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1.0 GENERAL

1.1 Related UBC Guidelines

.1 Section 01 78 39 Project Record Documents
.2 Section 01 78 23 Operation and Maintenance Data
.3 Divisions 8, 10, 14, 20, 21, 23, 25, 26, 27, 28, 32, 33

1.2 Co-ordination Requirements

.1 UBC Energy & Water Services
.2 UBC Building Operations Electrical Technical Support
.3 UBC Information Technology (IT)

1.3 Description

.1 General requirements for all Division 26.

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 Energy & Water Services.
   .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
   http://web.it.ubc.ca/forms/network

2.2 High Voltage Vaults and Service Rooms

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

2.3 Electrical Receptacles for Specific Purposes

.1 Provide duplex electrical receptacles of CSA spec 5-20 for custodial use at each floor level and near the doorway in each stairwell.

.2 Provide at least one convenience duplex electrical receptacle of CSA spec 5-20 in each electrical room, connected to standby power if available.

.3 A 120V Class A GFCI receptacle shall be provided within 1m of all basins in kitchenettes and washrooms.
2.4 General Installation

.1 The installation shall be installed in a manner that is conducive with quality workmanship. Exposed wiring that is visible in common areas shall be installed square and true to other areas and installations.

.2 All Electrical Rooms shall be designed and installed so that no equipment will be installed behind a door swing or above a door.

.3 Adequate unobstructed wall space shall be provided in all electrical rooms to permit the installation of new (future) equipment and shall not be less than 1 m x wall height.

.4 The designer shall coordinate with the architect to ensure that all electrical and life safety equipment that is installed shall be readily accessible for maintenance, replacement and repair without the use of tools to remove building finishes such as decorative ceiling panels.

.5 Connection to existing services and street lighting circuits shall be included in detail on the IFC drawing set and shall be coordinated by the Project Superintendent at least 30 days before connection date.

.6 Do not install flush mounting boxes back-to-back in walls; provide minimum 150 mm horizontal separation. Provide minimum 600 mm separation in acoustic rated walls.

2.5 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 Energy & Water Services 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 Project Record White prints shall be delivered to the consultant at “substantial performance” in accordance with Division 01 General Requirements.

.5 For final Record Drawing submission, refer to Section 01 78 39 Project Record Documents.

.6 At time of energization of any new electrical installation a one line drawing shall be posted in the main electrical room.

2.6 Electrical Operating and Maintenance Manuals

.1 For detailed requirements, refer to Section 01 78 23 Operation and Maintenance Data.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines

.1 Division 26, Section 33 71 00 Electrical Utility Transmission and Distribution
.2 Division 10, Section 1 Room Requirements
.3 Divisions 27 and 28

1.2 Coordination Requirements:

.1 UBC Building Operations Electrical Technical Support
.2 UBC Energy & Water Services
.3 UBC Information Technology

1.3 Description


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.
.5 Fire Alarm Riser Diagram.
.6 Building area access routes for service of installed systems.
.7 Emergency Lighting System equipment details.

2.2 Off Site and Site Services

.1 Through discussion with UBC Energy & Water Services 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.
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 Energy & Water Services, 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 Division 26

1.2 Coordination Requirements

.1 UBC Building Operations Electrical Technical Support

2.0 MATERIAL AND DESIGN REQUIREMENTS

.1 Wiring exposed to excessive vibration (i.e. generators) shall be copper and type SIS.

.2 Load side wiring of variable frequency drives (VFD) shall not share raceways or junction boxes with other VFD’s or loads. Load side wiring shall be directly connected to the load without a disconnecting means in the circuit.

.3 Components used to fasten, mount or secure electrical equipment and cables outdoors or in other corrosive locations shall be suitable and rated for such.

.4 General use receptacle circuits shall be installed with a maximum of 4 duplex receptacles.

***END OF SECTION***
1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Building Operations Electrical Technical Support
.2 UBC Energy & Water Services

1.2 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 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 Energy & Water Services prior to design submission. There are no exceptions.

.3 Any request for variance, such as where small buildings are concerned, must be reviewed with Building Operations Electrical Technical Services.

.4 Refer to Standard Drawing No. E1-1 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.

***END OF SECTION***
1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Energy & Water Services
.2 UBC Building Operations Electrical Technical Support

1.2 Description

.1 UBC requirements for Protective Device Coordination and Arc-Flash Analysis for AC or DC electrical equipment.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

.1 The engaged consultant shall provide short circuit analysis and protective device coordination studies as prepared by the equipment manufacturer for all electrical protective devices to verify each device can safely withstand and interrupt the available fault currents to which they are applied.

.2 Utility information shall be provided, upon request, to the consultant or equipment manufacturer by UBC Energy & Water Services

.3 Coordination information shall be shown on a graphical chart in log-log format for all applicable low voltage devices and for all devices used for Medium Voltage protection. All device settings shall be indicated either on the chart or accompanying the chart.

.4 The maximum allowable Arc Flash Hazard category for any part within Medium Voltage unit substations shall not exceed level 2 (8 cal/cm^2) as per Section 26 11 13 Primary Unit Substations, 2.1.9 and 2.13.

.5 The engaged consultant shall provide an Arc Flash hazard analysis for all applicable components of the project’s electrical distribution system per CSA Standard Z462.

.6 The engaged consultant shall ensure that every effort is given to minimize the Arc Flash Hazard category while maintaining selective device coordination. Reduce distribution transformer sizes or incorporate circuit breakers with LSI capabilities to achieve a maximum of 8 cal./cm sq. at all switches, circuit breakers and MCCs.

.7 The Arc Flash hazard analysis shall clearly indicate the Incident Energy, Arc Flash protection boundary and Hazard Category for each applicable device.

.8 All documentation shall be in colour and provided in soft copy PDF format. Scanned copies shall not be permitted.

.9 All applicable equipment shall have Arc Flash Hazard labels affixed as required in Section 26 10 00 Secondary Power Distribution, 3.0.

***END OF SECTION***
1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Energy & Water Services
.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:
   .2 CSA C68.3.

2.2 U.B.C. Power System Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12480V</td>
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<tr>
<td>Phases</td>
<td>3</td>
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<tr>
<td>Wires</td>
<td>3</td>
</tr>
<tr>
<td>Frequency</td>
<td>60 Hz</td>
</tr>
<tr>
<td>System Neutral</td>
<td>Low resistance grounded 100A, 10 sec, 7.2 KV, 72 ohms</td>
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<tr>
<td>Available short circuit capacity</td>
<td>Maximum 300 MVA, 13.9 kA</td>
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2.3 Detailed Cable Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation</td>
<td>220 mil ethylene-propylene (EPR) insulation (133%), suitable for continuous operation at 105C conductor temperature, emergency conditions at 140C and 250C for short circuit conditions.</td>
</tr>
<tr>
<td>Shield</td>
<td>Metallic: 5 mil bare copper tape with 100% coverage and a minimum of 12.5% overlap.</td>
</tr>
<tr>
<td>Conductor</td>
<td>ASTM Class B soft bare copper, compact stranded.</td>
</tr>
<tr>
<td>Size</td>
<td>Building Services: 1 Conductor - 4/0 AWG per phase</td>
</tr>
<tr>
<td></td>
<td>Feeders: 1 Cond. 500 KCM per phase</td>
</tr>
<tr>
<td>Construction</td>
<td>Solid plastic</td>
</tr>
<tr>
<td>Jacket, Outer</td>
<td>PVC</td>
</tr>
<tr>
<td>Rated Voltage</td>
<td>15 KV</td>
</tr>
</tbody>
</table>

2.4 Applicable Manufacturers

.1 Aetna Insulated Wire Company.
.2 Phillips Cable.
.3 Prysmian Cable.
.4 Alcatel.
.5 Okonite
.6 Southwire
.7 All substitutes shall be pre-approved by UBC Energy & Water Services.

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 WorkSafeBC 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 armour and conductors not under test.

   .2 UBC Energy & Water Services 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.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines

.1 Division 26

1.2 Coordination Requirements

.1 UBC Building Operations Electrical Technical Support
.2 UBC Energy & Water Services

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 26.

