transformer nameplates including connections, voltage ratings, impedance, and other data as required by CSA, one on core and coils and one on exterior of enclosure.
- .3 On completion of manufacture, but prior to shipment, the following tests shall be performed and results certified by a registered Professional Engineer.
  - .1 All CSA C9 tests, including losses.
  - .2 Partial discharge test – Factory Test.
  - .3 Sound level test – Factory Test.

.18 Three copies of these results shall be forwarded to the Consultant for approval prior to transformer shipment from the factory.

2.5 Transformer Neutral

.1 Transformer secondary neutral shall be solidly grounded to ground bus mounted in transformer cubicle.

.2 Connect grounding bus in transformer cubicle with ground bus in 12 KV switchgear.

2.6 Ground Bus

.1 Provide a ground bus capable of terminating all ground and neutral connections. Allow for 3 spare 4/0 lugs and space for 6 future lugs.

2.7 Ground Fault Protection

.1 Current Transformer
- .1 Ground fault sensor current transformer sized to match requirements of ground fault relay up to full load current rating of transformer.

.2 Ground Fault Relay (51G)
- .1 Provide a secondary over current ground fault relay 50/51M with current pick-up range (0-XXX) amps, 0 - 10 seconds, adjustable definite time, with current transformer sensor in the neutral conductor of the transformer relay. Ground fault conductor shall trip main vacuum breaker.

2.8 Temperature Relay

.1 Transformer temperature relay with 3 temperature sensors, one for each winding. Relay shall have three contact settings to be set at:
- .1 80 °C Alert.
- .2 100 °C Alarm.
- .3 120 °C Trip.

2.9 UBC Utilities Revenue Meter

.1 Revenue meters shall be switchboard mounting, 3 element watt hour demand type, PML Type 7330 ION.

.2 Multifunction Meter with Ethernet capability. Refer to Section 16460, Metering.

2.10 System Monitoring

.1 The following monitor points and contacts shall be wired out to terminal block for UBC BMS system to monitor:
- .1 LBS 1 status (open-close).
- .2 LBS 2 status (open-close).
- .3 Main circuit breaker status (open-close).
- .4 Capacitor power supply status (normal).
- .5 Transformer fan on transformer temp 'alert'.
- .6 Transformer temp 'alarm'.
- .7 Three (3) spare spaces.

.2 Refer to Section 15970 or Section 15901 for technical requirements of BMS.

2.11 Interlocking

.1 Safety interlocks shall be provided as required, equal to Kirk or FPE. Load break switches shall be interlocked with the transformer tap door and the 12 KV PT access door. Refer to interlocking diagram.

2.12 Vibration Isolation Requirements

.1 Particular attention shall be paid to the installation of the transformer to reduce the noise level in the transformer room.

.2 Supply transformers generating a space average noise level in the transformer room not exceeding 60 decibels measured in any third octave bank between 50 Hz and 1000 Hz based on a 300 KVA transformer.

.3 Other sizes shall meet equivalent noise level with noise correction based on 10 Log KVA re. 300 KVA.

.4 Supply vibration isolation such that the airborne noise isolation provided by the building structure is not limited by structure borne noise transmission. The following are minimum isolation requirements:

- .1 Mount the transformer core on 25 mm deflection spring isolators, including in series neoprene elements with an effective deflection of 2.5 mm, and restraints meeting the National Building Code with respect to seismic requirements.

- .2 For a slab on grade installation, use neoprene isolators sized for a minimum 2.5 mm deflection, with seismic restraints.

- .3 If the transformer core is mounted on separate transverse steel supporting members, independent of the transformer enclosure, size the members for a 140 Hz cantilever resonant frequency under the dead load of the member (0.013 mm dead load cantilever deflection) and the spring stiffness.

.4 Provide sufficient flexibility in the braided connectors on both the low voltage and high voltage sides of the transformer such that the vibration isolation provided by the spring/neoprene isolator supports is not limited by the braided connectors. If such flexibility is impractical, isolate the cabinets on neoprene isolators with 2.5 mm deflection and isolate the conduit.

.5 Within the electrical room, provide neoprene hangers with 0.1" static deflection in threaded rod supports for all new conduit, cable trays, etc. Avoid rigid connections to the structure. Avoid any contact of electrical equipment to drywall partitions where transformer rooms are located adjacent to occupied spaces.

.5 Submit shop drawings detailing proposed isolation.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 16

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations

1.3 Description

.1 UBC requirements for Secondary Power Distribution.

2.0 MATERIALS AND DESIGN REQUIREMENTS

.1 Two secondary voltage levels are acceptable at the University:
  .1 208 Volt
  .2 600 Volt 3 Phase Wye System.

.2 The selection of distribution voltage shall be based on building layout. Conditions such as large distribution loads, high building and large footprint shall be used to determine the preferred secondary distribution.

.3 If a 600V secondary distribution is selected, all motors 3/4 hp and up, all HID light - sources, shall be supplied at this level.

.4 Any building supplied by 208 or 600 Volts shall have entrance switchgear designed and labelled as "Suitable for Service Entrance".

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines

1.2 Coordination Requirements

.1 UBC Utilities

1.3 Description

.1 UBC requirements for Metering.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

.1 UBC Utilities shall supply Revenue meter to unit sub manufacturer at the project's cost.

2.2 Revenue Metering

.1 Revenue meter shall be Measurement Canada Sealed, *Schneider Electric* Type 7330 ION Multifunction Meter with Ethernet options.

.2 It shall be for use with 3 current transformers and programmed for CT's to allow for direct readout.

