**ANNEXURE-I**

**Sub: Erection ,Commissioning and Testing of Test Plant Equipments and Upgradation of UHV Test Plant In Bl-III**

**SCOPE OF WORK:**

**1)450 MVA TRANSFORMER**

**1.1)** Erection of 245 kv solid core post insulators.

Marking out of positions, considering the distance of various items of electrical equipments from the floor. Walls and ceilings and also from one another and symmetrical arrangements

Placing of fastenings and supporting structures and metal-works.

Setting up of Support insulators..

The insulators shall be used for mounting and supporting of 4” IPS Aluminium tubular busbars.

1.2) Laying of new Cooling Water Pipeline for 15 MVA Generator and 450 MVA Transformer

Erection, laying, fixing and commissioning of new Inlet water pipeline 150 NB, Galvanized ERW Steel Pipes, for Water as per IS-3589/1991, with Flanges on both ends. Installation shall be complete with bolts, nuts, CAF Gaskets. Total Quantity=150metres.

Erection, laying, fixing and commissioning of new Outlett water pipeline 150 NB, Galvanized ERW Steel Pipes, for Water as per IS-3589/1991, with Flanges on both ends. Installation shall be complete with bolts, nuts, CAF Gaskets. Total Quantity=150metres.

Gaskets must fit without warping, twisting, or bending

Installation of following fittings of water pipelines:

Flanges Size 150 NB Qty=70 Nos

Bend 90 degrees 150 NB Qty =20 nos.

Sluice Valve 150 NB Qty=4 nos.

Painting and testing of new water pipeline size 150 NB .Total length =300 meters.

Fabrication of suitable reducers to fit the inlet and outlet port of 450 MVA Transformer.

The fixing of these water pipelines by support structures shall be in scope of contractor. Suitable openings in the walls have to be made by the contractor for routing of the pipelines.

**1.3)**Supply and Installation of MS Flanges, size 150 NB confirming to ASA 150 with raised face, Qty=100 nos.

**1.4)**Supply and Installation of MS Flanges, size 200 NB confirming to ASA 200 with raised face, Qty=100 Nos.

**1.5)** Construction of New Earth Pits for power Earthing with material in Bay-8,BL-III.

The earthing system shall be designed to achieve the uniform earth resistance of less than 1 ohm at the site. The grounding system consists of the following sub-systems:

Making of Treated Earth Pits (1.5 m x 1.5 m x 3.0 m) as per the procedure.

This involves excavation of Pit, installation of electrode, providing salt, charcoal, back filling, making concrete bed, concrete pit with top cover, cable entry provisions etc and shall also conform to all the latest, relevant Standards /BIS Code. A hole of the required diameter and depth is augured in the earth for the earthing pipe. The earthing pipe is then put inside the hole. A mixture of coke and salt is filled in the hole in which the earthing pipe is provided.

For pipe electrode earthing pit,300 mm Ø 6000 mm deep (Approx. 20 ft.) bore in the earthand use 65 mm Ø 6000 mm long (Approx 20 ft.) G.I. pipe electrode. Forged at the top up to 75 mm length and 12 mm hole provided for taking earthing connection.

Cover Top of GI pipe with a T joint to avoid jamming of pipe with dust & mud and alsouse water time to time through this pipe to bottom of earth plate75 mm thick RCC Cover shall be used. Arrangement for earthing lead terminations from equipment body, and connection for main earthing Grid.

Note: Scope includes supply of all the material required for making of earth pit complete.

The boring machine shall be arranged by the contractor.

The remnants around the earth pit are to be cleaned properly. The earthing filling material shall be in scope of supplier.

Fabrication of 40 x 3 MS Flats clamps (100 nos). Brazing of Clamps on grounding rods. The clamps shall be in supplier’s scope.

Laying of earthing cable Interconnection of all earth pits through earthing cable. Termination of cable.

All earth pits shall be provided with CC collars and top covers /brick masonry Watering pipe is required for each earth pit.

Maintain less than one Ohm Resistance from EARTH PIT conductor to a distance of 15 Meters around the EARTH PIT with another conductor dip on the Earth at least 500 mm deep.

Check Voltage between Earth pit conductor to Neutral of Mains Supply 220V AC 50 Hz it should be less than 1.0 Volts.

NOTE: The earth resistance should be 1 Ω or less at any cost otherwise payment will not be made till rectification.

**1.6)** Supply of GI Flat, 75 mm x10 mm.Qty=2000 mtr

**1.7)** Supply of GI Flat, 50 mm x10 mm .Qty=1000 mtr

**1.8)**Supply & Termination of control cable with numbering ferules & cu lugs of required size proper dressing & binding with tape etc. 4C X 2.5sq.mm.Qty=2000 Nos.

**1.9)**Supply & Termination of control cable with numbering ferules & cu lugs of required size proper dressing & binding with tape etc. 7C x 2.5 sq.mm. Qty=2000 Nos.

**1.10)**Supply,Erection and commissioning of Relay Panels for 11/90 kv,13.33 MVA,Single phase (03 Nos) Transformer.

The numerical Transformer Differential Protection Relay is required for Protection of 11/90 kv, 13.33 MVA,Single phase (03 Nos) Transformer.

1) Current Differential Protection (ANSI NO.87G)

1.1) Integrated Vector group and ratio adaptation via numerical formulae.

1.2) Restraint during Inrush,CT saturation over excitation

1.3) Integrated CT Ratio/mismatch correction inside the Cit. ICT required.

CT Ratio difference permissible.