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<th>Drawing No.</th>
<th>Description</th>
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<td>Single line diagram. Distribution systems 12 KV dual radial feeders typical building supply</td>
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<td>E1-2</td>
<td>Electrical unit substation one line diagram</td>
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<tr>
<td>E1-2b</td>
<td>Electrical Outdoor unit substation one line diagram</td>
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<td>E1-3</td>
<td>Electrical unit substation key interlocks</td>
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<td>E1-4</td>
<td>Typical electrical room layout</td>
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<td>Jurisdictional block diagram</td>
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<td>E1-6</td>
<td>Unit substation feeder transfer control box</td>
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<td>E2-1</td>
<td>Standard concrete encased electrical duct</td>
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<td>E2-2</td>
<td>Standard electrical service conduit directly buried</td>
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<td>E2-3</td>
<td>Standard electrical ductbank concrete encased</td>
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<td>E2-4a</td>
<td>Electrical ductbank clearances to DES Hot Waterlines</td>
</tr>
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<td>E2-4b</td>
<td>Electrical ductbank clearances to DES Hot Water for 600 volts or less</td>
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<td>E2-4c</td>
<td>Electrical ductbank clearances to DES Hot Water for 12,000 volts</td>
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<td>E3-1</td>
<td>Standard electrical precast manhole</td>
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<td>E3-2</td>
<td>Standard electrical manholes pour in place</td>
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<td>E3-3</td>
<td>Additional reinforcing for pour in place electrical manholes</td>
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<td>Drawing No.</td>
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<tr>
<td>E3-4</td>
<td>Standard electrical manhole cover and riser details</td>
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<td>E3-5</td>
<td>Standard electrical manhole sump detail</td>
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<td>E3-6</td>
<td>Typical manhole grounding and details</td>
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<td>E4-1</td>
<td>Cable identification tags 12 KV</td>
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<td>Mounting and shield grounding details for splices between 2 (or more) 15 KV ‘X’ - Link 500 MCM &amp; 4/0 cables</td>
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<td>Interior Wiring Systems, Standard Transformer and Panel Identification</td>
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***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines
.
.1 Divisions 20 to 28

1.2 Coordination Requirements
.
.1 UBC Building Operations Electrical Technical Support

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 XLPE 90°C insulation. Minimum wire size shall be #12 AWG except for control wire. Wires #12 AWG and larger shall be stranded. #14 AWG conductors shall be an acceptable minimum size if no part of the conductor is installed outside of the Student Housing and Hospitality Services residential suite it services.

.2 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.

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

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

.5 Wiring installed in underground ducts installed outside of building footprint (i.e. Building Services, Distribution or Lighting) shall be copper, RWU rated, XLPE.

.6 Electrical wiring shall be installed in Rigid PVC, Rigid Metal, or EMT conduit. Use metallic surface raceway equal to wire mold in finished areas for renovation projects. Where deviation from this rule is necessary, a variance shall be obtained in writing from UBC Building Operations Electrical Technical Support before proceeding with the work. The variance shall apply only to the particular installation for which it is given.

.7 An additional conduit matching the largest utilized size, shall be provided for all building power feeds, power sub-feeds, and all electrical systems requiring inter-building connections.

.8 High Voltage conductors run within buildings shall be installed in rigid steel conduit unless encased in no less than 50mm of concrete and clearly marked with embedded brass plate indicating danger, voltage and burial depth.

.9 Armoured cable may only be used for the following:
.
.1 Drops to individual luminaires and shall have a maximum length of 1.5m (5'). Daisy-chaining of luminaires is not allowed.

.2 Final connection to motors, transformers or vibrating equipment to a maximum length of 3m. Cable shall be run neatly, not secured to heat emitting mechanical systems and secured using mechanical fasteners not cable ties.
.3 Within Student Housing & Hospitality Services residential suites for power and lighting circuits only. No part of the installed Armored Cable shall exit the individual suite. Armored cable shall not be permitted to be used for any other system within residential suites.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines

.1 Divisions 26 and 28
.2 Division 27 Section 27 05 26 Grounding and Bonding for Communications Systems

1.2 Coordination Requirements

.1 UBC Energy & Water Services.
.2 UBC Information Technology
.3 UBC Building Operations Electrical Technical Support

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 latest edition of the Canadian Electrical Code. In all cases the material shall be copper.
.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.
.5 In all buildings with 600V distribution a system ground bus shall be installed in each Electrical Room housing a Distribution Centre rated 400A or larger or a transformer 15kVA or larger.

2.2 Ground Wires

.1 Unit substation and pad-mounted transformers servicing buildings 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 CSA approved compression connected.
.3 All ground connections shall be labeled. The label shall contain at minimum the type of equipment grounded, location of the equipment and equipment name as identified on the single line diagram.

2.5 Telecommunications Bonding

.1 Please refer to 1.1.2 Section 27 05 26 Grounding and Bonding for Communications Systems for specialized telecommunications bonding requirements.
2.6 Fire Alarm Bonding

.1 Please refer to Section 28 31 00 Fire Detection and Alarm for specialized Fire Alarm systems bonding/grounding.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines

.1 Division 26

1.2 Coordination Requirements

.1 UBC Energy & Water Services
.2 UBC Building Operations Electrical Technical Support

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.

.3 All secondary distribution transformers shall incorporate vibration isolation reviewed and approved by the structural engineer.

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.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines

.1 Section 26 05 06 Standard Drawings

1.2 Coordination Requirements

.1 UBC Building Operations Electrical Technical Support
.2 UBC Energy and Water Services

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 lamacoid 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.

2.2 Labeling General

.1 Junction Boxes
   .1 Junction boxes in visible areas shall be labeled with machine printed material. The label(s) shall consist of Panel #, Cct #(s), FA zone #, etc.

.2 Fusible Disconnects
   .1 Fusible Disconnects shall have a firmly affixed lamacoid label indicating fuse type and maximum fuse rating.

.3 Labels Outside
   .1 Labels located outside shall be of the engraved lamacoids type and be affixed with UV or corrosion resistant ties.

.4 Equipment and Devices
   .1 All equipment and devices shall be labeled with their tag # first and if this is not available the circuit #, IP address or Zone shall be labeled with machine printed material. Examples of the equipment and devices that shall be labeled:
      • Receptacles
      • Light switches
      • Motors / Pumps
      • AHU’s
      • Heaters
      • Equipment specific to the area
2.3 Distribution Equipment and Panel Board Identification

.1 Refer to Section 26 10 00 Secondary Power Distribution, 3.0, and Standard Drawing E10-2.

.2 Electrical distribution panels and transformers shall be labeled with colour-coded lamacoids indicating Normal, Stand-By or Life-Safety/Emergency systems. Refer to UBC Standard Drawing E10-2 for colours.

2.4 Secondary Distribution Raceways and Cables Identification

.1 Raceways and cables for interior LOW VOLTAGE systems shall be identified in accordance with Drawing E10-1.

***END OF SECTION***
1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Building Operations Electrical Technical Support
.2 UBC Energy & Water Services

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 26 05 05 High Voltage Cables.

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 Wismer & Rawlings – Service Division.
    .2 Schneider Canada.
    .3 Prime Engineering.
    .4 Eaton Technical Services.
    .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 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 Breaker Remote Controls and Synch Check
      .1 Verify each breaker can remotely open and close when voltage is present.
      .2 Verify closed transition transfer between normal and alternate feeders and back.
      .3 Verify system lockout on attempted out of synch or dead bus closure for all combinations of phase orientation.
      .4 Verify time delay for all breaker close and rack in/out functions.
      .5 Verify no time delay for all breaker open functions.
      .6 Verify all pilot lights indicate correctly.

    .3 High Voltage Vacuum Circuit Breakers
      .1 Verify that cell electrical and mechanical interlocks function correctly.
.2 Remove the breaker from the cell, and check the tightness of all control wiring.
.3 Check motorized racking mechanism for operation and binding.
.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 rack in and close breakers and check contacts for alignment mating and wipe.
.8 Operate the breaker and check the operation of the assembly.
.9 Follow manufacturers' specifications for lubrication.
.10 Operate the breaker electrically.
.11 Verify mechanical emergency open function of breaker.
.12 Put the breaker in test position in the cell; operate the breaker using the control switch.
.13 Open the breaker by closing the relay tripping contacts.
.14 Insulation resistance test measurements from phase to phase and phase to ground.
.15 Pole resistance to be measured by a contact resistance test set.
.16 Supply copy of Fuse Coordinate Study to UBC Building Operations.

.4 Protective Relays – Phase and Ground Protection
.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 Differential protection test.
   .6 Target and seal-in unit operation test.
   .7 Check all settings to the co-ordination study or setting data sheet.
   .8 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.

.9 Record and report all field settings for each LSI and thermal magnetic circuit breaker.

.10 Record and report all conductor termination torque settings applied.

.10 Transfer Switches

.1 Visual inspection for condition.

.2 Confirm nameplate, warning decals & arc flash labels are attached to the operating side of the equipment and are legible.

.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. Ensure shorting block is accessible and clearly labeled.

.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. Ensure V.T. fusing is accessible and labeled.

.8 Test and calibrate all active components.

.9 Record and report all field settings.

.10 Record and report all conductor termination torque settings applied.

.11 For closed transition transfer switches confirm shunt trip operation of upstream utility CB by 3rd party injection testing of reverse power relay. Provide 3rd party report as part of transfer switch submittal package.

.12 UBC Energy and Water Services require the following tests and submittals for closed transition transfer switches:

.1 CTTS factory settings for maximum interconnect duration shall not exceed 100msec.

.2 CTTS factory settings shall not permit peak shaving or soft load transfer.

.3 CTTS factory settings shall include passive synchronization for closed transition.

.4 CTTS shall incorporate a separate reverse power relay (32R) set to a maximum of 5% generator rating for 1 second. The reverse power relay shall be mounted on the operating face of the transfer switch, incorporate a resettable “flag” and be capable of being reset without opening the transfer switch enclosure.

.5 The 32R relay must connect to a shunt trip device in the transfer switch utility supply breaker. This operation shall be commissioned by a 3rd party using injection testing of the 32R relay.

.11 Panelboards and Disconnects

.1 Visually inspect all internal components and ratings.

.2 Check all internal connections and confirm wire sizes.

.3 Ensure bushings are installed and all unused conduits are capped.

.4 Confirm nameplate, warning decals and arc flash labels are attached to the operating side of the equipment and are legible.

.5 Confirm required spaces and spare circuit breakers are installed.