.3 The meter shall be flush mounted @ 54" above finished floor (centre of meter) in a barrier instrument compartment in the distribution enclosure. Provide surface mounted on the inside of the door of the metering compartment a 10-pole test block for current and potential circuits.
- .1 For 120/208V Systems wire the meter as shown on Drawing E4-4.
- .2 For 347/600V Systems wire the meter as shown on Drawing E4-5.

.4 Approved Test Block Manufacturers:
- .1 ABB type FT-1.
- .2 Sangamo.
- .3 Superior #1082F.

2.3 Metering Transformers

.1 Metering transformers shall be provided by the switchgear manufacturer.

.2 Three current transformers (CT's) shall include revenue metering accuracy of 0.3B0.9, ratio XXX/5 for *Schneider Electric* 7330 ION multifunction meter. Mount CT's on transformer secondary bus.

.3 Metering at 600V secondary shall include three voltage transformers, revenue accuracy, 360:120 ratio shall be mounted in a separate barrier instrument compartment.

2.4 Mechanical Meters

.1 Gas, water and steam meters are to be integrated into the electrical metering system. Pulse outputs from each of these meters are to be brought to the electrical *Schneider Electric 7330 ION* meter for recording purposes.

.2 Refer to Drawing E4-6 for wiring requirements of the gas, water and steam metering integration into *Schneider Electric 7330 ION*.

3.0 Other

.1 A raceway shall be provided between the ION 7330 meter and the nearest communications closet. Provide an IT demarcation box within 3 metres of the ION 7330 meter.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 17 (17110 – 2.6)

1.2 Coordination Requirements

.1 UBC Building Operations Crews 46 (Fire and Life Safety), 31M (Mechanical Maintenance), and 35 (Garage Mechanics), should be involved with both planning/design stages and commissioning of new generator installations and renewals of existing. This to include tank locations, anti- siphoning, piping, genset enclosures, and transfer switches etc.

.2 UBC Information Technology.

1.3 Description

.1 Generator for emergency and stand-by power.

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General Requirements

.1 Generators for emergency and stand-by power shall be installed in all buildings except for very small buildings. Consult UBC Building Operations for cases where emergency generators are not required.

.2 If a stand-by generator is installed then all emergency power shall be supplied from it and battery packs shall not be used other than at the generator/transfer switch location to allow for breakdown maintenance.

.3 Closed transition transfer switches shall include a redundant back-up protection relay to prevent any possible back feed to the utility. All methods of providing this form of protection shall be submitted to UBC Utilities for approval prior to equipment installation.

.4 In general, fume and bio-hazard hoods should not be supplied from emergency power. Alternate proposals to supply fume and bio-hazard hoods from emergency power may be discussed with UBC Building Operations – Technical Services.

.5 In general, elevators not designated as “Elevator for Use by Firefighters” by the BC Building Code should not be powered from generators unless specifically required to be by the BC Building Code. Alternate proposals to supply non-designated elevators from emergency power may be discussed with UBC Building Operations – Technical Services.

.6 Emergency generators shall supply only life safety requirements except as otherwise noted or as required by the BC Building Code.

.7 Emergency generators shall be diesel fuel type only.

.8 Emergency generators shall have a minimum 12 hour run time without refueling.

.9 Confirm positive fuel prime to all fuel pumps.

.10 See Section 15901 for requirements for BMS and Fire Alarm System for generators.

2.2 Generator Housing and Location

.1 Generators to be primarily located at ground level in separate concrete shelters. Generators can ONLY be located at roof level if they can be replaced by lifting with a mobile crane.

.2 If located at roof level, locate diesel exhaust away from potential air intakes and open windows.

.3 Generators should be housed in areas which are large enough to work on them, and remove and replace components, without having to remove portions of the structure in which they are mounted.

.4 Generator areas should be provided with room lighting, power and heat (on emergency supply) for maintenance.

.5 The areas shall be insulated and heated so as to minimize maintenance on the units.

.6 Generator rooms and transfer switch locations shall be provided with an emergency battery lighting pack for breakdown safety and maintenance on the units.

2.3 Equipment Type

.1 Generators shall be sourced from original equipment suppliers such as Cummins, Cat or equivalent so that parts are readily available and locally supplied and supported.

.2 Transfer switches shall be Asco, (or equivalent), with double-bypass capability.

.3 Fuel filters shall be Racor pleated filters or UBC approved equal.

.4 Obtain approval list of acceptable manufacturers and products from UBC Technical Services. System shall be compatible with existing UBC operating control systems.

2.4 Loadbank Requirements

.1 If generators are only carrying a light load from the building, a loadbank shall be installed so that the generator runs at fifty percent of rated load at a minimum. This loadbank shall be of such a design that resistors can be taken out as building loads increase over time.

.2 To assist with maintenance, generators shall have a second circuit breaker on the generator output prior to the transfer switch. This is for tying in load banks for annual testing without disturbing cables and lugs of normal loads, as per CSA C282-05 B18 and for tying in a back up generator when major repairs are required on the normal generator when it is taken out of service.

2.5 Time Delay

.1 The time delay on restoral to utility should be set to thirty minutes, rather than the normal ten minutes. Allowing the generator to continue running for thirty minutes after the reset of the transfer switch to the utility is better for the generator and ensures smoother power transfer in the event of multiple interruptions and power surges (which occur frequently on an outage).

2.6 Fuel Tanks

.1 All diesel fuel tanks shall be above ground and double walled unless a single walled tank is contained by a separate containment tank, for example, a day tank.