1.4) Through stabilization through saturation detector.

1.5) Zero Sequence current filtering for each winding.

1.6) Insensitivity to DC currents and CT errors due to freely programmable tripping characteristics and fundamental filtering.

1.7) Harmonic Restraint with second Harmonic component, optionally with or without cross block, may be deactivated.

1.8) Over fluxing restraint with fifth harmonic, may be deactivated.

1.9) Triple slope Tripping characteristics

1.10) Fast clearance of Heavy internal Transformers faults with high set differential element IDIFF>>

2) Overload Protection (49), IEC 60255-8, IEC 60354

3) 3) Definite Time over current protection. Phase selective at site, Inverse Time over current protection, phase selective at site 50/51,50N/51N

4) Lockout, 86

5) Over fluxing

6) 4 setting groups triggered by external inputs.

**2) CAPACITOR BANK**

2) Shifting, Assembly,Erection & commissioning of outdoor type 2 Nos. 156 KV,3 phase, 2000 amp 190 MVAR capacitor banks, complete as per drawing, specification and all as per instructions of Engineer-in-charge.

Shifting of capacitor units (900 units) to UHV Lab

Shifting of racks),busbars,support structures to UHV Lab

Installation of support structures and racks.

Complete assembly of capacitor banks. The bank shall comprise of 3 phases.

Mounting of capacitor units on the racks. Weight of capacitor unit100 kgs.As no overhead crane is available, alternate means for lifting the capacitor units have to be adopted.

Installation of Tinned Copper busbars (100 nos, 100mm wide ,10 mm thk) flexible copper links and braids(300 nos)

Installation of 33 kv solid core post insulators between racks.

Installation of 44 kV solid core post insulators on cement concrete plinth.

Installation of 22 kV solid core post insulators on racks..

No of series section =12 No of parallel units per series section=9

Earthing of capacitor bank.

**2.2)** Supply, Shifting, Erection and Commissioning of Outdoor Polymer Surge Arrestors

IEC Line Discharge Class: \_Class 3

Maximum Continuous Operating Voltage (kVrms)= 170

Rated Voltage (Ur) (kVrms) =150

Temporary Overvoltage TOV:

1 sec=U1s=138 kV

10 ec=U10s=131kV

Nominal Discharge Current (kAcrest) = 10

Qty=6 Nos

**2.3)**Shifting,Erection and Commssioning of 03 nos of 156 kV Voltage Transformer

Placement and Mounting of 156 Kv High voltage Transformer with proper alignment..

Fabrication of proper support structure

Earthing of 156 Kv High voltage Transformer.

**2.4)**Busbar Connections:-

4 ″ IPS(EH) Aluminium Tubular busbar,dia=114.2 mm,thickness=8.51 mm, ID = 97.18 mm, Weight 7.678 Kgs/Mtr.,suitable for current rating of 2500 amps. Aluminium tubular bus bar pipe shall be Alloy 63401 Temper Designation WP (range 2) as per IS 5082: 1998.Material of Aluminium Tubular bus pipe shall be cold drawn aluminium tube with minimum 55% IACS conductivity at 20 deg C temperature. (International Annealed Copper standards).Tje total length of busbars to be installed shall be 400 metres.

The overhead busbars have to be mounted underhung from ceiling using solid core post insulators as supports.The busbars have to supported at both the ends. The busbars shall be aligned in line co-axially with each other. The Maximum span between two busbars supports shall be 5 metres. A drain hole of 10mm diameter should be drilled at bottom centre point of tubes to facilitate drainage of condensate moisture

The shape and profile of busbars shall have to be modified as per site requirements. Bending of busbars,shall have to be done as per requirement. Bending of busbars shall be entirely in the scope of party.

Welding of Aluminum 100 mm tubular Bus bar. Tubular busbars shall be welded together with aluminium welding sleeves, to provide the required total length.The welding shall be carried out by highly skilled welder and there shall not be any carona

Installation of Expansion Joints to ensure that the busbars are free to expand and contract and to prevent busbar distortion. The support insulators shall not be stressed so that they do not crack and busbars distortion.

Supply and Fabrication of 60 nos of suitable clamps for supporting and holding 4” IPS Aluminium tubular busbars from the solid core post insulators.

Fabrication of Plastic external end caps to suit aluminium busbar

The installed aluminium tubular bus bar shall not have any sharp edges, cuts,abrasions, etc and shall be free from visible corona

The centre-line distance between busbars shall be as specified.

The connection of busbars shall be as drawing .

**Bi-Metallic Terminal Coonectors:**

1)The connectors shall be bimetallic connectors made from Aluminum Alloy castings conforming to designation A6 of IS 617 with 2 mm thick bimetallic liner.

2)Application; For connecting equipment terminals made of copper with AL tube .The Al tube shall be 4”IPS(EH)AL Tube,O.D.=114.2 mm,TK=8.51 mm.

3) Rated System Voltage=220 Kv, Rated Current=2500 Amps

4) Rated Short Time Current=40 KA for 01 seconds

5) Continuous Rating: Nominal. Material of hardware=Bolts, nuts and plain washers shall be of MS Hot dip Galvanized As per IS 2629 and tested as per IS 2633.Spring washer shall be electro galvanized to suit service condition-3 of IS 1573.

Wherever required as per conditions supports have to be installed for supporting busbar connections so that there is not undue detrimental load/tension on terminals of any equipment.

