

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

SECTION-TESTING & COMMISSIONING

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SECTION - TESTING & COMMISSIONING

TESTING AND COMMISSIONING PROCEDURES

1.0 GENERAL

- 1.1 The contractor shall submit a field quality plan consisting of following:
- a) Receipt, storage, pre-erection inspection of all materials in the scope of contractor
 - b) Structural work erection
 - c) Civil works
 - d) Welding procedure for aluminium pipe bus and earth mat system.
 - e) Cabling
 - f) Pre-commissioning tests.
 - g) Commissioning.
- 1.2 An indicative list of pre-commissioning and commissioning is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P. /instructions of the equipment supplier or owner without any extra cost to the owner. The contractor shall arrange all instruments required for - conducting these tests along with calibration certificates and shall furnish the list of instruments to the owner for approval.

2.0 GENERAL CHECKS

- 2.1 Check for physical damage.
- 2.2 Visual examination of zinc coatings/ plating
- 2.3 Check from nameplate that ail items are as per order/ specification
- 2.4 Check tightness of all bolts, clamps and connecting terminals using torque wrenches.

- 2.5 For oil filled equipment check for oil leakage, if any.
Also check oil level and top up wherever necessary.
- 2.6 Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces.
- 2.7 Check cleanliness of insulator and bushings.
- 2.8 All checks and tests specified by the manufacturer in the drawings and manuals as well as all tests specified
- 2.9 Check for surface finish of grading rings (corona. control rings).
- 2.10 Pressure tests on all pneumatic lines at 1.5 times the rated pressure shall be conducted.
- 2.11 Proper lubrication of all moving parts.
- 2.12 Check space heaters.

3.0 POWER TRANSFORMER (REACTOR)

3.1.0 PRE-COMMISSIONING TESTS:

- 3.1.1 Driving out by using streamline oil filter, vacuum pump, centrifuge and heater set.
- 3.1.2 Dielectric strength of oil both in main and OLTC chamber.
- 3.1.3 Insulation resistance of windings.
- 3.1.4 Checking of phase sequence test.
- 3.1.5 Continuity test.
- 3.1.6 No load voltage ratio, at all tap positions.
- 3.1.7 Checking of vector group, polarity and miter phase connections.
- 3.1.8 Tap changer operation check (Mechanical & Electrical local, remote, group and solo) including indication and alarm circuits.

3.1.9 Magnetizing current check at 415V, 3-Phase, 50 cycles supply for all the three phases.

3.1.10 Measurement of winding resistance.

3.1.11 Breather (check, for silica gel)

3.1.12 Buchholtz's relay operation.

3.1.13 Low oil level for main tank/OLTC chamber.

3.1.14 Physical line connections as per phasing diagram.

3.1.15 Natural connection to earth effectivity.

3.1-15.1 Calibration of different temperature indicators, relays, switches.

3.1.16 Cooler control operational check both from local and remote.

3.1.17 Check all fans and oil pumps.

3.1.18 COMMISSIONING:

After obtaining approval from the purchaser and supplier the contractor shall proceed to commission the transformer.

3.2.0 GENERAL CHECKS TO BE DONE BEFORE/AFTER COMMISSIONING

3.2.1 All off valves are in correct positions, closed or opened as required.

3.2.2 All air pockets are filled with oil.

3.2.3 Thermometer pockets are filled with oil.

3.2.4 Oil is at correct levels in the bushings, conservator, diverter switch tank; etc.

3.2.5 Earthing connects are done.

3.2.6 The condition of silica gel in the breathers.

3.2.7 Arcing horn gaps on bushings are properly adjusted.

3.2.8 Heaters in cubicles, conservator etc., where provided should be checked.

3.2.9 Any other alarm / trip contacts of flow meters differential pressure gauges etc.

3.3.0 If all the above tests/checks are found satisfactory, a time of at least 24 hours for setting of oil shall be allowed and air released from all points. The transformer shall be energized after setting the protective relays to the minimum extent possible. Wherever possible the voltage shall be built up in steps. Any abnormality during commissioning such as vibration of radiator parts, hum etc., should be observed. After a few hours of energisation at no load, the transformer shall be switched off. The Buchholz relay should be checked for collection of air/ gas. Abnormalities noticed shall be corrected. All protective relays should be reset to normal values. Transformer shall be re-energised and loaded gradually.

After commissioning the contractor shall furnish the test results and all relevant details, drawings of erection testing and commissioning of the Transformer all properly bound with plastic jackets.

4.0 CIRCUIT BREAKER - PRE COMMISSIONING CHECKS

In the GTR, more details are given regarding Dynamic contact resistance checking etc which is not reflected here in this Specific Breaker document. This should be corrected for all the specific equipment files.