.2 All diesel tanks shall be sized to provide a minimum of twenty-four hours of generator run time.

.3 Underground tanks that are inherited with their piping systems shall be pressure tested every two years. Above ground tanks shall be visually inspected once per year and pressure tested every five years.

.4 Fuel storage tanks shall be protected from freezing.

2.7 Maintenance Manuals

.1 At least two complete sets of manuals, (these shall include operators, owners, troubleshooting, full repair manuals as well as any disks and software diagnostics), shall go to the shop level before sign off and acceptance of units.

2.8 Emergency Lighting Battery Packs

.1 Emergency lighting battery packs, where used, shall be ‘Ready-Lite’, 12V only, 360 watt units. The battery packs shall not be self-testing as this disturbs the building users.

.2 Heads to be 9 watt units mounted on manufacturer supplied shelf and shall not be hard wired to the AC supply. The units shall be plugged into a receptacle only and shall be rated for 120 VAC.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guideline
.2 Division 17 (17110 – 2.13)

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations
.3 Coordinate commissioning of the Emergency Lighting System with UBC Shop Crew 46 (Fire and Life Safety).
.4 UBC Information Technology.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

.1 Lighting design shall be carried out by the engaged Electrical Engineer with energy conservation as an important criteria in mind. Only high output sources such as fluorescent, HID, shall be used.

.2 Design lighting with energy conservation as an important criteria.

.3 Uniformity and low brightness contrast shall be achieved by judicious use of luminaries and luminaries' locations.

.4 All lighting shall be designed to suit the task and task location rather than the general lighting. ASHRAE 90.1, IES and WCB guidelines shall be taken into consideration and calculations submitted where requested.

.5 As a general rule, the following task lighting levels shall be used:

.1	Offices	700 lux maintained.
.2	Classrooms and Seminar Rooms	500 lux maintained.
.3	Corridors	100 lux maintained.
.4	Washrooms	150 lux maintained.

.5 Special areas such as laboratories, drafting rooms, etc., in accordance with the users task requirements and IES recommendations.

.6 The designer shall take into account the University's 4 to 5 year group placement program of fluorescent relamping. All maintenance factors shall be maximized because of the generally clean environment at the University buildings.

.7 When mounting luminaries in high ceiling spaces consideration must be given to access and maintenance such as larnp changing. If special equipment is required for access it shall be included in the building budget.

.8 In all corridors, stairways and other public areas the Electrical Engineer is to propose his/her design to the Electrical Engineer, Technical Services, phone: 604-822-0852. The design proposed for all public areas must not only ensure the life safety of building occupants at all times but also must minimize lighting energy required to zero, if possible. (i.e. lights off until

an emergency). The lighting fixtures shall be wired to an emergency panel if an emergency generator is available.

.9 Automatic switching using infrared or ultrasonic devices such as occupancy sensors shall be used.

.10 Integrate corridor, common area and all other area lighting into the BMS system or a local lighting control system to allow for automated shut-off during unoccupied hours.

.11 All fluorescent luminaries shall be equipped with additional parabolic reflectors.

.12 All fluorescent luminaries shall be equipped with 3500 K 32 W T8 lamps with electronic ballasts.

.13 Wherever possible, switching shall be provided for two or three levels of lighting, and in classrooms specifically, the highest level shall only be turned ON at the lectern. The switch at the door should turn ALL levels off. Line voltage switching is generally preferred but, where switching becomes complex, low voltage switching may be used.

.14 G.E. has been selected as the University standard.

.15 Where four tube fluorescent luminaries are installed, they shall be wired such that inner tubes are on one ballast and outer tubes on the other.

2.2 Emergency Lighting

.1 Emergency lighting must be installed in accordance with the B.C. Building Code.

.2 A central battery powered emergency lighting system may be considered. A small building may be supplied with battery packs. Exit lights should be long-life, low energy, LED-type.

.3 Provide standby emergency generator if motor loads require emergency power.

.4 All battery pack lighting, remote heads and exit lights shall be manufactured by ‘Ready-Lite’ or approved equal. ‘Ready-Lite’ is available from local suppliers and shall be stocked by UBC Building Operations. It is important that UBC have stock in standard sizes so that repairs can be done quickly and effectively as required for the life safety system.

.5 The battery packs shall be either 12 volts DC or 24 volts DC.

.6 All battery packs shall be mounted on an appropriately sized shelf, supplied from ‘Ready-Lite’ or approved equal.

.7 Generator and Electrical rooms shall be provided with an emergency battery lighting pack.

.8 If 12 volt DC are used they shall be the 36 watt or 360 watt units only and should not be self testing as clients do not understand the self test and call in a trouble call unnecessarily.

.9 If 24 volts DC are used they shall be either a 360 watt unit or a 720 watt unit only. They shall also be a basic model without meters or self testing.

.10 For both 12 volt DC and 24 volt DC systems, the heads and remote heads shall be 9 watts each.

.11 Battery packs that are fed from a 120 volt AC. source shall have a 120 volt duplex receptacle mounted adjacent so that the battery pack can be plugged into the receptacle. This is to facilitate testing and replacement when needed.

.12 UBC discourages the use of 'central units' as it is better to have the distributed battery packs rather than losing the central unit and having all the emergency lighting go down.

.13 Coordinate commissioning of the emergency lighting system with UBC Shop Crew 46 (Fire and Life Safety). Contact UBC Building Operations in advance of verification to provide opportunity for work crews to be present during commissioning.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 *UBC Campus Plan (Phase 6), Part 3, Section 2.5.2 on page 30.*
UBC Vancouver Campus Plan: Part 3 Design Guidelines

.2 UBC Exterior Lighting Master Plan Part 4 Section 4.1.