**2.5)**Erection of suitable support structures for above tubular busbars

**2.6)**Supply and installation of Bimetallic terminal connectors for Circuit Breaker.Qty=18 Nos.

**2.7)** Supply and installation of aluminium welding sleeves. Qty=30 Nos

**2.8)**Supply & Fabrication of suitable clamps for supporting and holding 4” IPS Aluminium tubular busbars from the solid core post insulators.Qty=100 Nos

**2.9)** Supply and installation of TEE Connectors for tube Through,Tube Tee Off Qty=20 Nos.

**2.10)**Supply,Erection and commissioning of control and relay panel for capacitor bank comprising of overcurrent relays,over voltage relays,undervoltage and unbalance current relays suitable for capacitor bank complete with metering ,push buttons ,indications , alarms, etc.Qty=2 Nos.

**2.11).**Dismantling of existing capacitor bank.

Removal of 700 units of 60 and 100 MVAR Capacitor bank

**2.12)** Dismantling of control panel for capacitor banks

Removal of cables. Qty=02 Nos.

**3) WALL BUSHINGS**

3.1)Shifting,Erection and commissioning of 03 nos of 100 kv, 4000amps Horizontally mounted wall bushings combined with current transformer.Qty=8 Nos

Fabrication of 08 nos of the mounting and supporting fixtures/plates which shall enables conductor to pass through the shielded partition and wall and insulate the conductors from this partition. The attachment device to the partition shall be a mounting plate or flange forming part of the bushing. The wall bushing is to be mounted by a welded aluminium intermediate flange (wall flange) fitted with two insulators, one for each side of the wall.

Earthing of bushing flange in order to prevent electrical discharges between the bushing flange and the wall to which the bushing is installed.Earthing is to be done by applying a flexible cable between one of the fastening screws and the mounting plate in the wall.

Cleaning of insulator surface

Pre commissioning checks such as Measurement of capacitance and tan delta.

Horizontal mounting of wall bushings, Filling up of oil in the bushings and removal of air bubbles..

Installation of corona shields.

3.2) Supply and Installation of terminal connectors for wall bushings Qty=16 Nos

**4) VCB PANELS**

**Shifting, Erection and Commissioning of 11 KV Vacuum circuit breaker Panels.**

Shifting,Erection, Testing and Commissioning of 01 no of 5 panel switchboard comprising of 11kV Draw out type VCB Panel complete with CTs, PTs, Numerical type protection relays and 01 nos of 2 panel switchboard of 11 KV vcb.

Loading, Shifting and in-Plant transportation of VCB panels to site.

Unloading of VCB Panels. The Panels shall be installed in position and leveled on the

Cable trench/foundation providing suitable supporting MS Channels, angles frames and

Foundation bolts..

Grouting of foundation bolts. Grouting fasteners shall be in scope of supplier.

Dismantling and removing of existing 01 no of VCB Panel. Placement of new VCB Panels in

its position. Modification of existing busbars to suit the new arrangement

Earthing of Panels. Install and connect all ground points and verify that it is a solid low

Resistance ground

Testing the new panels and all controls before energization.

**5) CURRENT TRANSFORMER**

Shifting erection & commissioning of outdoor type 220 kv 2000 amp 6 nos. current transformer Qty=6 Nos

Supply and installation of Bimetallic terminal connectors for CTs and VTs.Qty=15 Nos.

Fabrication installation of mounting structure (stands ) for CT,PT , SF6 220 KV breaker, LA ,wall bushing, 220 kv Insulator ,LMS.Qty=01 Job.

**6)11 KV POWER CABLES**

6.1)Laying, dressing and clamping of power cables (11 KV, UE, 1C x 500 sq mm.Qty=5000 meters:

Transportation of 11KV (UE) XLPE cable drum from store to site of work will be carried out carefully and its unloading will be undertaken by the contractor with the help of crane. During transportation / unloading 11KV XLPE cable drums if any damage done to the cable the same shall have to be fully made good by the contractor by his own risk and cost.

The power cables shall be laid on the cable racks.

Cable with kinks, straightened kinks or any other apparent defects like defective armouring etc. shall not be installed.

Cables shall not be bent sharp to a small radius either while handling or during Installation. The minimum safe bending radius for XLPE (HV) cables shall be 20 D (D is over all diameter of the cable).

The ends of XLPE cables shall be sealed after cutting the cable with suitable sealing Compound / tape, if is likely to get exposed to rain in transit /storage. Suitable heat Shrinkable caps may also be used for the purpose.

Route of cables of different voltages:- Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted such that this requirement cannot be met, LV/MV cables shall be laid above HV cables.

Proximity to communication cables: Power and communication cables shall as far as possible cross each other at right angles. The horizontal and vertical clearance between them shall not be less than 60 cm and it shall be as per the Standards.

Wall / floor crossings;-Adequately sized sleeves shall be provided for all wall and floor crossings.

Cable Tags: After pulling, cables shall be provided with identification tags consisting of 1.5mm thick aluminium strips of size 30x60mm on which cable numbers shall be die-punched. The tags shall be tied to the cables with non-corrosive wire. In case of single core cables, the said wire should be non-ferrous. Cable tags shall be tied to cables within the distances of 1 to 2 meters on either side of crossing of any wall, floor, at the field end termination and at every 30M interval in straight run.

Power cables having more number of cables per phase shall be laid in trefoil formation or shall be laid as per standard practice adopted for laying. Cables laid in horizontal cable trays as well as on vertical ladders shall be fixed at adequate number of places to hold the cable firmly.