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.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines

.1 Division 26

1.2 Coordination Requirements

.1 UBC Energy & Water Services
.2 UBC Building Operations Electrical Technical Support

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:
  .1 120/208 Volt, 3-Phase 4-Wire Wye System
  .2 347/600 Volt, 3-Phase 4-Wire Wye System.

.2 All isolation, step-up, and step-down power transformers shall have a solidly-grounded wye secondary.

.3 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.

.4 If a 600V secondary distribution is selected, all motors 3/4 hp and over shall be supplied at this level.

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

.6 New Panelboards shall utilize bolt-on molded case circuit breakers. Panelboards shall contain copper buswork. All panelboards shall have phases balanced to within 15% and shall contain a typewritten directory on cardstock. The directory shall include the circuit number, room(s) number and load description. All new panelboards shall have a minimum of 6 spare breakers and the equivalent of 6 spaces at time of handover. All new panelboards shall be located on the same floors as the loads they serve.

.7 All loadcentres shall have main lugs. Panelboards and loadcentres shall not be back-fed through a circuit breaker.

.8 Where possible every load shall be supplied by a panelboard on the same floor.

.9 Daisy-chaining of electrical panels shall not be permitted. All panelboards shall be fed from separate overcurrent devices.

.10 Life Safety, Stand-by, Emergency Power distribution shall not contain any switches between the generator distribution overcurrent device and each transfer switch. All CBs upstream of Life Safety transfer switches shall have auxiliary contacts monitored by the transfer switch or generator or fire alarm system that will notify building maintenance personnel of a "not
normal" situation. The monitoring wiring diagram shall form a separate section of the generator submittals.

.11 The electrical distribution shall be designed to limit incident energy to maximum 8 cal/cm² at all switches, circuit breakers and MCCs while retaining acceptable coordination selectivity. Incorporate LSI Circuit Breakers, not fuses, where necessary to achieve the desired results.

.12 All transformers shall be mounted at floor level with minimum 1m clearance to access connection lugs and perform maintenance.

3.0 SECONDARY DISTRIBUTION EQUIPMENT IDENTIFICATION AND LABELING

.1 Secondary distribution equipment, such as Panel Boards, Load Centers and MCCs shall have conspicuously attached a permanent 2” X 4” Hazard Warning Label to meet OHSA and NFPA standards that clearly identifies:

.1 Incident Energy
.2 Arc Flash protection boundary
.3 Hazard Category

.1 Secondary distribution equipment that is identified as Hazard Category two or higher, the above label shall be 3.5” X 5”

.2 Panel Boards, Load Centers and Transformers shall be labeled and identified in accordance with Standard Drawing E 10-2 in all new buildings, UBC Renew projects and in any major additions to existing buildings.

.1 Each Panel Board, Load Center, Transformer and MCC shall have permanently affixed a (2” X 4”) BLACK letter on WHITE background identification lamacoid as illustrated in Standard Drawing E 10-2.

***END OF SECTION***
1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Energy & Water Services. Refer to www.energy.ubc.ca.

1.2 Description

.1 UBC requirements for Indoor and Outdoor Unit Substations.

2.0 MATERIAL AND DESIGN REQUIREMENTS – INDOOR UNIT SUBSTATIONS

2.1 Indoor Unit Substations General Requirements

.1 The unit substation assembly shall be CSA approved 15 KV rated and be a completely unitized assembly of components as described in the next section.

.2 Outdoor fluid filled padmount unit substations are acceptable to UBC and shall meet the minimum requirements in sub-section 3.0 and only in coordination with Energy & Water Services - Electrical Technical Services.

.3 Switchgear located in sprinklered rooms, or rooms where the likelihood of water ingress could occur from above, shall have drip hoods installed on all cubicles. Openings for ventilation shall have suitable sprinkler protection. Where multiple cubicles are joined to form a single unit, individual drip hoods shall form a single continuous water barrier by means of factory provided upturned flanges or approved caulking methods.

.4 Rooms containing substations, transformers shall not be air conditioned.

.5 Unit Substation Components shall consist of:

.1 15 KV switchgear.
.2 Main feeder and standby feeder cable entrance sections.
.3 Drawout, 15KV vacuum circuit breakers and protection relay.
.4 Cast coil transformer, (aluminum shall not be specified).
.5 Metering.
.6 Secondary Distribution (if applicable).

.6 Characteristics of the unit substation shall be:

.1 Primary voltage
  .1 12,480 volts.

.2 Secondary voltage
  .1 347/600 volts or 120/208 volts.

.7 Transformer KV Rating

.1 KVA rating as required.
.2 Fan cooling to provide 50% additional capacity.

.8 High voltage equipment shall be rated.

.1 3 phase 60 hertz.
.2 95 KV BIL.
.3 300 MVA interrupting capacity at 12.5 KV.

.9 Primary service connections shall be nominal 3 phase 3 wire 12.5 KV.
.10 Secondary voltage shall be 347/600 volts 3 phase, 4 wire, or 120/208 volts 3 phase, 4 wire.

.11 Maximum allowable Arc Flash Hazard/Risk Category within any part of the unit substation between primary cable entrances and main secondary bus shall not exceed level 2 (8 cal/cm²).

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

.13 Where it is necessary to construct the components in separate enclosures these, when mounted and bolted together, shall present a unified appearance as to height, form and color.

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

.15 Access to all individual components must be readily obtainable. All cubicles shall have hinged doors to allow for easy infrared scanning. Doors shall be maximum 1200 mm wide with a minimum 90 degree opening. All panels on which relays, meters, or instruments are mounted shall have a barriered compartment with hinged door. All hinges shall be concealed.

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

.17 Access doors shall have two vault-type handles with padlocking feature or be secured with bolt(s) where required. This will allow easy infrared scanning.

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

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

.20 All power connections shall be rigid bussing adequately supported for available fault currents. All equipment shall be wired at manufacturer’s plant and required field connections wired to accessible load terminals. Grounding ball studs shall be affixed to bus at each cable entrance compartment and on the high voltage bus within the transformer section.

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

.22 A flat copper bonding strip of 0.50 sq. in. (1.3 sq. cm) minimum cross sectional area shall extend the length of the unit substation and be extended to all non-current carrying metal parts of the unit substation and the neutral grounding bus. Grounding ball studs shall be located for easy access during maintenance and shall be located within easy access of all door openings.

.23 All control fuses mounted in substation shall have downstream long life LED indicating lights, with nameplates, to indicate circuits are energized. Supply one set of spare fuses for all fuses locations.

.24 Provide wiring terminal box with terminal block for all outgoing control circuits and spare contacts. Terminal block shall be located where access is possible without de-energizing.
.25 Corrosion resistant approved warning signs shall be securely mounted on the outside of the
unit substation cubicles.

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

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

.28 Approved manufacturers of unit substations are as follows:
   .1 Eaton.
   .2 Electric Power Equipment.
   .3 Schneider Electric.
   .4 Unit Electrical Engineering (UEE).
   .5 Prime Engineering.

2.2 Performance Standards

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

2.3 Submittals

.1 Shop drawings shall include:
   .1 All major electrical equipment.
   .2 High voltage switch.
   .3 Unit substation
      .1 High voltage breaker.
      .2 12 KV switchgear.
      .3 Transformer cubicle.
      .4 Protection and control.
   .4 Factory Transformer Test Report – test report of no-load and load losses, winding
      resistance tests and impedance test.
   .5 Co-ordination study and curves.
   .6 Secondary distribution.
   .7 High voltage cable.
   .8 High voltage terminations.
   .9 Secondary bus.
   .10 Distribution centre.
   .11 Revenue metering.
   .12 Seismic restraints.
   .13 Ground pad.

.2 Submit the following test reports associated with the unit substation:
   .1 Production Tests - manufacturer’s standard product test as requested in Section 26 08
      00 Commissioning of Electrical Systems 2.1.
   .2 Unit Substation Test - manufacturer’s factory test on supplied unit substation as
      specified in Section 26 08 00 Commissioning of Electrical Systems 2.1.
   .3 Site Commissioning - test report on site commission as specified in Section 26 08 00
      Commissioning of Electrical Systems 2.3.
.4 Factory Transformer Test Report – test report of no-load and load losses, winding
resistance tests and impedance test. Refer to Section 26 12 00 Medium-Voltage
Transformers, sentence 2.4.4, for required loss limits for various size transformers.

.3 Station Ground Resistance
.1 Submit ground resistance test as outlined in Section 26 08 00 Commissioning of
Electrical Systems 2.3.6.

.4 Cable Testing
.1 Submit conductor and cable test reports as outlined in Section 26 05 05 High Voltage
Cables 2.12 Testing.

.5 Voltage Calibration
.1 Submit voltage calibration report as outlined in Section 26 08 00 Commissioning of
Electrical Systems 2.4.

.6 Seismic Certification
.1 Submit certification of compliance with seismic requirements as specified in Section 26
05 48 Vibration and Seismic Controls for Electrical Systems.

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

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

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

.10 Shop drawings shall be submitted for review prior to construction. Shop drawings shall be
AutoCAD or PDF with minimum 600 dpi resolution. Hard copies shall be on AO (841 mm x
1189 mm) sized drawings. Supply digital files with Shop Drawing submittal.