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations

1.3 Description

.1 UBC requirements for Exterior Lighting.

2.0 MATERIAL AND DESIGN REQUIREMENTS

.1 For each project, exterior lighting must be provided for all roadways, plazas, walks, steps, etc., to a level sufficient to meet safety requirements of all users, but as a minimum to meet I.E.S. published standards where available. Where public use of the project at night is required, this lighting shall extend beyond the boundaries of the project site to include contiguous access and parking areas.

.2 Lighting equipment shall be vandal proof by use of proper design and sufficient mounting height; specifically, post top units, at low mounting height (below 5m) and bollards shall not be used.

.3 Building highlighting/floodlighting is discouraged.

.4 Landscape (garden-shrub-lawn) type lighting is not acceptable.

.5 Exterior lighting shall be controlled by photocell and astronomical time clocks (hard wired, not battery powered) or BMS system.

.6 Where feasible, floodlighting of high quality, low glare design installed on building areas inaccessible to the public can be used.

.7 Luminaries shall be easily and safely accessible by maintenance personnel.

.8 In all cases, lamps of low energy input-high lumen output with appropriate color rendition shall be used, such as:
  .1 Four lane roadways: 250 W HPS -10m mounting height.
  .2 Refer to UBC exterior lighting master plan.

.9 Poles shall be steel and be painted with one coat of primer and 2 coats of paint.

.10 Poles complete with luminaries shall be able to withstand 160 km/h winds.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 17 (17100 – 1.4.10, 17110 – 1.4)
.3 Division 08710, Sentence 2.1.3.14 for tube lock-box specifications.

1.2 Coordination Requirements

.1 UBC Utilities
.2 UBC Building Operations - Coordinate verification of the Fire Alarm system with UBC Shop Crew 46 (Fire and Life Safety – Phone: 604-822-9529) and Crew 22 (Sprinkler Plumbers - Phone: 604-788-3025).
.3 UBC Information Technology

2.0 MATERIALS AND DESIGN REQUIREMENTS

2.1 General Requirements

.1 The fire alarm system shall be a complete electrically supervised, single stage, non-coded addressable system.

.2 The system shall be Simplex, Siemens or Edwards and shall include the following devices as required by the project:
  .1 Main Control Panel.
  .2 Annunciator.
  .3 Break glass stations.
  .4 Gongs.
  .5 Heat detectors.
  .6 Smoke detectors.
  .7 Transponders.

.3 All fire alarm systems must be designed by a Professional Engineer currently registered in BC.

.4 All fire alarm systems shall comply with the following standards:
  .1 ULC CAN4-S524.
  .2 BC Fire Code.

.5 Interfacing fire alarm system with BMS system.
  .1 Review Section 15001 for interfacing.
  .2 Provide dry contact signals to BMS indicating stage 1 and/or stage 2 alarm conditions as applicable.

.6 Each ancillary function of the fire alarm system should have its own independent bypass switch, (i.e. fans, door holders, security locks, bells, elevator homing, BMS, monitoring, etc.). Each switch is to be clearly labeled.

.7 Commissioning/Verification

  .1 As part of the commissioning and verification of the fire alarm system the UBC Shop Crew #46 (Fire and Life Safety - Phone: 604-822-9529) should be provided with a copy of the as-built plans, a copy of the fire alarm panel program (Sequence of

Operation), a copy of the fire alarm verification report and a copy of the device list in a Microsoft Word text file. These should be provided at the shop level before the system is accepted or occupancy of the building is allowed.

.2 Also, provide to UBC Shop Crew #46 (Fire and Life Safety) a fan schedule, which shall show any changes that occurred or deviated from the original sequence.

.3 Also, provide to UBC Shop Crew 46 (Fire and Life Safety) a schedule of elevator operation and security doors on maglock function during an alarm.

.8 As a matter of design and commissioning, the fire alarm fan shutdown shall not impact the fume hoods in a building from functioning normally or adversely affect building pressurization. Further, the building should operate safely during a fire alarm fan shutdown without depending on the BMS system to do so.

.9 The UBC BMS system is not UL listed for Life Safety; the fan shutdown and any required adjustments to the building should be affected by hard wired interlocks and/or mechanical dampers. UBC Shop Crew #46 (Fire and Life Safety) shall be provided with a sequence of operation of the fire alarm fan shutdown prior to hand over. The fire alarm panel shall be solely responsible for fan shutdowns and ancillary functions in the event of a fire alarm.

.10 Where buildings do not have sufficient fire separations to be considered separate buildings, they shall have one fire alarm panel. IRC/Woodward is an example of such a building and UBC has experienced few problems with this installation due to the clarity of the design, (i.e. one fire alarm panel). The UBC Bookstore/Smith, Kaiser/McLeod, and Dentistry/Strangway are examples of buildings with multiple panels in which we continue to experience ongoing problems. Smoke control is also an under recognized problem in these connected, multi-panel buildings.

.11 Avoid nodes and networked panels in buildings where possible. One panel is preferred.

.12 Auxiliary power supply systems should be avoided as battery back up systems creates problems for maintenance.

.13 All batteries for a fire alarm system should be located in one, easily serviced location.

.14 Ancillary functions should be fed from separate circuits, independent of the A.C circuit that feeds the fire alarm panel, (i.e. door hold open devices). This will avoid having all the doors in a building close during the monthly bell test which requires the shutoff of the A.C. circuit to the fire alarm panel to test battery function.

