1.0 GENERAL

1.1 Coordination Requirements

.1 UBC *Facilities Electrical*
.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 *Facilities Electrical*.

.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*****