.11 Before assembly of the unit substation, submit the following information in digital format:
.1 Electrical one-line diagram.
.2 Protective device co-ordination graph.
.3 Layout plan with dimensions.
.4 Reviewed and approved equipment cubicle drawing, including circuit breaker control
wiring diagrams and key interlock scheme.
.5 Shop drawing information.

2.4 Drawing Requirements

.1 AutoCAD Drawings Shall Include:
.1 Equipment layout and overall dimensions.
.2 Equipment specifications.
.3 One line diagram.
.4 Relating information including relay specs; time-current graphs; wiring diagrams, and
tripping system.
.5 Seismic support and restraints.
.6 Metering information.
.7 Terminal block wiring and labeling.
.8 Labels.
2. Electrical One-Line Diagram
   1. The electrical one-line diagram shall show the connection of all the service entrance equipment. It shall contain the proposed service entrance relay settings.

3. Protective Device Co-ordination Graph
   1. A standard size 4 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 Energy & Water Services protective equipment. The manufacturer shall provide the required co-ordination study. Refer to Section 26 05 04 Protective Device Coordination and Arc Flash Analysis.

4. Equipment Drawing - Unit Substation
   1. The unit substation shop drawings shall be submitted for review prior to assembly.
   2. The drawings shall show fully dimensioned equipment assembly details and the wiring diagram of the circuit breaker control scheme.

2.5 Metering Requirements
   1. Metering shall be supplied by Switchgear Manufacturer at the project’s cost and installed by manufacturer.

   2. Switchgear manufacturer to incorporate Schneider Electric PM8240 meter with i/o module meter into construction.

2.6 Testing & Commissioning
   1. Factory tests shall be performed as specified in Section 26 08 00 Commissioning of Electrical Systems. Provide written report of test results prior to shipment of unit substation.

   2. Provide written report of test results prior to energization of unit substation.

   3. Unit substation, when fully assembled, shall be made available for inspection in the factory by the Engineer.
      1. Unit substation to have factory test and site and commissioning as outlined in the Specification.

2.7 Cubical Specifications
   1. Cable Entrance and Withdrawable Breaker Cubicles
      1. Shall house incoming cable terminations with provision for stress cones and cable supports.
      2. Shall include grounding ball studs on both incoming buses.
      4. Shall house Current Transformers (CT).
      5. Shall house electrically operated withdrawable vacuum circuit breakers.
      6. Shall house electrical operating controls for breaker racking mechanism behind lockable door.
      7. Shall house electrical operating controls for breaker open/close override behind lockable door.
      8. Shall include viewing windows.
      9. Doors shall have provisions for heavy duty padlock.

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

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

2.11 15kV Withdrawable Circuit Breakers
.1 15kV, 3 pole, 600 Amp group operated vacuum circuit breaker with magnetic actuator.
.2 Each vacuum interrupter shall be mounted in molded epoxy housing with a minimum pole spacing of 210 mm. Vacuum interrupters shall be designed and rated as “sealed for life”.
.3 The breaker shall be operated by an electrically operated magnetic actuator controlled by position sensors and by electronic module. The energy required for operation shall be provided by integrated capacitors capable of storing sufficient energy for a complete operating cycle: open – close – open.
.4 The breaker shall have local control buttons for open and close with an emergency mechanical opening operation and shall include a position indicator.
.5 Rated interrupting capacity shall be minimum 300 MVA and 16kA RMS symmetrical at 15kV. Rated current 630 Amps. Rated duty cycle: open - 0.3 sec. - close/open - 15 sec. - close/open.
.6 Number of operations at rated current = 30,000. Number of operations under short circuit = 100.
.7 Rated impulse withstand of 95 KV BIL.
.8 Breaker shall be type tested in accordance with ANSI Standard C57 and/or IEC 62271-100, CEI 17-1 file 1375.
.9 Breaker shall be withdrawable type via motorized operator and manual racking lever.

.10 Electric operators shall be 24 or 48V DC type compatible with unit substation control voltage and be powered directly from the DC Battery System.

.11 The breaker shall have position sensors to prevent racking out while breaker is in the closed position.

.12 The breaker shall have an integrated lockable hasp for the provision of personal lockout with mechanical and electric interlock to prevent the breaker from being able to be racked in.

.13 The breaker shall be able to be fully racked in and out with the doors closed.

.14 The breaker door shall be able to be closed after applying personal padlocks to the breaker.

.15 All doors shall have provisions for padlocks.

.16 A window shall be provided to permit viewing of the breaker in both the open, closed and racked out position.

.17 Approved manufacturers are:
   .1 ABB
   .2 Eaton
   .3 Schneider Electric

2.12 15kV Breaker Trip

.1 Tripping power shall be obtained from the DC battery system.

.2 The operating voltage for breaker trip shall be either 24 or 48 V DC.

.3 Auxiliary trip coils shall be DC operated and independent of availability of AC current.

.4 In addition, provide a shunt trip for over temperature and ground fault trip. Power to be from the DC battery system. Provide LED lamps for monitoring of shunt trip.

.5 Provide one set of NO and NC auxiliary contacts to indicate whether breaker is open or closed wired to a terminal block located in an outlet box at the top of the cubicle.

2.13 Relay Current Transformers and Zone of Protection

.1 Current Transformers (CT) shall be installed within the switchgear to create a complete protection zone. The zone of protection shall include cable terminations for both incoming feeders, HV circuit breakers, main transformer and main secondary bus and distribution board.

.2 Provide window style, 600V, relay accuracy C100 CT’s, ratio XX:5, in each 15kV cable entrance section. CT window shall be sized to allow for cable to pass through without interference to cable or its termination. CT’s shall be permanently and securely mounted in switchgear cable entrance section.

.3 Provide window style, 600V, relay accuracy C100 CT’s, ratio XXX:5 in the low voltage section. Locate CT’s as close as possible to the secondary connections of the transformer to maximize the protection zone area. CT’s shall be permanently and securely mounted in switchgear.
.4 The Arc Flash Hazard category within any area covered by the Zone of Protection shall not exceed level 2 (8 cal/cm^2).

### 2.14 Protection Relay

.1 Overcurrent and short circuit protection shall be provided by a single Schweitzer Engineering Laboratories (SEL) 700GT+ series relay.

.2 The SEL relay shall also provide protection for primary and secondary ground faults.

.3 Protection shall be of the circuit closing type with programmable current range from 0.1 to 96.0 amps.

.4 CT inputs shall be rated for 5 amp CT secondary.

.5 The SEL relay shall be powered directly from the DC Battery System.

.6 The SEL relay shall be surface mounted on the switchgear.

### 2.15 Capacitive Voltage Transformers

.1 Three (3) Capacitive Voltage Transformers (CVT) shall be installed in each 15kV cable entrance section.

.2 CVT’s shall be mounted on the line side of each 15kV breaker and used exclusively for the purposes of synchronization check only as required in 2.16.

.3 CVT’s shall have a voltage rating of at least 22kV to permit high potential cable testing.

### 2.16 12kV Feeder Synchronization Check

.1 Provide synchronization check to confirm correct phase relationship between both normal and alternate 12kV feeders.

.2 The synchronization check shall be incorporated into a single SEL 700G relay, as part of 2.14, and be capable of accepting the voltage outputs from the capacitive voltage transformers (CVT) for the purposes of synchronization comparison only.

.3 The device shall monitor each of the three phases of each feeder to ensure correct phase relationship.

.4 The device shall electrically lock out the operating controls for both 15kV breakers to prevent paralleling in the event of incorrect phasing.

.5 The device shall electrically lock out the operating control for any breaker attempting to close on a dead bus.

.6 The device shall illuminate a pilot light in the event of an “out of synch” condition.

.7 The device shall not interfere with the open operation of any breaker.

.8 The device shall be powered directly from the DC Battery System.

### 2.17 Breaker Remote Operation

.1 Both the normal and alternate breakers shall normally be operated remotely via control cabinet located in an area outside of the arc flash protection boundary.
.2 The control cabinet shall house a single operating switch to transfer from one feeder to the other.

.3 The control cabinet shall house operating controls to open and close individual 15kV breakers.

.4 The control cabinet shall house pilot lamps to indicate breaker position for both 15kV feeders.

.5 A time delay shall be incorporated of up to 15 seconds before the first action for the purposes of transferring between feeders or closing an individual breaker. This time delay will allow sufficient time for anyone that may still be within an arc flash protection zone to safely exit the area before the breakers operate. There shall be no time delay associated with opening an individual breaker.

.6 Control wiring between the unit substation and the control cabinet may be via individual control wires, fibre optic cables or a combination of both.

.7 All breaker operations shall be supplied from the DC Battery System.

.8 The control cabinet shall have a hinged cover with provision for a heavy duty padlock.

.9 The control cabinet controls shall look similar to that in UBC Standard Drawing E1-6.

2.18 Location of Auxiliary and Control Equipment

.1 All components used for protection and control shall be housed in a separately barriered compartment from any high voltage equipment. This also applies to all auxiliary components including terminals, relays and pilot lamps.

.2 Provide a 27mm conduit extending from the barriered control section of each feeder to a junction box on top of the substation equipment to allow for connection to external devices or monitoring equipment.

2.19 DC Battery System

.1 Provide 24 or 48 volt DC battery system complete with heavy duty charger. Batteries shall have sufficient storage capacity to fully operate the circuit breakers (open – close – open), pilot lights and protection and control system in the event of a power failure.