Prior to installation, cables shall be tested for

a) Continuity of conductors

b) Insulation resistance between conductor and earth

c) Insulation resistance between the conductors

After installation each cable shall be tested for

a) Insulation resistance between conductors

b) Insulation resistance between the conductors and earth

c) Absence of cross phasing

All empty drums after cable laying shall be transported to scrap yard by contractor.

After termination, the contractor shall close all cable entry holes.

Quantity mentioned above may vary either way by 20%.Not withstanding the quantities mentioned above the payment shall be made as per actual measurement taken.

The contractor shall provide his own chain pulley block, axle cable wheels and other connected accessories required for loading /unloading/coiling and uncoiling of cable drums and required for the cable laying work.

6.2) Laying, Dressing and Clamping of H.T. Power Cable (11 Kv, UE, 1Cx 300 sqmm) Qty=500 meters

6.3)Termination of 11kV (UE) XLPE 1C x 500 sq mm cable.Qty=400 Nos

6.4)Supply &Termination of 11kV (UE) XLPE 1C x 300 sq mm cable.Qty=25 Nos.

**7)15 MVA MG SET**

**7.1)**Unloading, Shifting and Erection of 15 MVA Alternator with 4MW AC Motor along with associated equipments and accessories such as VFD,Static excitation equipment ,interposing transformers, winding change over cubicles etc and auxiliaries like HP and LP lubricating System, cooling system etc.

Weight of 15 MVA generator is 67 MT apprx and motor is 8 MT.Mobiliztion charges for crane.Installtion of equipments on foundation. . The MG Set has to be skidded or moved on rollers/pipes into osition.Dragging of MG set to distance of 10 meters by chain and pulley.

Alignment of couplings of MG Set 5A and s motor. Adjust to bring throw to less than 0.05 mm. Measure run-out of coupling halves with respect to bearing housing. Tightening of coupling bolts of MG SET 5A with Motor. Complete the coupling of generator with motor. Removal of top halves of all bearings .Check rotor level at bearings with water level Sling check with bearing liners removed. Adjust pedestal of bearing to align with rotor.Checking of levels of MG Set with spirit levels. Adjustment of shims under bearings. Adjustment of axial and side clearances of all bearings. Parallel, Angular and axial alignment using dial gauges. in four different positions: top, bottom, right and left, i.e. every 90°, while both shafts are turned simultaneously. Boxing up of Bearing. Tightening of foundation bolts of pedestal of bearing. Dowelling of pedestal with insulation bolts. Check air gap for all six poles. Assist in Balancing of MG set. Placement of appropriate balance weights. Connection of oil and water pipelines. Installation of bearing temperature indicator. Complete assembly of MG Set. Connection of power cables and neutral bus bar of CT. IR and PI Measurement. Trial run of machine and ensuring Vibrations and temperature of all bearings and machine is within acceptable levels.Handing over of MG Set 5A for testing.

Unloading, Shifting, Erection and Commissioning of 450 MVA,70/1000 KV, 3phase Testing Transformer

Lifting of transformer with hydraulic jacks. Placement of pipes/greased rail poles underneath for rolling. Dragging of Transformer to a distance of 5 meters by winch /turfer/chain and pulley. During shifting of transformer, it must be ensured that floor is not damaged. Unloading of transformer. Placement of transformer on plinth. Grouting of transformer.Assembly,Erection and Commissioning oEarthing of Transformer. Install and connect all ground pointsand verify that it is solid low resistance ground. Neutral Earthing Installation of Neutral grounding arrangement. Shipping weight=330 ton.

Qty=1 Job

**7.2)** Supply, Shifting, Erection and Commissioning of 245KV, 3 pole Outdoor SF6 gas filled circuit breakers of 3150 Amp. normal current rating & 40 KA for 3 sec. short time current rating complete with various accessories & supporting structures .Must be suitable for Capacitor Switching. Quantity=3 Nos

Rated voltage (kV rms), 245

Frequency (Hz.) 50

Continuous current 3150 (A rms)

Type 3 pole outdoor SF6

Mounting Hot dip galvanised lattice steel support structure, bolted type to be supplied by the Bidder.

Number of Poles 3

Type of Operation: Individually Operated single poles

Auto reclosing duty Single and Three phase

Rated operating duty 0-0.3 sec. -CO- 3 min -CO cycle

"First pole to clear" factor (Type of tripping) As per IS-13118 (Trip free)

Max. closing time (ms) -- 150

Max. total break time (ms) Less than 3 cycles or 60 ms

1.2/50 microsecond impulse withstand voltage (kV peak) 1050

1 minute power frequency withstand voltage (kV rms) 460

Rated breaking current capacity:-

Line charging at rated voltage at 90 deg.leading power factor(A) rms= 125

Small inductive current (A) rms:\_ 0.5 to 10 without exceeding switching o/v 2.0 p.u

Cable charging breaking current (A)=250

Short circuit current

a) AC component (kA rms) =40

b) % DC component Corresponding to minimum opening time as per IEC-56

c) Duration of short circuit =1 sec

Rated short circuit making current capacity (kA) =100

Permissible limit of temperature rise:\_ As per clause 5.27

Max. acceptable difference in the instants of closing/opening of contacts

i. Within a pole (ms) 5

ii. Between poles (ms) 10

Min. creepage distance of support insulator (mm)=6125

Short time current carrying capability for one second (kA) 40

i) Rating of auxiliary contacts = 10 A at 220 V D.C.

ii) No. of auxiliary 10 NO and 10 NC as spare with due contacts provision to add more if required

Breaking capacity of auxiliary contacts =2 A DC with the circuit time constant not less than 20 ms