- 4.1 Insulation resistance of each pole.
- 4.2 Check adjustments, if any, suggested by manufacturer.
- 4.3 Breaker closing and tripping time, pole discrepancy etc.
- 4.4 Slow and power closing operation and opening.
- 4.5 Minimum pick up voltages of trip and close coils.
- 4.6 Contact resistance.

- 4.7 Functional checking of compressed air plant and all accessories including adequacy of the air receiving for design set of operations.
- 4.8 Functional checking of control circuits, interlocks, tripping through protective relays and reclose operation. Confirming required spare contacts etc are wired to the TBs.
- 4.9 Insulation resistances of control circuits, motor, etc.
- 4.10 Resistance of closing and tripping coils.
- 4.11 Check on simultaneous closing of all three poles, three-phase/single phase auto reclosures.
- 4.12 Blocking of operation at low pressure.
- 4.13 Checking of electrical & mechanical interlocks.

5.0 DISCONNECTORS - PRE COMMISSIONING CHECKS

- 5.1 Insulation resistance of each pole.
- 5.2 Manual and electrical operation and interlocks.
- 5.3 Insulation resistance of control circuits and motors.
- 5.4 Ground connections of structures & operating handle.
- 5.5 Contact resistance 'of each pole per gap between male and female contacts.
- 5.6 Proper alignment so as to minimise to the extend possible the vibration during operation.
- 5.7 Measurement of operating Torque for Isolator and Earth switch.
- 5.8 Resistance of operating and interlocking coils.
- 5.9 Manual and Electrical -interlocks.
- 5.10 Clearances in op.-In & closed operations.

6.0 CURRENT TRANSFORMER - PRE COMMISSIONING CHECKS

Tan delta & capacitance also reqd. GTR says to check oil sample also?

- 6.1 Insulating Resistance test.
- 6.2 Polarity test.
- 6.3 Ratio identification test - checking of all ratios on all cores by primary injection of current.
- 6.4 Dielectric test of oil (wherever applicable).
- 6.5 Magnetising characteristics test.
- 6.6 Checking of earth connection at only one point.
- 6.7 Shorting of spare C.T. cores.
- 6.8 Dielectric tests (wherever applicable).
- 6.9 Checking gas pressure wherever required.

7.0 VOLTAGE TRANSFORMERS - PRE COMMISSIONING CHECKS

- 7.1 Insulation Resistance Test
- 7.2 Polarity test oil all windings
- 7.3 Ratio test of all windings
- 7.4 Dielectric test of oil (wherever applicable)
- 7.5 Open delta test with low voltage (wherever applicable)
- 7.6 Capacitance and tan delta measurement.
- 7.7 Checking gas pressure measurement where required.

8.0 LIGHTNING ARRESTOR

- 8.1 Grading leak-age current
- 8.2 Resistance of ground connection.

9.0 STATION EARTHING

- 9-1 Check oil resistivity
- 9.2 Check continuity of grid wires
- 9.13 Check earth resistance of the entire grid as well as various sections of the same.
- 9.4 Check for weld joint and application of zinc rich paint on galvanised surfaces.
- 9.5 Dip test on earth conductor prior to use.

10.0 DRAKE ACSR STRINGING WORK TUBULAR BUS WORK AND POWER CONNECTORS

- 10.1 Physical check for finish
- 10.2 Electrical clearance check
- 10.3 Testing of torque wrenches on all bus bar power connectors and other accessories.
- 10.4 Millivolt drop test on all power connectors.
- 10.0 Sag and tension check on conductors.

11.0 ALUMINIUM TUBE WELDING

- 11.1 Physical check
- 11.2 Millivolt drop test on all joints.
- 11.3 Die penetration test/Radiography test on 10% sample basis on weld joints.
- 11.4 Test check on 5% sample Joints after cutting the weld piece to observe any voids, etc.