.2 Batteries shall store sufficient energy to ably maintain, monitor and control for up to 24 hours.

.3 The DC charger shall be fed directly from the substation at 120 volts.

.4 The DC charger shall have output relays with Form C dry contacts for the following conditions:
  .1 AC power loss
  .2 Charger failure
  .3 DC power loss

.5 The DC charger shall have an internal audible alarm that will annunciate during any of the above abnormal conditions.

.6 The DC Battery System may be located in a separately barriered section of the switchgear or stand-alone outside of the switchgear. The system shall be designed such that any
component of the system can be readily and safely accessed without shutting down the substation.

2.20 Main Secondary Breaker

.1 A main secondary breaker, 600 or 208 volt, is not preferred.

.2 In lieu of a secondary main breaker, provide current transformers (CT) to perform necessary overload, short circuit protection and Arc Flash Hazard Category reduction as outlined in Section 26 11 13 Primary Unit Substations, 2.1.8.

.3 A main secondary breaker may only be provided for the purposes of derating downstream buses or as approved by UBC Energy & Water Services.

3.0 MATERIAL AND DESIGN REQUIREMENTS – OUTDOOR UNIT SUBSTATIONS

3.1 Outdoor Unit Substations General Requirements

.1 Substation assembly shall be CSA, cUL or field (SPE-1000) certified.

.2 15 KV, 16kA rated, switchgear, environmentally friendly fluid or gas insulated with integrated high voltage main feeder and standby feeder cable entrance section.

.3 Fluid filled transformer and integrated vacuum fault interrupter, with FR3 Envirotamp insulating fluid.

.4 Overcurrent protection and auxiliary control components.

3.2 15 KV Outdoor Switchgear Minimum Requirements

.1 16kA rated equipment maintenance free design.

.2 Dead front cable entrance and exit sections. Cable connections shall be IEEE 386 15kV, 600 amp deadbreak type.

.3 Cable connection bushings shall be minimum 36" from bottom of equipment.

.4 Environmentally friendly fluid or gas insulating medium only. Air insulated equipment shall not be permitted.

.5 2 separate high voltage 3 phase fully load break rated isolating switches (2 ways) in a loop/feed through configuration within in common tank.

.6 Each operating switch shall have one cable entrance connection with a 3rd outgoing cable connection directly on the common bus.

.7 Cable entrance and exit connections shall not be located on same side as operating components.

.8 Cable entrance and exit connections shall only be mounted on back or side walls. Cable connections shall not be permitted on top or bottom of equipment.
.9 Load break isolating switches shall have either 2 operable positions, Closed-Open or 3 operable positions, Closed-Open-Ground.

.10 Load break Isolating switches shall be padlockable in the Open position to meet WorkSafe BC requirements.

.11 Ability to operate load break isolating switches independently of each other while energized.

.12 Large viewing window(s) for load break isolating switch contact position verification.

.13 Approved manufacturers of outdoor gas or fluid insulated switchgear are:
   a) Eaton/Cooper
   b) G&W Electric
   c) S&C Electric
   d) Prime Engineering

3.3 Fluid Filled Transformer with Integrated Vacuum Fault Interrupter Minimum Requirements

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

3.4 Secondary Cabinet Minimum Requirements

.1 Secondary Cabinet Front access door, including either 2 padlockable handles or a single padlockable handle and 2 tamperproof pentahead bolts.
.2 Secondary Cabinet Side access panel.
.3 600 volt donut style XXX:5 C100 (C50 minimum) CT’s (3) permanently mounted at secondary phase bushings.

3.5 Overcurrent Protection and Auxiliary Control Equipment Minimum Requirements

.1 Provide minimum 500VA 600/120-240V station service transformer with DIN rail mounted primary and secondary class CC fuses.
.2 Provide 120VAC - 24VDC power supply c/w sealed lead acid battery backup. Batteries shall be sufficiently sized to provide protection and control for up to 24 hours. Batteries shall be provided by UBC.
.3 24VDC power supply shall have integrated form C relay output and local audible alarm that activate on loss of AC or general trouble.
.4 Provide 24VDC powered SEL 700 GT+ relay for primary, secondary 50/51 and ground fault protection.
.5 Provide 120VAC, 75W silicone wafer heaters (Watlow or equivalent), thermostatically controlled, mounted in SEL relay section.
.6 Provide 600 volt donut style CTs, field mounted, in transformer high voltage cable entrance section.
.7 Provide (3) 15.3 kV MCOV surge arrestors with 600 amp IEEE 386 connection for installation in high voltage cable entrance section.
.8 Provide 600 volt donut style CTs, factory mounted, on secondary transformer bushings.
.9 All auxiliary equipment including relays, heaters, lights etc. shall be powered from the station service transformer and located within transformer primary cable entrance section or operating switch section within separately barriered swing out enclosure.
.10 All operating and control components shall be located behind lockable NEMA 3R or 4 rated panel covers.
3.6 Approved Manufacturers of Outdoor Transformers and Associated Enclosures

.1 Eaton/Cooper
.2 Vantran Industries
.3 Partner Technologies Inc. – PTI
.4 Prime Engineering
.5 Schneider Electric

3.7 Relay Current Transformers and Zone of Protection

.1 Primary and secondary Current Transformers (CTs) shall be installed within the transformer enclosure to create a complete protection zone. The zone of protection shall include all components within the entire transformer enclosure and incorporate the VFI, transformer and secondary supply cables.

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

.3 The SEL 700GT+ relay shall act as the main protection device for the zone of protection and programmed with the following settings:
   a) HV 50/51
   b) HV 51N
   c) LV 50/51
   d) LV 51G

.4 All other ancillary protective devices (49, 63, etc.), if used, shall connect into the SEL 700GT relay.

.5 The factory supplied protection controller (if provided) shall act as a backup protection device and shall effectively coordinate with the SEL 700GT+ relay.

.6 Refer to UBC standard drawing E1-2b for Protection and Control Single Line.

3.8 Switchgear and Transformer Cable Interconnection

.1 High Voltage cable interconnection between the switchgear and transformer shall be installed by UBC Energy & Water Services only and charged to the project.

.2 All protection and control equipment wiring shall be installed by the contractor.

3.9 Concrete Equipment Pad and Seismic Anchoring

.1 The contractor shall design and provide the concrete equipment pad and all interconnecting conduits.

.2 15kV switchgear and transformer shall be physically separated by the minimum requirements of the equipment supplier and applicable codes with a minimum of 300mm clearance between equipment.

.3 UBC Energy & Water Services shall approve all concrete pad layouts along with all protective bollard locations or architectural surrounds prior to any installation.

.4 UBC Energy & Water Services may refuse permanent power connection to any installation that is not installed as per approved layout design.
.5 The contractor shall ensure all seismic anchoring requirements are met as per UBC Technical Guidelines section 26 05 48.

3.10 Grounding and Bonding

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

***END OF SECTION***
1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Energy & Water Services
.2 UBC Building Operations

1.2 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 15.3 kV MCOV distribution class surge 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 Grounding ball studs shall be affixed to the primary transformer bus and meet accessibility requirements as per section 26 11 13 2.1.

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.

<table>
<thead>
<tr>
<th>Transformer Size (KVA)</th>
<th>No. Load Losses (Watts)</th>
<th>Load Losses (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>2,300</td>
<td>7,500</td>
</tr>
<tr>
<td>1000</td>
<td>2,900</td>
<td>9,000</td>
</tr>
<tr>
<td>1250</td>
<td>3,250</td>
<td>10,100</td>
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<tr>
<td>2000</td>
<td>5,200</td>
<td>14,300</td>
</tr>
<tr>
<td>3000</td>
<td>5,700</td>
<td>19,500</td>
</tr>
</tbody>
</table>
.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 120/208V.
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 LSIS
   .4 Jinpan International
   .5 Hammond EnduraCoil
   .6 Rex Power Magnetics

.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 Energy and Water Services Revenue Meter

.1 Revenue meters shall be switchboard mounting, 3 element watt hour demand type, Schneider Electric PM8240 meter with i/o module.

.2 Multifunction Meter with Ethernet capability. Refer to Section 26 27 13 Metering.

2.10 System Monitoring

.1 The following monitor points and contacts shall be wired out to a terminal block located in a junction box on the unit substation roof for future connection to UBC BMS system to monitor:
   .1 Circuit breaker #1 status.
   .2 Circuit breaker #2 status.
   .3 SEL Relay health status.
   .4 DC Battery System – AC power loss.
   .5 DC Battery System – Charger failure.
   .6 DC Battery System – DC power loss.
   .7 Transformer fan on transformer temp ‘alert’.
   .8 Transformer temp ‘alarm’.
   .9 Three (3) spare spaces.

.2 Refer to Section 25 05 00 Building Management Systems (BMS) Design Guidelines 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. 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.

***END OF SECTION***
1.0 GENERAL

1.1 Coordination Requirements

.1 UBC Building Operations

1.2 Description

.1 The Low-Voltage Transformer technical guideline outlines the requirements for dry type distribution transformers utilized at UBC facilities with primary/secondary voltages between the ranges of 120 to 600 volts.