**7.3)** Fabrication &Erection and Commissioning of Isolator Panels for housing 12 kV, 2000 A, 3 phase Isolators (4 nos.) as per site requirement (with supply of material cu bus bar,HT insulator , HT sleeve )Qty=4 Nos

Fabrication of Isolator Panels for housing – 12 nos. of 12 kV, 2000 A Isolator selection Panel with power output of each of 3 different power sources (20 MVA, 30 MVA, 9/5 MVA) being taken to 3 different test points with interlocking that simultaneous selection of 2 power sources at same test point and selection of a power source at two different test points. Isolators shall be supplied by BHEL. The Panel shall be indoor, metal clad cubicle, fabricated with 2.5 mm thick CRCA sheet, degree of protection shall be IP 42,dust and vermin proof, painted with a shade of RAL 7032 (powder coated). The minimum thickness of sheet steel used shall be 2.5 mm. The panel shall be fully covered with 2.5 mm thick sheet and bolted with M10 bolts in 50 x 50 angle. The panel shall be provided with glass inspection window.

Each cubicle shall have a front hinged door with removable bolted side, top and rear covers. All covers and door shall be provided with neoprene gaskets. Hardware should be MS with Zinc plating. Front single leaf door with inspection glass window shall be made of 2.5 thick CRCA sheet steel. Side top and rear bolted covers made of 2.5 mm thick sheet steel. Sheet steel, busbars and Isolators to be provided by BHEL and all other material such as insulators, door locks ,castle keys etc shall be in scope of supplier.

Finish: Powder coating, structural finish: 60-80 microns thick.

Shade, External and Internal –Grey as per RAL 7031.

Shade of base – Black.

Protection Class IP42.

The front cover shall be provided with a door lock and panel key.

03 nos. of isolators have to mounted one above the other in three tier configuration.

Common vertical busbars of copper size 100 mm x 12 mm x 4500 mm, one for each phase shall be mounted.

11 kV solid core post insulators shall have to be mounted for support of these busbars.

11 kV solid core post insulators shall have to be mounted for electrical clearances from earth.

11 kV solid core post insulators shall have to be mounted for electrical clearances from phase to phase.

Installation of Door lock (key is trapped when door is open) shall be provided for each isolator.

Installation of Mechanical castle key operated interlocks for each isolator.

Secure the operating mechanism earthing strap to the mechanism mounting base.

Secure incoming and outgoing conductors as required.

Laying and Termination of control cables from auxiliary switches for interlocking, signaling and indication.

Testing of isolators

**7.4)** Shifting, Erection and Commissioning of 1000 KVA,11/.415 Kv Transformer.Qty=1 Nos

Shifting,Erection and commissioning of 1no. 1000 KVA, 11/0.415 kV, 3 phase, ONAN cooled, oil-immersed Transformer having Vector-group Dyn. 11, suitable for outdoor installation, complete with all fitting and accessories along with oil for first filling.

**7.5)**Construction of electronic equipment earth pit with complete material.

Quantity=10 Nos

Making earthing pits inclusive of supply of all materials as per IS 3043 - 1987 complete with copper earthing plate of dimension 600 x 600 x 6 mm, 50 KG common salt and 50 KG charcoal so as to completely cover the earthing plate. The pit will be 2 mts. deep in soil, having 2" dia GI pipe from plate to inspection chamber, the inspection chamber shall be 1000 mm x 500 mm x 400 mm deep brick masanory chamber with CI cover. The exposed parts of all nut bolts after fixing will be completely covered with bitumin. Appropriate precaution must be taken to ensure that watering pipe is clear of any blockage. 2 nos 50 x 6 mm copper earthing strip to be installed from plate to inspection chamber. Note: - The contractor shall fill the earthing pit only after inspection of depth of the pit and quantity of the earthing plate and strip for each pit by Engineer in charge /consultant.

Note: Scope includes supply of all the material required for making of earth pit complete.

Running, connecting to the earth risers, interconnecting of GI Flats of 75 mm X 10 mm, above the ground, along the transformers/ Switchgear / MCC panels / System neutrals / columns - as per the earthing layout drawing of the area. Length=2000 meters.

Running, connecting to the equipment and to the station ground risers of GI Flats of 50 mm X 10 mm, above the ground, along the Cable Trays / Structures / Columns, Bus ducts, DBs & Motors - as per the earthing layout drawing of the area - to ensure bonding to the station earthing system of all cable racking trays. Length=1000 metres.

Scope includes supply of all the material such as GI Flats of 75 mm x10 mm (2000 mtr) and 50 mm x10 mm (1000 meters) as mentioned above.

According to the Indian Electricity Rules, the frame of all motors, transformers etc and the metal casings of all power consuming equipment shall be earthed by two separate and distinct connections with earth.

Earthing of all the Panels and other equipment.

**7.6)**Installation of Perforated cable trays complete in all respects along with their supporting/fixing arrangements**.**

(i) Laying & fixing of cable trays on supporting system, earthing of cable trays and laying of of power cables in cable trays, fixing of cables on trays, Fabrication of cable mounting steel structure with MS Channel/Angle flat of various sections by welding/ bolting and grouting.Total length of cable trays shall be 500 metres.