12.0 INSULATORS

12.1 Visual examination for finish damage, creepage distance etc.

13.0 CABLES

13.1.0 PRELIMINARY CHECKS:

13.1.1 Check details as per specification-

13.1.2 Check for physical damage.

13.2.0 COMMISSIONING CHECKS:

13.2.1 Megger test between each core & armour/sheath.

13.2.2 Continuity check.

13.2.3 Connections.

13.2.4 And all other checks as specified by equipment manufacturers/
Engineer.

14.0 MOTOR

14.1.0 PRELIMINARY CHECKS:

14.1.1 Check name plate details according to specification.

14.1.2 Check tightness of all bolts, clamps and connecting terminals.

14.1.3 Check ground connections.

14.1.4 Bearing lubrication.

14.1.5 Check clearance inside terminal box.

14.2.0 COMMISSIONING CHECKS:

14.2.1 Megger testing of motor windings and cables.

14.2.2 Motor windings, control and power cables continuity check.

14.2.3 Resistance of motor windings in case of large motors.

- 14.2.4 Control and interlocks.
- 14.2.5 Overload and short circuit relay tests and settings.
- 14.2.6 Phase sequence and rotation.
- 14.2.7 Operating of timer in case of star-delta starting.
- 14.2.8 Starting and no load current.
- 14.2.9 No. of load operation (observe vibrations, temperatures of bearings and body of the motor)
- 14.2.10 On load operation, starting and running currents (observe vibrations, temperatures of bearings and body).
- 14.2.11 In case of close loop arrangement for cooling the windings of the motor, inlet and outlet temperature of the cooling air.
- 14.2.12 And all other checks as specified by equipment manufacturers/ Engineer.

15.0 COMMISSIONING CHECK LIST FOR CONTROLS

RELAY PANELS:

15.1.0 PRELIMINARY CHECKS:

- 15.1.1 Check name plate details of every associated equipment according to satisfactorily
- 15.1.2 Check for physical. dam age of various meter and relays.
- 15.1-3 Check tightness of all bolts and nuts and wiring terminals.
- 15.1.4 Check earthing

15.2.0 COMMISSIONING CHECKS:

- 15.2.1 Switch developments.
- 15.2.2 Each vaire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawings. All inter

connections between panels/ equipment shall be simiiably checked.

15.2.3 All the wining shall be meggered.

15.2.4 Checks on relays.

15.2.5 Checks on meters.

15.2.6 Settings of relays, other alarm, tripping de ice, and inter locks as per schemes.

15.2.7 Phase angle checks - Measurement of magnitude and phase angle of current transformer secondary currents and potential transformer secondary voltages.

15.2.8 Punctional checking of all control circuitry - viz., closing, tripping, control, inter lock, supervision and alarm circuits including proper functioning of the component equipment.

16.0 COMMISSIONING CHECK LIST FOR RELAYS

16. Check name plate details according, To specifications.

16.2 Check for any physical damage.

16.3 Check intenal wiring

16.4 MEGGER:

- a) All terminals to body.
- b) A.C. to D.C. terminals.

16.5 Check operating charactenistics by secondary injection.

16.6 Check minimum pick up voltage of D.C. coils.

16.7 Check operation of electrical mechanical targets.

16.8 Relay settings.

16.9 Check C.T. and V.T. connections, with particular reference to their polarities for directional distance type relays.

17.0 COMMISSIONING CHECK LIST FOR METERS

- 17.1 Check
- 17.2 Check for physical damage.
- 17.3 Check calibration by comparing with sub standard.
- 17.4 Megger all insulated portions.
- 17.5 Check C.T. and V.T. connections with particular reference to their polarities for Power type meters.

18.0 18.0 OTHER EQUIPMENTS : BATTERY & BATTERY CHARGER, 415V, L.T. A.C. PANELS, DIESEL GENERATOR, DISTRIBUTION TRANSFORMERS:

The Contractor should submit the Check-lists (QP) for all equipment being supplied by him. KPTCL to give available data with them and TCE to supplement the same.

- 18.1 The pre-commissioning/commissioning checks and dried out in accordance with the tests shall be as per manufacturer's instruction manual and instructions of the owner. The charge /discharge cycle of battery shall be strictly followed.

19.0 COMMISSIONING CHECK LIST FOR ELECTRICAL INSTALLATION GENERAL

- 19.1.0 Phasing out.
 - 19.1.1 By means of phasing rods, if available or by measuring voltages on transformer secondary.
- 19.2.0 FUNCTIONAL CHECKING:
 - 19.2.1 Checking all closing, tripping, supervision and interlock of control devices.
 - 19.2.2 Check operation of all alarm circuits.
- 19.3.0 CABLE TESTING:

19.3.1 All 11kV, 415 and 230V power cables are to be meggered with suitable meggers to check the insulation resistance.

19.4.0 EARTHING:

19.4.1 Measure resistance of each earth well/rod by isolating the same from station grid as well as from other ear wells/rods and then measure resistance of two cables at a time by D.C. drop method.

19.4.2 Check continuity, of grid conductor and wires.

19.4.3 Soil resistivity tests.

19.5.0 In addition to the above, any other tests specified by manufacturers shall be carried out as per the manufacturer's instructions.

19.6.0 Test fire detection system if provided.

Check operation of protective relays by putting short circuit bar at different location, conduct system stability test by primary injection test method.