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 Design

The following variables must be evaluated when specifying a transformer:

.1 Primary and Secondary voltage/phase/frequency requirements.
.2 Total loading on the transformer.
.3 Future capacity required.
.4 Type of loads.
.5 % of linear and non-linear loads.
.6 Environmental requirements (Water/dirt egress, sound).
.7 Spacing and weight requirements for proposed location.
.8 Adequate ventilation in proposed location.
.9 Mounting type.
.10 Mechanical protection.
.11 Tamper resistance in areas accessible to the public.
.12 Ease of access for inspection, maintenance, removal and replacement.

2.2 Transformer Types

The following dry type transformers may be specified based on the following requirements:

.1 General Purpose:
   .1 General purpose transformers shall be specified when there are less than 15% non-linear loads.

.2 K-Factor Rated:
   .1 K-Factor Rated transformers shall be utilized in applications where 15% or greater non-linear loads are present:
      • 15-35% non-linear loads → K-4 rated transformer.
      • 36-75% non-linear loads → K-13 rated transformer.
      • 76-100% non-linear loads → K-20 rated transformer.

.3 Harmonic Mitigating:
   .1 Harmonic Mitigating transformers can be specified for the following applications:
      • Mitigation of potential nuisance tripping of overcurrent protection upstream in the distribution due to harmonics.
      • Mitigation of harmonics to sensitive equipment that are highly susceptible to voltage distortion.
      • Improving the effects of decreased Power Factor due to harmonics.
.4 Autotransformer:
  .1 Autotransformers shall only be specified for single load applications.
  .2 Autotransformers may only be used in lieu of general purpose transformers in applications where isolation is not required and the latter cannot be utilized due to space and weight restrictions.

.5 Encapsulated:
  .1 Encapsulated transformers can be specified for the following applications:
    - Harsh environment locations (ie: Laboratories, Street Lighting).
    - Hazardous locations requiring Class 1, Division/Zone 2 rated equipment.

2.3 Material Specifications

  .1 Capacity: The allowable range of capacities shall be from 3kVA minimum to 300kVA maximum.
  .2 Frequency: 60Hz shall be the default frequency.
  .3 Cooling: ANN Air Natural Convection Cooling shall be utilized for all transformers.
  .4 Winding Configuration: The transformer shall be delta connected primary with wye connected secondary unless another winding configuration is explicitly stated and required.
  .5 Conductors: Core conductors shall be copper windings, with terminations brazed, welded or bolted. Aluminum windings are only acceptable for transformers sized at 30kVA or less that service normal distribution equipment (emergency, essential, stand-by and life safety do not qualify).
  .6 Insulation: Insulation class shall be 220°C with 150°C temperature rise for all open wound transformers. Encapsulated transformers insulation class shall be 180°C with 135°C temperature rise.
  .7 Impregnation: All open wound transformers shall be immersed and baked in a CSA/UL recognized 220C varnish. Encapsulated transformers shall be completely encased in an approved resin or epoxy.
  .8 Efficiency: The transformer shall be meet the following Energy Efficiency Standards: Canada - (NRCan 2019) SOR/2018-201, Amd. 14 & ON Reg. 404/12
  .9 Basic Impulse Level: Transformers shall have a minimum 10kV BIL unless otherwise stated.
  .10 Impedance: Shall not be greater than 6%.
  .11 Grounding:
    .1 A ground terminal for all grounding and bonding conductor connections shall be secured inside the transformer enclosure and not installed on or over any vented portion of the enclosure.
    .2 Ground core & coil assembly to enclosure with a flexible copper grounding strap or equivalent.
    .3 Transformer secondary neutral shall be solidly grounded to the ground bus.
Neutral: Wye connected secondaries shall have the neutral brought out to a separate fully rated neutral bus.

Sound Level: The transformer shall at minimum shall meet the sound requirements outlined in NEMA Standard ST-20 Table 3.9.

<table>
<thead>
<tr>
<th>kVA</th>
<th>NEMA Standard ST-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-9</td>
<td>40dB</td>
</tr>
<tr>
<td>10-50</td>
<td>45dB</td>
</tr>
<tr>
<td>51-150</td>
<td>50dB</td>
</tr>
<tr>
<td>151-300</td>
<td>55dB</td>
</tr>
</tbody>
</table>

Lower dB ratings shall be specified for sensitive locations that require minimal sound disturbance.

Enclosure Type: The enclosure shall be NEMA 1 for general purpose areas. Locations subjected to water egress shall utilize NEMA 3R. Locations with more extreme environmental conditions may utilize NEMA 4/4X enclosures. Locations subjected to circulating dust, lint and fibers shall utilize NEMA 12 enclosures.

Enclosure Finish: ANSI/ASA 61 grey finish.

Seismic Rating: International Building Code (IBC), SDS=2.00g ; z/h = 1.00 ; Ip = 1.5 rated transformers shall be specified by the designer as required for critical applications.

Installation Hardware: Where applicable, lifting lugs shall be adequately strengthened, sized and arranged on the transformer to provide a suitable lift for the completely assembled unit. Provision on the transformer base for skidding and jacking shall be provided as required.

Windows: Infrared windows shall be required.

Nameplate: The nameplate shall meet or exceed the requirements of the Canadian Electrical Code and CSA/cUL.

Certifications: All transformers shall bear a CSA or cUL certification label. Alternatively, ensure the equipment has any Nationally Recognized Testing Laboratory (NRTL) member organization’s certification label, certifying the equipment for installation in Canada.

Standards: All transformers shall be constructed and tested to CSA C9, C22.2-47, IEEE C57.12.01, IEEE C57.12.91 and NEMA ST-20. In addition to the standards listed prior, K-Factor Rated and Harmonic Mitigating transformers must incorporate IEEE C57.110 and IEEE Std 519 standards.

Warranty: Minimum of 1 year of warranty required.

Approved Manufacturers are:
1. Schneider Electric / Square D.
2. Eaton.
3. Hammond.
4. Delta.
5. Rex Power Magnetics.
6. Marcus

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

.1 Location:
   .1 Location shall comply with all applicable codes and standards. This includes requirements set out by the CEC, Technical Safety BC and the BC Building Code.
   .2 Location shall consider the entire life cycle of the transformer. The transformer must be installed in a location that can be easily accessed by maintenance personnel. Access for removal and replacement of the transformer must be considered and any location that will require modification to building infrastructure for removal will not be deemed acceptable.
   .3 The impact of the sound and vibration of the transformer must be considered when finalizing the location. Sensitive business and research operations must be considered.
   .4 If applicable, mechanical protection shall be added in locations that are exposed to an increase risk of damage.
   .5 Any equipment installed above or below the transformer shall not affect access or performance of either piece of equipment, such as:
      .1 Pull Boxes.
      .2 Junction Boxes.
      .3 Cable Tray.
      .4 Mechanical Equipment - Smoke, Heat, CO2 detectors .

.2 Clearance:
   .1 A minimum of 1m (3.28 feet) of clearance is required in front of the transformer as per the Canadian Electric Code.
   .2 The following clearances are required on the sides, back, and top at a minimum:
      .1 Transformers up to and including 150kVA: 152mm (6 Inches).
      .2 Transformers over 150kVA to 300kVA: 305mm (12 inches).

.3 Mounting:
   .1 Floor:
      .1 All floor mounted transformers must be on a concrete pad. Mounting directly on the floor is not allowed.
      .2 Concrete pad dimensional requirements:
         .1 Minimum 4 inch height.
         .2 Minimum of 6 inches of extension past transformer sides.
   .2 Wall:
      .1 The largest size allowed or wall mount is 75kVA.
      .2 Where applicable utilize manufacturer approved wall mounting kits.
   .3 Ceiling:
      .1 The largest size allowed is 30kVA.
      .2 Where applicable utilize manufacturer approved ceiling mounting kits.
   .4 Stacked: Stacking of transformers is only allowed if all other options have been exhausted due to lack of space. Stacking is only applicable to floor mount applications and is not allowed for ceiling or wall mount configurations. Stacking shall comply with the following requirements:
      .1 The transformer stacked on top is the same size or smaller than the transformer below.
      .2 The conditions outlined in 2.4.2 have been satisfied.
      .3 The ambient temperature must not exceed 30°C.
.4 Connections:
   .1 Flexible metal conduit shall be utilized for final connections to the primary and secondary sides of the transformer to reduce vibration and sound transmission.

.5 Grounding:
   .1 The ground terminal shall be connected back to the main building ground bus.
   .2 The minimum size grounding conductor shall be #6AWG.

.6 Vibration Isolation:
   .1 All transformers shall have vibration isolation pads between the core and coil assembly and the enclosure.
   .2 Spring based vibration isolation mounts are required to be installed between the transformer and mounting surface. Where possible utilize mounts offered by the same manufacturer as the transformer.

***END OF SECTION***
1.0 **GENERAL**

1.1 **Related UBC Guidelines**

1.1.1 Division 33, Section 33 10 00 Water Utilities - 2.4; Section 33 51 00 Natural Gas Distribution - 2.4; and Section 33 63 00 Steam Energy Distribution - 2.5; Division 27, Section 27 05 08 Description of System – 1.4

1.2 **Coordination Requirements**

1.2.1 UBC Energy & Water Services

1.3 **Description**

1.3.1 UBC requirements for Metering.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

2.1 **General**

2.1.1 Switchgear manufacturer shall supply and install Revenue meter to unit sub manufacturer at the project’s cost.

2.2 **Revenue Metering**

2.2.1 Revenue meter shall be Measurement Canada approved, Schneider Electric Type PM8240 with i/o module Multifunction Meter with Ethernet options.