The perforated cable trays shall be supported on the solid supporting arrangement made from channel of minimum size 100x50mm and angle iron of size 50x50x6mm thick angle approximately at a distance of 0.1 to 1.2m center to center either from ground/wall or ceiling. However, the supporting system shall be designed by bidder suitable to bear the uniform load of ladder length for 600 mm wide tray. M.S. angle iron brackets shall be further supported/anchored to wall as per the site requirement.

ii) The MS Anchor fasteneners(200 nos) shall be is scope of supply of the contractor.

iii) The brackets and supporting system shall be painted with two coats of zinc chromate primer followed by two coats of synthetic enamel paint of approved colour conforming to relevant Indian standard.

iv) Bidder is at its liberty to manufacture the cable supports arrangement at site or at his own workshop. Bidder shall have to arrange all the tools/tackles, including welding machines etc. for the manufacturing of these cable supports.

v) The depth of trays shall be 100 mm and thickness 2 mm (min.) with width of 600mm.

vi) The free vertical distance between parallel perforated trays/racks/ladder shall be at least 250mm and the perforated trays shall be 50mm away from the walls. The trays shall be fixed to the brackets with proper nuts and bolts system.

vii) The perforated trays shall be free from sharp edges and burns etc. so that joint between two trays shall be without any clearance and matched in proper shape.At the bends the curvature in all axis of perforated trays/racks shall be 20R or maximum size of cable.

viii) The supporting brackets/fixing bolts size shall be so calculated that the design load as specified does not exceed. The cables shall be fixed in the perforated trays by means of plastic ties or plastic coated wires etc.

ix) Cable shall be fixed in cable trays in single tier formation and cable shall be clamped with aluminium flat clamps and galvanized bolts / nuts.

x)EARTHING: The perforated cable trays along with their supporting arrangements shall be

properly earthed with nut and bolts from the earthing, generally in the vicinity of the tray routing. The earthing shall be as per latest I.E. rules and IS/IEC recommendation. The size of earth connection shall be such that its conductance should be more than the conductance of 14 sq.mm. Copper conductor cross section.

xi) The welding and the welded work shall generally conform to IS: 816 & IS: 9595. Unless otherwise specified

Qty=500 meters

**7.7)**Supply of MS Anchor Fasteners.Qty=200 Nos.

**7.8)** Laying, dressing and clamping of 1100 Volt Grade, 1C X 300 sq.mm Aluminium conductor (FRLS) armoured,LT Power Cables along cable trenches, trays etc. including de-watering and cleaning of trenches etc. as required. Total quantity=500 metres.

**7.9)** Supply and Termination of 1100 volt Grade 1C X 300 sq.mm Aluminium conductor (FRLS/ AYWY) armoured LT Power cable. Quantity=100 nos.

**7.10)** Supply, Laying dressing and clamping of 1100 volt grade control cable PVC(Type-A) Insulated, Electrolytic, Annealed Stranded Round Copper Conductor colour coded, cores laid up Extruded PVC(Type ST1)Inner sheathed GI Wire/ strip armoured, overall FRLS-PVC(Type ST1)Outer sheathed control cables conforming to IS 1554 Part 1 1988 complete with wiring material such as numbering ferrules, lugs ,glands etc , to be laid along cable trenches, trays etc. including de-watering and cleaning of trenches etc. as required.

4C X 2.5 sq.mm =3000 metres

**7.11)** Supply, Laying dressing and clamping of 1100 volt grade control cable PVC(Type-A) Insulated, Electrolytic, Annealed Stranded Round Copper Conductor colour coded, cores laid up Extruded PVC(Type ST1)Inner sheathed GI Wire/ strip armoured, overall FRLS-PVC(Type ST1)Outer sheathed control cables conforming to IS 1554 Part 1 1988 complete with wiring material such as numbering ferrules, lugs ,glands etc , to be laid along cable trenches, trays etc. including de-watering and cleaning of trenches etc. as required.

7C x 2.5 sq.mm=300 metres

**7.12)** Laying and termination of Profibus communication cable.Drawing of cable in GI pipes of 100 NB dia.Total quantity=3000 metres

**7.13)** Laying of shielded cables .Qty=3000 meters

No of cores=2

mm2 per conductor=1.5

**7.14)**Supply and termination of Shielded cable Quantity =2000 nos

**7.15)**Laying, fitting and fixing 100 mm dia. GI pipes, medium class with all necessary accessories like socket, bend, tee, union, cross, short piece, etc. fitted with holder bat clamps, including cutting pipes, making threads, fittings, fixing, etc. complete in all respects, including jointing materials in position above ground.Qty=500 meters

**7.16)**Supply ,Shifting, erection and commissioning of MCB Distribution Boards 6 way,TPN,12 W,I/C+O/G=8+18 Neutral Links

**7.17)**Supply ,Shifting, erection and commissioning of MCB Distribution Boards MCB distribution boards 12 way,TPN, with bus bar of 200 amps. Rating dully fitted with "c" series, TP MCBs of 32 amps rating (12 nos.)10 ka breaking capacity.

**7.18)**Supply ,Shifting, erection and commissioning of MCB Distribution Boards MCB distribution board horizontal type ,16 way with neutral link ,single phase, with busbar fitted with 1no isolator four pole 63 amp ,8 no MCB single pole 10 amp and 4 no MCB single pole 16 amp.

**7.19)**Supply ,Shifting, erection and commissioning of MCB Distribution Boards 8 way 415 Volts AC TPN double door Distribution board with powder coated sheet steel enclosure complete with busbars, neutral links, DIN channels, 08 nos. of 4 amps ,3 pole MCB with 10 KA breaking capacity. Incomer MCB shall be 63 amps with 20 kA breaking capacity.