.15 Coordinate verification of the fire alarm system with UBC Shop Crew 46 (Fire and Life Safety – Phone: 604-822-9529) and Crew 22 (Sprinkler Plumbers - Phone: 604-788-3025). Contact UBC Building Operations in advance of verification to provide opportunity for work crews to be present during verification.

.16 Coordinate commissioning of the emergency generator with UBC Shop Crew 46 (Fire and Life Safety – Phone: 604-822-9529), Crew 22 (Sprinkler Plumbers - Phone: 604-788-3025), Crew 35 (Mechanic in the Garage) and Crew 31M (Mechanical Maintenance). Contact UBC Building Operations in advance of verification to provide opportunity for work crews to be present during commissioning.

2.2 Main Control Panel

.1 The main control panel shall be modular type, complete with all necessary plug-in modules or plug-in cards, and shall contain zone indication and all manually operated functions in the front cover behind a lockable door with viewing window. The fire alarm panel shall have an additional two (2) spare bypass switches. The panel shall contain enough bypass switches with a least 3 spares to provide each special system and/or ancillary system with bypass capability.

.1 One switch to bypass fan shutdown controls.
.2 One switch to bypass gong operations.
.3 One switch to bypass signal to fire department.
.4 Others will be used for special systems.

.2 Switches shall be toggle switches grouped and identified with colored engraved perimeter legend nameplates, permanently attached with screw fastenings. Nameplates shall be colored with wording as follows:

.1 Switch (b), blue, Fan Shutdown Bypass.
.2 Switch (c), yellow, Gong Bypass.
.3 Switch (d), red, Central Fire Hall Bypass.

.3 All switches shall have normal and off identifications, and when switched in the “OFF” position be monitored by trouble indication lights and panel trouble circuit.

.4 The main control panel shall contain detection zone modules, trouble module, audible signal modules, annunciator, lamp supervision and fire hall connections grouped to suit selected zones. Separate detection zone modules shall be used for manual, automatic and duct smoke indications. Final quantity of zone modules to suit layouts outlined on the drawing. Standby power shall be sized to meet the requirements of the B.C. Building Code 3.2.9.4.

.5 The panel shall be supplied with a graphic annunciator.

.6 UBC’s preferred fire alarm panel is a Simplex 4100 ‘U’ or equivalent (to be demonstrated to UBC Crew #46). This will allow us, in the future, to have a peer to peer, type seven, network system with fiber optic, copper, or both, to a central shop location for local monitoring and control.

.7 The location of fire alarm control panel shall be in the Main Electrical Room.

2.3 Pre-Action Control Panel for Sprinkler System

.1 Pre-action control panel for sprinkler system, if required, shall be bypassed for testing purposes.

2.4 Central Fire Alarm Monitoring

.1 The University operates a Central Fire Alarm Monitoring System.

.2 This system monitors all UBC fire alarm systems and reports them to the alarm monitoring company for alarm, supervisory alarm condition and trouble condition.

.3 The alarm monitoring company will notify the Vancouver Fire Department for response to fire and inform UBC Building Operations, Crew #46, for trouble response and supervisory alarm conditions.

.4 The Central Fire Alarm Monitoring System is comprised of a transponder at the building fire alarm system, Europlex 3008, telephone pairs to the Henry Angus Building, the Fire Alarm racks with the signal collecting equipment and the DVAC's modems.

.5 A Europlex 3008 transponder shall be mounted next to the building fire alarm panel, maximum 1 m distant, and 1.8 m to the top of the cabinet. The transponder shall be equipped with a class 2 transformer. The fire alarm panel and the transponder require 1 m clear, level workspace in front. A 100x100x53 box shall mount not more than 600 from the transponder. The box will be the Communication demarcation.

.6 The transponder shall use the same power circuit as the fire alarm panel, 2 #12 R90 stranded conductors in 12 EMT as per UBC Technical Guidelines. Install an isolated ground wire back to the building ground bus.

.7 A 21 mm (3/4") EMT conduit shall be installed between the fire alarm panel and the transponder and between the transponder and the demarcation box. *The demarcation box will be 100mm x 100mm (4"x4") deep box. Install a 27mm (1") EMT conduit between the demarcation box and the Main Communications Room (MCR). All conduits shall carry a pull string. See Division 17 drawing ITSD – 20.*

.8 See UBC Standard Drawing E6-1.

2.5 Gongs

.1 Gongs shall be 25 0 mm (IO") for 24 volt DC operation, Simplex 2901-9722.

.2 Unless otherwise noted gong shall be mounted with the top at 2400 mm (96") above the finished floor, or 51 mm (2") below the ceiling, whichever is lower.

2.6 Transponder

.1 Provide and install one new transponder Europlex 3008 BF at fire alarm panel.

.2 Provide six no. 14 conductors from the alarm and trouble output to the transponder and make all connections.

.3 A 21mm (¾") EMT conduit shall be installed between the fire alarm panel and the transponder and between the transponder and the demarcation box. The demarcation box will be 100mm x 100mm (4"x4") deep box. Install a 27mm (1") EMT conduit between the demarcation box and the Main Communications Room (MCR). All conduits shall carry a pull string. See Division 17 drawing ITSD-20.

.4 Connect fire alarm wiring to UBC IT supplied demarcation jack. See Division 17 drawing ITSD-20.

.5 After the fire alarm panel has been verified and the certificate of verification produced to the Engineer, arrange with Building Operations to program the transponder and make all connections to the communications system.