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

2.2.3 The meter shall be flush mounted @ 54” above finished floor (centre of meter) in a separately barriered 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.

2.2.3.1 For 120/208V Systems wire the meter as shown on Drawing E4-4.

2.2.3.2 For 347/600V Systems wire the meter as shown on Drawing E4-5.

2.2.4 Approved Test Block Manufacturers:

2.2.4.1 ABB type FT-1.

2.2.4.2 Sangamo.

2.2.4.3 Superior #1082F.

2.3 **Metering Transformers**

2.3.1 Metering transformers shall be provided by the switchgear manufacturer.

2.3.2 Three current transformers (CT’s) shall include revenue metering accuracy of 0.3B0.9, ratio XXX/5 for Schneider Electric PM8240 with i/o module multifunction meter. Mount CT’s on transformer secondary bus.

2.3.3 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 Main building gas and water meters are to be integrated into the electrical metering system. Pulse outputs from each of these meters are to be brought to the Schneider Electric PM8240 meter for recording purposes. Refer to standard drawing E4-6 for wiring connections.

.2 The Division 26 contractor shall install all pathways and wiring between the mechanical meters and the electric meter. Coordinate with Division 20 contractor and UBC Energy & Water Services.

.3 District Energy meter shall be network connected directly to UBC ION metering network. Refer to Division 20, 23 and 27 for applicable details and Drawing E4-6c.

.4 Refer to Drawing E4-6 for wiring requirements of the gas and water metering integration into Schneider Electric PM8240 meter.

3.0 Other

.1 A raceway shall be provided between the PM8240 meter and the nearest communications closet. Provide an IT demarcation box within 3 metres of the PM8240 meter. Refer to Division 26 standard drawing E4-6 and Division 27 standard drawing ITSTD-22.
1.0 GENERAL

1.1 Related UBC Guidelines

.1 Division 27, Section 27 05 05 Communication Rooms Design Guidelines – 2.6
.2 Division 26, Section 26 51 00 Interior Building Lighting – 2.6

1.2 Coordination Requirements

.1 UBC Building Operations Electrical Technical Support
.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 buildings as defined in .2 below.

.2 If any of the following are included in building design, then a generator for emergency and standby power shall be installed within the building structure or in an enclosure on the building site.
   .1 10,000 GSM or larger
   .2 Active smoke control
   .3 High Building as defined by the latest edition of BCBC

.3 When a generator is installed, the following equipment shall be connected to the emergency/standby source.
   .1 All active smoke control equipment and controls
   .2 Fire Alarm Control Panel
   .3 Emergency and exit lighting
   .4 Heat Trace wiring
   .5 Sprinkler system equipment (dry and pre-action system compressors, excess pressure and fire pumps, heating systems for water service rooms, etc.)
   .6 Sanitary sump pumps and storm sump pumps
   .7 Main electrical room lighting and least one convenience receptacle

.4 If a 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.

.5 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.

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

.8 Emergency generators shall be diesel fuel type only.

.9 Emergency generators shall have a minimum 24-hour run time under 100% loading without refueling.

.10 All generators shall be capable of being refuelled from ground level. The refuelling location shall be accessible for fuel trucks to park within 5 meters.

.11 Confirm positive fuel prime to all fuel pumps.

.12 See Section 25 05 00 Building Management Systems (BMS) Design Guidelines for requirements for BMS and Section 28 31 00 Fire Detection and Alarm for fire alarm system for generators.

.13 In buildings where generators are installed a 5-20R receptacle supplied by a dedicated over current device shall be installed immediately below each panel that derives its supply from the emergency/standby distribution.

2.2 Generator Housing and Location

.1 Generators to be primarily located at ground level in separate enclosures.

.2 Generators should be housed in areas which are large enough to allow for maintenance, testing and repair, and remove and replace components, without having to remove portions of the structure in which they are mounted.

.3 Generator areas should be provided with room lighting, power, ventilation and heat (from generator supply) for maintenance.

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

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

.3 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 To assist with maintenance, generators shall have a second circuit breaker rated for 100% load 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. The output of the second breaker shall extend to a 3R outdoor-rated Cam-Lok 1016E female connection box mounted on the generator enclosure or in an accessible location exterior to the building envelope.
2.5 Time Delay

.1 The time delay on restoral to utility should be set to fifteen minutes.

2.6 Generator Transfer Switches

.1 Automatic Transfer Switches (ATS) shall be supplied with fully rated double-bypass isolation capability.

.2 The entire ATS & bypass assembly shall be certified to CSA C22.2 No. 178.

.3 ATS shall have a minimum 18 cycle Withstand and Close-on Rating on all equipment rated at 400 amps and greater.

.4 ATS bypass/isolation handles shall be permanently attached & require a maximum of two steps to perform bypass/isolation operation.

.5 ATS main contacts and bypass contacts shall be fully withdrawable on equipment rated at 400 amps and greater.

.6 All components within the ATS shall be supplied, commissioned and supported by the ATS provider.

.7 Closed Transition Transfer Switches (CTTS) shall include a separate redundant protection relay to prevent any possible back feed to the utility. All methods of providing this form of protection shall be submitted to UBC Energy & Water Services for approval prior to equipment installation.

.8 CTTS redundant backfeed protection may be a reverse power relay set not more than 5% of the generator rating and extended parallel relay set at not more than 1 Second.

.9 Transfer switches shall be motorized or solenoid contact type such as Asco 7000 series (or equivalent).

2.7 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 Underground tanks that are inherited with their piping systems shall be removed as part of any replacement.

.3 Fuel storage tanks shall be protected from freezing.

2.8 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 A complete set of manuals for each Transfer Switch shall be provided. The manuals shall include all schematics and wiring diagrams for actual supplied components and commissioning report. Generic manuals will not be accepted.
2.9 Central Inverter Systems

1. For buildings 2,500 GSM to 10,000 GSM an "always on" Central Inverter System shall be provided to supply all BCBC required exit signs and egress lighting.

2. A single piece of Unit Equipment shall be installed at each Central Inverter System location.

3. Total loading shall not exceed 60% of system capacity as calculated for BCBC requirements.

***END OF SECTION***
1.0 GENERAL

1.1 Related UBC Guidelines

1.2 Coordination Requirements

2.0 MATERIAL AND DESIGN REQUIREMENTS

2.1 General

2.2 Lighting design shall incorporate the principles of sustainability (environmental & financial) and its products and systems shall be energy conserving, long life, have a low cost of ownership and be accessible for service and maintenance.

2.3 For interior building lighting solutions, preference shall be given to Light Emitting Diode (LED) light sources. HID lighting shall not be permitted.

2.4 Daylight harvesting opportunities shall be implemented in areas where natural daylight is available.

2.5 Uniformity and low brightness contrast shall be achieved by judicious use of luminaires and their locations.

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

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

2.8 When mounting luminaires in high ceiling spaces, consideration must be given to ensure access for maintenance such as fixture, driver, lamp and ballast replacement. The use of scaffolding is discouraged. Indoor lighting shall be accessible either from ladders on flat surfaces such as floors or stair landings or from powered lifts with a maximum lift of 6.1 m. Building access, floor construction, and elevators shall permit entry and use of existing UBC lift equipment for proper and safe maintenance (Genie GR20 with weight of 1,112 kg (2451 pounds) and able to pass through a standard 3’x7’ door opening.) If special
equipment is required for lighting maintenance, then the consultant shall, prior to tender, prepare and submit a Lighting System Maintainability Plan to UBC for review and approval and it shall contain documentation describing the special equipment and a maintenance schedule and spare parts list. Existing Building Operations and Work Safe BC Fall Protection procedures shall be minimized by the design.

.9 The lighting design proposed for all public areas such as corridors and stairways shall ensure the life safety of building occupants at all times and shall also minimize lighting energy required to maintain BCBC minimum levels (i.e. lights off until occupancy has been detected or an emergency has occurred). A portion of the lighting fixtures shall be wired to a Life Safety power panel if an emergency generator or Central Inverter is available. Lighting circuits fed from emergency power panels shall be arranged so that they may be switched or dimmed during normal operation.

.10 Suspended luminaires shall be direct/indirect. Full indirect suspended luminaires are not acceptable.

.11 Non-linear specialty fixtures such as pot lights, cylinders, wall sconces, wall washers and other decorative lighting shall be minimized and shall not exceed 10% of the total quantity of fixtures in the building project.

.12 Metal Halide (MH) lighting solutions are not acceptable. LED solutions, especially for high bay applications, shall be pursued.

.13 Banks of multiple switches shall be labeled to avoid confusion.

.14 All light fixtures provided shall be stock items (no custom made fixtures) readily available from local suppliers. A written commitment from the manufacturer that replacement parts and fixtures will be available for a period of 5 years after project completion is required.

.15 Light fixtures shall not contain batteries.

.16 All light fixtures shall be attached to building structure using mechanical fasteners. Tape and or adhesive methods shall not be used.

2.2 Lamps

.1 Lamps shall be the longest life available. Preference will be given to LED linear T8 lamps, linear fluorescent T8 lamps shall not be used.

.2 T8 LED lamps shall be rated for at least 50,000 hours operation with 3 hours per start. Acceptable manufacturers are: General Electric, Osram, Sylvania, or Philips.