**7.20)**Supply,Erection and commissioning of 04 nos. of LT ACB PANELS, Designing, engineering, manufacture, supply installation, commissioning and testing of pedestal amount, LT ACB panel, out of 2 mm CRCA steel sheet, dust & vermin proof, duly painted with red oxide & power coated with steel grey pain after pretreatment of acid/alkali wash with a provision for incoming side cable entry & outgoing bottom cable entry. The panel shall comprise of 2000 Amps. Capacity copper bus bar. The bus bars shall be insulated by heat shrinkable P.V.C. sleeves of R.Y.B.

Rating: 2000 Amps

No. of poles: 4

Type of breaker: Air Break Type, Manually operated Draw out type

Voltage rating:415 V AC, at 50 HZ

Insulation voltage (main ckt):1250 Volts

Insulation voltage (control ckt):415 Volts

Impulse with stand Voltage (KV):12

Type of test: Combined sequence.

Routine test: To be carried out

Test certificate with breaker

Copy of combined sequence test & type test to be provide along with the breaker

Rated breaking capacity,Ics=Icu=Icw,75 KA RMS

Each ACB panel shall have 6 nos of output feeders with 200 amps MCCB

Rating: 200 Amps, No of Poles: 3/4, Manually operated draw out type

Voltage rating: 415 V AC at 50 HZ

Insulation Voltage (main ckt)690 Volts T ACB Panels.

**7.21)**Supply,Erection and commissioning of Relay Panels for 15 MVA AC Generator. Quantity=01 No.

Protection Functions:

Current Differential Protection (ANSI NO.87G)

Stator Earth Fault Protection non-directional, directional (ANSI NO.59N, 64G, 67G)

Sensitive Earth Fault Protection (also rotor earth fault protection) ANSI NO.50/51GN (64R)

Definite Time over current time protection with under voltage seal-in. (ANSI NO.51)

Definite Time over current time protection. Directional (ANSI NO 50/51/67)

Inverse Time over current time protection. Directional (ANSI NO 51V)

Over voltage Protection (ANSI NO.59)

Under Voltage Protection (ANSI NO 27)

Frequency Protection (ANSI NO 81)

Reverse Power Protection (ANSI NO 81)

Over excitation protection, Volts/Hertz,(ANSI NO 24)

Fuse failure monitor (ANSI NO 60FL)

Trip Circuit Protection (ANSI NO.74TC)

Forward Power Protection (ANSI NO.32F)

Under excitation,(loss of field protection)ANSI NO 40.

Negative Sequence Protection (ANSI NO.46)

Breaker Failure Protection (ANSI NO.50F)

Rotor Earth fault protection (fn.R-measuring)(ANSI NO 64R)

Motor starting time supervision (ANSI NO.48)

Supervision of Phase Rotation

Operational Measured Values

Currents: operational measured values of currents, Primary; Secondary, 3 phases on all sides. All currents for each winding.Tolerance: 0.2% of measured values or ±10 mA±1digit

Differential Protection Currents: Primary; Secondary.Tolerances: 0.1% of measured values or ±10 mA±1digit

Phase angles of currents: Primary; Secondary

Tolerances :< 0.5"

values or ±0.2V±1digit

Impedance:R,X

Tolerances: 1%

Power:S,P,Q.

Tolerance: 1% of measured values or ±0.25%Sn.

Power Factor:cosø(p.f)

Tolerance: 1% ±1digit.

Phase Angles: ø

Tolerance :< 0.1%

Frequency

Tolerance: 10 mHz (at V>0.5Vn:40Hz <f<65Hz)

Overexcitation:V/f

Tolerance: 1%.

Records:

No of fault records:Max 8 fault records.

Instantaneous values:

Storage Time: Max 5 sec,

Sampling Interval: Depending on the actual frequency

R.m.s Values:

Storage Time: Max 80 sec

Sampling Interval: Fixed (20 ms at 50 Hz)

HARD WARE:

LOG INPUTS:

Rated Frequency: 50 Hz

Rated Current: 1A

Rated Voltage:Vn (at 100V):100 to125V

Power consumption with In=1A: Approx. 0.05 VA

Capability in CT circuits:

Thermal (r.m.s. values):100 In for 1 sec, 30 In for 10 sec, 4In continuous.

Dynamic (peak):250In (one-half cycles)

Capability in VT circuits: 230V continuous

Auxiliary Voltage: 24 to 48 Volts AC

Tolerance:-20 to +20%

Superimposed (peak to peak) ≤15%

Binary Inputs: 15

Maximum Permissible Voltage: 300V

Current Consumption energized:Approx 1.8 mA

Output Relays: 21(1 NO:5 optional as NC via Jumper)

Switching Capacity:

i)Make: 1000W/VA

ii)Break: 30VA

iii)Break (for resistive load):40W

iv)Break (for L/R≤50ms):25VA

v)Switching Voltage: 250V

vi)Permissible current: 5A continous,20VA for 0.5 sec

LED: Number: Red (green):1

i)Error (red):1

ii) Assignable LED (red):14

Housing:1/ 19" 15BI,20BO ,1 live status contact.

Unit Version: Flush mounting housing, screw type terminals

System Interface: No System Interface

Serial Interface:Local,PC interface, electrical RS 232,9 pin sub miniature connector,max distance=15 m.

Self-monitoring and supervision of relay.