.6 The fire alarm panel and the Europlex transponder should be fed from the same A.C. circuit.

2.7 Alarm Annuciator

.1 Supply a fire alarm annunciator.

.2 The location of the annunciator shall be acceptable with the UEL Fire Chief and Building Operations Electrical Engineer.

.3 The fire alarm annunciator shall be located on the inside of the building envelope to protect against rain and weather damage.

.4 The fire alarm annunciator shall be mounted on an insulated wall or on standoffs to avoid cold condensation issues.

.5 The annunciator shall be manufactured by a company usually engaged for such equipment.

.6 The fire alarm annunciator shall have a keyed enabled switch to avoid tampering by the public when in alarm acknowledge, supervisory acknowledge and trouble acknowledge functions.

.7 The annunciator graphic, silk screen printed on lexan window. Zones shall be displayed by at least two LED's and clearly legible.

.8 The annunciator shall be housed in a stainless steel cabinet of sufficient size and come with key lockable door. For indoor applications a mild steel painted enclosure may be supplied, the annunciator shall include a parallel set of momentary contact switches for the bell silencing and fire alarm reset for the use by fire fighters.

.9 The Annuciator shall be equipped with a lamp test switch, trouble buzzer, bell disconnect and reset switch.

2.8 Other Requirements

.1 Where an addressable system is used the appropriate manual station shall be provided.

.2 Automatic heat detectors shall be 5 7’ C rates of rise in normal areas and 93 'C fixed temperature in Boiler Rooms. Simplex 4255-51 or 4255-54 to suit.

.3 Smoke detectors shall be photo-electric type (I 2098-961 1) and shall have a remote alarm indicating light (12098-9788). No combined type detectors will be acceptable.

.4 Door hold open devices shall be monuments rather than integrated door closure and hold open devices.

.5 Manual stations shall be mounted 1525 mm (50") above the finished floor. Manual stations shall be zoned separately from automatic fire detectors.

.6 All wiring shall be installed to conform to the requirements of the Canadian Electrical Code Part 1, and applicable Provincial Amendments and Bulletins. Wiring shall be protected from mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class I requirements. Conductors shall be Stranded wire and will require tinning or compression fittings at each termination or splice. The minimum size of any conductor shall be #12 for gong circuits, #16 for initiated circuits or as permitted by local inspection authorities. All wiring shall be 90' X-link insulated.

.7 In addition to other submittal requirements noted elsewhere, provide a copy of the installed Sequence of Operation.

2.9 Panel Manufacturer's Responsibility and Inspection Requirements

.1 Notwithstanding the Contractor's obligations, the entire fire alarm system shall be the responsibility of the panel manufacturer. Prior to acceptance of the system by the Consultant, the manufacturer shall check the entire system and certify the operation of all devices.

.2 The manufacturer shall make an inspection of the new fire alarm equipment installed under this contract, including those components necessary to the direct operation of the system such as manual stations, fire detectors and controls. The inspection shall comprise of an examination and subsequent verification of all equipment in accordance with the standard for testing fire alarm systems ULC-CAN4-S537. All equipment of the fire alarm system shall be co-ordinate with the panel manufacturer.

.3 On completion of the inspection, and when all of the above conditions have been complied with, the manufacturer shall issue to the Consulting Engineer.

.1 A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.

.2 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which such inspection and certification have been rendered. A certificate of verification with no deficiencies only will be acceptable at the substantial completion.

.3 Proof of liability insurance for the inspection.

.4 All costs involved in this and all subsequent inspections, both by the manufacturer and the electrical contractor shall be included in the electrical contractor's total tender price.

.5 After completion of system verification, arrange and conduct a final acceptance test to be witnessed by the Fire Department, the Electrical Consultant and UBC Personnel. Provide system demonstration to UBC Electricians.

.6 The Fire alarm system as-installed drawings shall, before occupancy, be provided to the Head, Crew #46 (Fire and Life and Safety – Phone 604-822-9529).

.7 In case of partial occupancy of a building; a partial verification of the fire alarm system may be performed. This shall not waive the requirement of a complete verification as part of the substantial completion.

.4 Include all costs for the Manufacturer to undertake a second examination of the installation and subsequent re-verification of the complete fire alarm system six (6) months after Substantial Completion. The re-verification schedule is to be provided in writing, seven (7) days prior to undertaking.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 17 (17100 – 1.4.11)

1.2 Coordination Requirements

.1 UBC Building Operations
.2 UBC Utilities
.3 UBC Information Technology

2.0 MATERIAL AND DESIGN

.1 The University operates two (2) independent time systems. The signals are transmitted via telephone *cable* pairs. One system is used for program bells, *and the other is a Simplex Central Clock System. Both systems use telephone pairs centrally located to room 58A in the Henry Angus building.*

.2 Clocks shall be a either synchronous type or satellite type.

.3 If a satellite type clock is used it shall be a 120V system, (not battery), and shall have a common circuit feed to all the clocks in the building.

.4 Clocks will be single or double faced, 305 mm diameter, white, round faced with black Arabic numerals equal to Simplex type 2310.

.5 Inside each building the systems are distributed from a local relay cabinet.