.3 T8 - 15 watt (maximum) LED lamps with 3500’ K color temperature operating from 120 volt instant start ballasts with standard ballast factors shall be the standard.

.4 T8 LED lamps shall not be line-voltage connected.

.5 LED lamps shall be used as substitutes for traditional applications involving CFL, MR-16, PAR 20, PAR 30, PAR 38 lamps. LED lamps shall be Energy Star rated. Acceptable manufacturers are: General Electric, Osram, Sylvania, or Philips.
2.3 Ballasts

.1 All LED and fluorescent lighting ballasts shall operate from 120 volt input voltage and shall be instant start electronic type with standard ballast factor. If fluorescent lighting must be used, the ballasts specified shall be compatible with GE and Philips T8 LED lamps. Ballasts shall have parallel lamp operation. Acceptable manufacturers are: General Electric, Osram, Sylvania, Philips/Advance or Universal.

.2 Ballast output frequency shall be greater than 42 kHz.

.3 Dimming ballasts shall be instant start with 0-10 volt control.

.4 Ballasts shall have lamp end-of-life detection and shutdown circuitry that meets ANSI standards.

2.4 Lighting Controls

.1 All interior lighting shall have controls such that when the lighting is not needed, it will automatically be either turned off or dimmed to a low output condition.

.2 Where low voltage relay controls are provided for new building projects they shall include a BACNET compatible BMS interface device which shall be wired to the local BMS control panel. This will ensure that all scheduling functions related to lighting systems will be under the control of the BMS system. Acceptable manufacturers are General Electric, Douglas, or equivalent approved in writing by UBC Building Operations Electrical Technical Support.

.3 Exterior building mounted lighting and exterior building area lighting that may be powered from the building project electrical system shall be under the control of the BMS scheduling system. Exterior lighting shall not be dimmable.

.4 Occupancy sensors shall be dual technology type with both Passive Infrared (PIR) and acoustic/ultra-sonic sensors, and may be either line voltage or low voltage types. Low voltage occupancy sensors with 1 or 2 poles and local power packs are preferred. Slave power packs are not acceptable. The occupancy sensor time delay settings shall be adjusted to 30 minutes for offices, classrooms or theatres and 20 minutes for washrooms. Acceptable manufacturers are Watt stopper, Sensor Switch, Leviton, Crestron, or Hubbel.

.5 Offices, classrooms, and lecture theatres shall have light control switches at all entrances, exits and vestibules. These interior spaces shall also have occupancy sensors, mounted at a high level in a corner and arranged for semi-automatic operation such that manual operation of the local switches is required to energize the lighting while occupancy sensors and local switches will de-energize the lighting. Large spaces may need more than one sensor.

.6 Corridors, lobbies, atria and similar public spaces shall be controlled by the BMS system and shall also have occupancy sensors, mounted at high levels, and arranged for full automatic operation. The BMS system shall energize lighting in these areas in the early morning and will also disable the occupancy sensors in these areas during the daytime occupied condition. Late at night when the building is un-occupied, the BMS system will energize the occupancy sensors and lighting in these areas will be turned off automatically once the un-occupied sensor time-out period has expired. The occupancy sensor time delay settings shall be adjusted to 20 minutes for corridors and public spaces. Large spaces may need more than one sensor. Programming shall support custodial requirements.

.7 Occupancy sensors, timers are not permitted in interior spaces that may be or may become hazardous, such as laboratories, electrical closets, electrical and mechanical service rooms.
.8 Lighting in audio/video enabled spaces, including theatre (type 1), classroom (type 2), seminar room (type 3), and video-conferencing/AV capture enabled shall be controlled by Crestron lighting control or equivalent. Equivalents will be evaluated by UBC IT Audio Visual. Approval of equivalent equipment will be provided in writing by UBC IT Audio Visual Technical Specialist. Refer to UBC Learning Space Design Guidelines for space type definitions and further lighting requirements.

.9 All classrooms and lecture theatres shall have LV lighting control switches at all entrances and exits to the space. In addition, LV switching controls shall be installed at the instructor’s end of the space. Classroom and lecture theatre lighting control shall include at minimum 4 dimmable zones. Zone 1 comprises the white board area lighting; zone 2 comprises the front of room area lighting; zone 3 comprises the front seating area lighting; and zone 4 comprises the back seating area lighting. The extent of zoning will vary depending upon the size of the teaching space.

.10 For all other audio/video enabled spaces, the lighting zones shall be designed to meet the application of the space and shall take into account audio/video technology being used. The design shall be approved by UBC IT Audio Visual in writing.

.11 Where applicable, all classrooms, lecture theatres, offices, corridors, stairways and other public spaces shall incorporate daylight harvesting via use of interior mounted photocells and arranged to take advantage of free illumination while maintaining acceptable minimum illumination levels within the space.

.12 LED dimmers shall be compatible with the LED lamps used and their drivers.

2.5 Exit Signage

.1 Exit lighting shall be provided in accordance with the BC Building Code and the Canadian Electrical Code as amended by BC Electrical Safety regulations.

.2 All exit signs shall be illuminated by LED light sources.

.3 Exit signs shall be powered at 120 volts from Life Safety power panels or central inverter power panels if available. If not available, Exit Signs shall be AC/DC compatible and be fed from Unit Equipment DC supply.

.4 Approved manufacturers are Ready-Lite Ultima series, or approved equal.

.5 Exit signs shall not incorporate batteries or any other type of stored energy source.

2.6 Emergency Lighting

Emergency lighting shall be installed in accordance with the B.C. Building Code and the latest edition of the Canadian Electrical Code.

.1 Emergency lighting Unit Equipment shall only be installed in buildings less than 2,500 GSM. In no case shall the total pieces of Unit Equipment installed in a single building exceed 12.

.2 Emergency lighting installed as part of renovations or tenant improvements shall be designed to incorporate the existing emergency lighting system in the building.

.3 Individual light fixtures shall not contain batteries.
.4 All Unit Equipment lighting, remote heads and exit lights shall be manufactured by ‘Ready-Lite’ or approved equivalent.

.5 The Unit Equipment shall be 360 Watt, 12V DC or approved equivalent. The Unit Equipment shall not be self-testing.

.6 Unit Equipment shall be mounted on a manufacture-supplied shelf specifically design for the purpose.

.7 Generator and Electrical rooms containing Transfer Switches shall be provided with Unit Equipment.

.8 Unit Equipment and remote heads shall be 12V, minimum 5W LED.

.9 Unit Equipment shall be cord-connected to a 120V receptacle mounted adjacent to the unit. Receptacle shall be connected to a local, un-switched 120V lighting circuit. In buildings with existing 347V lighting, 120V receptacle shall be connected to a dedicated circuit from a local panel.

***END OF SECTION***
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 Energy & Water Services

.2 UBC Building Operations Electrical Technical Support

1.3 Description

.1 UBC requirements for Exterior Lighting, Street Lighting and Landscape 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 IESNA 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 design shall incorporate the principles of sustainability and its products and systems shall be energy conserving, long life, have a low cost of ownership and shall be easily and safely accessible for service and maintenance. If special equipment is required for lighting maintenance, then the consultant shall, prior to tender, prepare and submit a Lighting System Maintainability Plan to UBC for review and approval and it shall contain documentation describing the special equipment and a maintenance schedule and spare parts list. Street lighting shall not be dimmable. **Light fixtures (where required) shall be mounted on concrete surfaces. Cast in place fixtures shall not be used.**

.3 Exterior lighting is supplied with electrical energy from nearby buildings. For each project where existing exterior lighting will be impacted by planned new construction, the new project scope shall include all needed adjustments, removals or relocations to the existing systems to ensure continued operation of existing exterior lighting systems beyond the project boundaries, as well as new exterior lighting for the new project. The scope for remediation of existing lighting systems shall be as per the original design intent. All impacted existing systems shall require coordination with UBC Building Operations Electrical Technical Support. Building Operations Policies and Procedures shall be followed when investigating and/or modifying existing systems.

.4 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.

.5 Building highlighting/floodlighting is discouraged.

.6 Landscape (garden-shrub-lawn) type lighting is not acceptable.
.7 Exterior lighting shall be arranged for full automatic operation and shall be controlled by the BMS system.

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

.9 In all cases, lamps of low energy input-high lumen output with appropriate color rendition shall be used.

.10 For lane and roadways, refer to UBC Campus & Community Planning design guidelines: https://planning.ubc.ca/sites/default/files/2019-12/PLANS_UBC_VCampusPlanPart32014.pdf.

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

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

.13 All conduit systems for street lighting shall be sized for designed conduit fill then increased by 1 trade size. Minimum conduit size shall be 37mm. All conduit and fittings shall be RPVC.

.14 All conductors for street lighting shall be minimum #8AWG RW90XLPE 1000V rated. Control and power conduits shall not share the same conduit system.

.15 Boxes used for street or landscape lighting shall be sized as per the CEC. All boxes shall be of concrete construction, come with galvanized steel covers labeled “ELEC” and incorporate a bonding lug.

.16 No electrical equipment such as transformers, ballasts, starters, drivers, etc. shall be installed in in-ground boxes or any below grade installations.

.17 Exterior lighting shall not be dimmable. DMX, DALI and other lighting control systems shall not be used without an approved variance from Building Operations, Electrical Technical Support.

***END OF SECTION***