Electrical Tests:

Standards:

IEC 60255

ANSI/IEEE C 37.90.0/.1/.1

UL508

DIN57433,Part 303

Insulating Tests:

Standard:IEC 60255-5

i)Voltage test:2.5Kv(rms)50/60Hz

All circuits except for auxiliary supply, binary inputs,communication,time synchronization interfaces.

ii) Voltage test: 3.5Kv DC Auxiliary supply and binary inputs.

iii)Voltage test:500v(rms)50/60Hz

Only isolated communication interfaces and time synchronization interfaces.

iv) Impulse voltage test (type test) 5 kv peak.1.2/50 µs:3 positive and 3 negative impulses at intervals of 5 sec.

EMC tests for noise immunity (type test)

i)Standards:IEC 60255-22

ii)EN 50082-2

iii)DIN 57435

Mechanical Stress Test and Climatic Stress test.

Erection of Relay Control Panel with Fabrication of suitable base frame

Laying of cable as per relay panel drawing and logic from panel to all CTs , Breaker

Relay programming of transformer protection & capacitor bank Protection relay all tripping & Alarm.

Communication all relay each other & existing PLC based SCADA system. as per Instruction of Engineering in charge .

**7.22)** Supply,Erection and commissioning of Remote I/O Panel with TFT LCD 46” screen display Mimic Panel, Laptop based programming unit and printer

**7.23)** Developing the PLC and SCADA. .Programming the sequence of operations, control loops, timing, operational and safety interlocks, building a high level of self-diagnostic features etc. in the PLC as per the site requirements

**7.24)**Supply,Erection and Commissioning of WINDING CHANGE OVER CUBICLE.

Suitable for 15 MVA 11 Kv AC Generator

System Voltage: 11 kV 50/60 Hz Ac 3 Phase

Rating of Converter: 15 MVA

No of Input Terminals: 12

Modes of Operation: 4--Star Parallel, Star Series, Parallel Delta andDelta Series.

Mode Selection:Through Interlocked load break Switches(to be done on no load before energizing the generator)

Indicating Lamps:04 nos for mode indications 110 volts LEDs

CTs and PTs :Class 0.1,cast resin ,3 nos of 1 phase units.

Metering:AC Voltmeter and AC Ammeter

Cable Entry From Bottom

Enclosure:IP54

Mounting: Floor Mounting

Power Terminations :Suitable for 11 kV XLPE Single Core Power cables

Outgoing Terminations 3 nos :Suitable for 11 kV XLPE Single Core Power cables

Mechanical Interlock: Provided to permit operation in any one mode only

Gland Plates: Undrilled Gland Plate detachable from bottom

Bus bars: Aluminium

Earthing Provisions: Two Independent earthing Terminals provided.

**7.25)**Supply,Erection and Commissioning of 3Ph/1Ph SELECTION PANEL

System Voltage:11 kV 50/60 Hz Ac 3 Phase

CTs:Core 1,3000/5,Class 1,Cast Resin,3 nos

Bus bars: Aluminium

No of Buses: 3

Cable Entry: Bottom

Protection: IPX4

PTs:6350/63.5 V,1 Ph,3 nos

Metering: Voltage Current and Frequency

Indications: Single phase and Three Phase Indication

Function; To connect generator winding in either 3 phase star mode or single phase zigzag mode

Phase Selection: Two Position, Single Pole Two nos Load Break Switch with common Handle 11 kV 3000 Amps.

Accessories:LEDs,HRC Fuse, Ammeter Selector Switch

**7.26)** Supply, Erection and Commissioning of LT MOTOR CONTROL CENTRE PANELS:

1) INCOMER PANEL 01 NO CONSISTING OF:-

1.1) TPN Fuse Switch Unit with Auxiliary, 500 Amps, Qty=01 no.

1.2) 500 A HRC Fuse, 500 Amps, Qty=03 no.

1.3) RYB Indicating Lamps, Qty=03 no.

1.4) On / off Indicating Lamp, Qty=02 no

1.5) 96 Sq.mm Multi-function Meter, Accuracy Class=1.0 with following Parameter Display:-

i)Voltage R,Y,B,RN,BN,YN,

ii)Current RYB

iii)Frequency

iv) Power factor R, Y, B

v) Watt W1, W2, W3

vi)Watt hours

vii) Run Hours

Qty=01 no

1.6) Resin Cast Transformer, 500/1 amps, Burden – 5/7.5VA, Accuracy Class- 1.0,Qty=03 no

1.7) Control Fuses 6 Amps

BUSBARS:

1) 500 Amp TPN Copper busbars

OUTGOING:

1) 1 No. 200 Amp 415 volts, Four Pole, Moulded Case Circuit Breaker, Breaking Capacity (KA) = 25

2) 1 No. 100 Amp 415 volts, Four Pole, Moulded Case Circuit Breaker, Breaking Capacity (KA) = 25

3) 2 No. 63 Amp, 4Pin (3P+E) 415 volts Plug and Sockets, complete with 2 nos of 415 volts AC ,63 amps TPN MCB, breaking capacity=10 KA.

4) 2 No. 32 Amp, 4 Pin (3P+E) 415 volts Plug and Sockets, complete with 2 nos of 415 Volts AC,32 amps TPN MCB, breaking capacity=10 KA.

5) 2 No 32 amps 3P (1P+E+N), 250 Volts AC Plug and socket, complete with 2 nos of 250 Volts AC 63 amps TPN MCB, breaking capacity=10 KA.

6) PLUG AND SOCKETS:-Specifications: IS 309-3, IEC: 1989. Outer casing made of non-corroding die cast aluminium alloy, interior moulded from superior grade phenolic/polyester compound. Overhang protection against accidental contacts with live parts. The earth connection makes first and breaks last.