.6 A 21mm (¾") EMT conduit shall be installed between the fire alarm panel and the transponder and between the transponder and the demarcation box. The demarcation box will be 100mm x 100mm (4"x4") deep box. Install a 27mm (1") EMT conduit between the demarcation box and the closest Communications Room (MCR). All conduits shall carry a pull string. See Division 17 drawing ITSD-20.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines

1.2 Coordination Requirements

.1 UBC Building Operations
.2 UBC Utilities

2.0 REQUIREMENTS FOR COMMISSIONING AND TESTING

2.1 Testing

.1 Unit Substation Factory Testing
- .1 Production tests: Perform all production tests listed in CSA Standard C22.2 No. 31 (current edition) and submit a detailed test report signed by the chief engineer or chief testing engineer.
- .2 Provide a production heat run test on the transformer to verify temperature rise.
- .3 Provide a factory sound level test for this transformer to verify transformer sound level. Submit copy of this test prior to shipping transformer.
- .4 Provide a three phase energization of transformer and switchgear at factory at both rated voltage and 110 % rated voltage. Verify that all meters and trip circuits function correctly. Consultant and UBC Utility Engineer shall witness the energization test.

.2 Unit Substation Tests
- .1 After manufacture, perform corona test to verify rating. A certificate signed by the Chief Testing Engineer shall be provided to verify the corona level and other production tests required by CSA C22.2 No. 31.

.3 High Voltage Cable
- .1 High voltage cables shall be tested as outlined in Section 16121.

2.2 Commissioning

.1 12 KV Unit Substation
- .1 Manufacturer shall provide on-site direction to the Contractor for reassembly of 12 KV unit substation.
- .2 Upon completion of reassembly, the manufacturer shall provide visual inspection to review and check all components for condition and correctness of installation.

.2 Vacuum and Cleaning
- .1 All electrical equipment tested shall be cleaned and left in first class condition.
- .2 Accumulated dirt and dust visible equipment shall be removed with high volume, low pressure blow-type vacuum.
- .3 Wiping shall be performed where required.
- .4 At completion of testing and cleaning, area around and adjacent to electrical equipment shall be cleaned and left in first class order.

.3 Insulators
- .1 Station insulators shall be inspected as follows:
  - .1 Clean and inspect insulators for chipped porcelains and radial cracks and foreign contaminants.

.2 Test insulators with DC high potential test set to the value specified by the manufacturer.

.4 Fuses
.1 Fuses shall be inspected and checked as follows
.1 Check fuse links for continuity.
.2 Check fuse cartridge and holder for correct alignment and adjustments.
.3 Inspect fuse mounting and grounding.
.4 Inspect for spare fuses & report any set of fuses without spare back-up fuses.

.5 Interlocks
.1 Verify system interlocking & labeling.

2.3 On-Site Testing - Switchgear Test:

.1 Immediately prior to energization the Contractor shall make all arrangements and pay all costs of field testing, cleaning and calibrating of the following items.

.2 The on-site testing, cleaning and calibration shall be performed by qualified field personnel from the following companies, if required:
.1 Siemens Westinghouse - Service Division.
.2 Schneider Canada.
.3 Magna IV.
.4 Tlaloc Electrical Testing.
.5 Or other approved testing firms.

.3 The tests and work to be performed are outlined as follows:

.1 12 KV Unit Substation
.1 Inspect all porcelain bushings and stand-off insulators for cracks, chips, dust, dirt and tightness.
.2 Inspect the operation of each breaker in its cell; checking auxiliary contacts and all tripping devices.
.3 Inspect and test overall grounding system.
.4 Inspect all potheads or stress cones.
.5 Test the insulation resistance of all bus using a DC Hi Potential test set. Measure current leakage of each phase to ground with all other phases grounded.
.6 Inspect and tighten, if necessary, all connections.
.7 Verify all C.T. characteristics.
.8 CT saturation test.
.9 Inspect the operation of each breaker in its cell; checking the racking mechanism and ground bus.

.2 Load Break Switch
.1 Switch to be checked for correct operation and alignment.
.2 All insulators to be inspected for cleanliness.
.3 Interlocks to be checked for correct operation.
.4 Bus work to be inspected and bolts checked.
.5 Insulation resistance test to be included with testing of the switchgear bus.
.6 The contact resistance of each pole to be measured.

.3 High Voltage Vacuum Circuit Breaker
.1 Verify that cell mechanical interlocks function correctly.
.2 Remove the breaker from the cell, and check the tightness of all control wiring.
.3 Check vacuum levels for vacuum circuit breakers and inspect for leaks.

.4 Check power and control stabs.
.5 Check porcelain and insulating for cracks and holes.
.6 Open and close breaker to check for friction and binding.
.7 Manually close breakers and check contacts for alignment mating and wipe.
.8 Operate the breaker mechanically and check the operation of the assembly.
.9 Follow manufacturers' specifications for lubrication.
.10 If external test cabinet is available, operate the breaker electrically.
.11 Put the breaker in test position in the cell; operate the breaker using the control switch.
.12 Open the breaker by closing the relay tripping contacts of each relay.
.13 Insulation resistance test measurements from phase to phase and phase to ground.
.14 Pole resistance to be measured by a contact resistance test set.
.15 Supply copy of Fuse Coordinate Study to UBC Building Operations.

.4 Protective Relays
.1 Electrical Tests
.1 Zero adjustment.
.2 Pickup value test.
.3 Time current characteristic tests - two points on curve.
.4 Instantaneous element pickup test.
.5 Target and seal-in unit operation test.
.6 Check all settings to the co-ordination study or setting data sheet.
.7 Prove tripping circuit via primary injection from C.T. terminals.

.5 Ground Fault Protection
.1 Check mechanical tightness of all electrical connections from the zero sequence or other ground fault C.T.'s.
.2 Verify settings as per co-ordination data.
.3 Test pickup value.
.4 Test the time current characteristics.
.5 Prove C.T. and tripping circuits via primary injection.
.6 Verify that the breaker and relay will reset after a tripping operation.

.6 Ground Electrode Resistance
.1 Ground resistance tests for substation grounding electrode shall be performed using the fall-of-potential method. A test mat will be established approximately 100 to 150 meters out from the ground grid and 9 to 15 traverse readings taken. From the resulting readings a curve will be plotted to establish the ground mat resistance.

.7 Surge Arrestors
.1 Visual inspection for
.1 Cracked and/or chipped porcelain.
.2 Check for overall cleanliness.
.3 All electrical connections are secure.

.2 Meggar test insulating base and cable.

.8 Cast Coil Transformer
.1 Insulation resistance tests to be carried out using an insulation resistance test set and the resulting insulation resistance values corrected to a base of 20° C. Polarization of Index readings at 1 (1) minutes and 10 (10) minutes shall be recorded.

.2 Winding resistance measurements to be taken on all windings and all positions of the off-load tap-changers, where applicable.
.3 Ratio, polarity and phase relationship tests completed for all taps, where applicable.
.4 Core insulation tests (when core ground is accessible).
.5 Cooling equipment and associated auxiliary controls to be inspected.
.6 Temperature indicator and associated control and alarm systems to be checked for continuity of wiring from instrument to transformer control cabinet and or wiring from transformer control cabinet to external system.
.7 Test insulation resistance of auxiliary and control wiring.
.8 All external bushing connections to be inspected for tightness.
.9 Inspect all bushings and insulators for cracks, chips, dust and overall cleanliness.
.10 Inspect transformer core, coils, terminal boards, tap changer, and all insulated surfaces for visible damage, foreign material or moisture, and tighten all electrical connections as necessary.
.11 External inspection of cell for rusting damage and apparent impediments of ventilation.
.12 Measure noise level rating around transformer with readings taken adjacent to each core & coil and between each core & coil.

.9 Secondary Distribution
.1 Inspect all bushings and stand-off insulators.
.2 Inspect buss supports and check all connections.
.3 Check insulation resistance; phase to phase and phase to ground.
.4 Verify all C.T. characteristics
.1 Meggar.
.2 Check Polarity.
.5 Verify all V.T. characteristics.
.1 Meggar.
.6 Check C.T. secondary circuits by secondary current injection of the C.T. terminals to verify the operation of all relays and meters.
.7 Check V.T. secondary circuits by voltage source at the V.T. terminals to verify the operation of all associated relays, meters, and control circuits.
.8 Test and calibrate all secondary breakers over 225 amps.

2.4 Voltage Calibration

.1 After energization and loads applied, secondary voltages of each transformer shall be checked against rated voltage. Taps shall be changed to correct deficiencies as required.

.2 Record output wattages of all transformers under load conditions. Voltage readings shall include all phases-phase and phase-neutral conditions.

2.5 Reporting

.1 Reports on all inspections and tests must be submitted with 10 working days of completion of tests.

1.0 GENERAL

1.1 Related UBC Guidelines

.1 UBC Technical Guidelines
.2 Division 16

1.2 Coordination Requirements

.1 UBC Building Operations
.2 UBC Utilities

1.3 General

.1 The University has adopted a series of standards covering various electrical components such as manholes, duct systems, lighting poles, etc.

.2 These Standard Drawings can be found in this PDF document.

.3 Wherever applicable, these standards shall be used on University work.

.4 Any electrical civil standard not listed below shall be performed to MMCD and CEC specifications.

1.4 Index to Standard Electrical Drawings

AutoCAD files can be found on the Technical Guidelines website under Division 16.

Drawing No.	Description
E1-1	Single line diagram. Distribution systems 12 KV dual radial feeders typical building supply.
E1-2	Electrical unit substation one line diagram.
E1-3	Electrical unit substation key interlocks.
E1-4	Typical electrical room layout.
E1-5	Jurisdictional block diagram.
E2-1	Standard concrete encased electrical dust.
E2-2	Standard electrical service conduit directly buried.
E2-3	Standard electrical duct bank concrete encased.
E2-4	Electrical duct bank clearance to steam distribution lines.
E3-1	Standard electrical pre-cast manhole.
E3-2	Standard electrical manholes pour in place.
E3-3	Additional Reinforcing for standard electrical manholes.
E3-4	Standard electrical manhole cover and riser details.
E3-5	Standard electrical manhole sump detail.
E3-6	Typical manhole grounding and details.
E3-7	Typical manhole separation.
E4-1	Cable identification tags 12 KV.
E4-2	Mounting and shield grounding details for splices between 2 (or more) 15 KV 'X'- Link 500 MCM cables & 4/0 cables.
E4-3	15 KV cable transition module details.
E4-4	PML 7330 ion meter 120/208, 3 phase, 4 wire system. 3 element wiring connection diagram.
E4-5	PML 7330 ion meter 347/600V, 3 phase, 4 wire system. 3 element wiring connection

	diagram.
E4-6a	Gas, water and steam meter integration into electrical metering system.
E4-6b	EcoTrek water and steam meter integration into electrical metering system.
E4-8	Foxboro Vortex pulse input steam meter with analog pressure transmitter wiring diagram.
E5-1	Exterior lighting-concrete footing for lighting standard.
E5-2	Exterior lighting-standard 35 ft. street lighting pole for perimeter roads.
E5-3	Exterior lighting-street light identification.
E5-4	Exterior lighting-illuminated bollard.
E5-5	Exterior lighting-illuminated bollard alternate.