

Annexure - 8 (ETC of ICT)

12.14.2 The winding-end termination, insulation system and transport fixings shall be so designed that the integrity of the insulation system generally remain intact during repeated work in this area.

12.14.3 Allowances shall be made on the winding ends for accommodating tolerances on the axial dimensions of the set of bushings and also for the fact that bushings may have to be rotated to get oil level inspection gauges to face in a direction for ease of inspection from ground level.

12.14.4 In particular, rotation or straining of insulated connections shall be avoided during the fastening of conductor pads (or other methods) on the winding ends onto the termination surfaces of the bushing.

12.14.5 Suitable inspection and access facilities into the tank in the bushing oil-end area shall be provided to minimize the possibility of creating faults during the installation of bushings.

13.0 Unused inhibited Insulating Oil

13.1 The insulating oil shall be virgin high grade inhibited, conforming to IEC-60296 & all parameters specified below, while tested at supplier's premises. The contractor shall furnish test certificates from the supplier against the acceptance norms as mentioned below, prior to despatch of oil from refinery to site. Under no circumstances, poor quality oil shall be filled into the transformer and only thereafter be brought up to the specified parameter by circulation within the transformer

Sl. No.	Property	Test Method	Limits
A1.	Function		
1a.	Viscosity at 100degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.) 3 mm ² /s
1b.	Viscosity at 40degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.) 12 mm ² /s
1c.	Viscosity at -30degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.) 1800 mm ² /s
2.	Appearance	A representative sample of the oil shall be examined in a 100 mm	The oil shall be clear and bright, transparent and free from suspended matter or

		thick layer, at ambient temperature	sediment
3.	Pour point	ISO 3016 or ASTM	D97 (Max.)- 40degC
4.	Water content a) for bulk supply b) for delivery in drums	IEC 60814 or ASTM D1533	(Max.) 30 mg/kg 40 mg/kg
5.	Electric strength (breakdown voltage)	IEC 60156 or ASTM D1298	(Min.) 50 kV(new unfiltered oil) / 70 kV (after treatment)
6.	Density at 20 deg C	ISO 3675 or ISO 12185 or ASTM D 4052	0.820 - 0.895 g/ml
7.	Dielectric dissipation factor (tan delta) at 90deg C	IEC 60247 or IEC 61620 Or ASTM D924	(Max) 0.0025
8.	Resistivity at 90 deg C	IEC 60247	150 X 10 ¹² Ohm – cm, (Min.)
9	Negative impulse testing Kv @ 25 degC	ASTM D-3300	145 (Min.)
10.	Carbon type composition (% of Aromatic, Paraffins and Naphthenic compounds)	IEC 60590 or ASTM D 2140	Max.Aromatic : 4 to12 % Paraffins : <50% & balance shall be Naphthenic compounds.
B1.	Refining / Stability		
1	Acidity	IEC 62021-1 or ASTM D974	(Max) 0.01 mg KOH/g
2	Interfacial tension at 27degC	ISO 6295 or ASTM D971	(Min) 0.04 N/m
3.	Total sulphur content	BS 2000 part 373 or ISO 14596 or ASTM D129	0.15 % (Max.)
4.	Corrosive sulphur	IEC 62535	Non-Corrosive on copper and paper
		ASTM D1275B	Non-Corrosive
5.	Presence of oxidation inhibitor	IEC 60666 or ASTM D2668 or D4768	0.08% (Min.) to 0.4% (Max.) Oil should contain no other additives .Supplier should declare presence of additives, if

			any.
6.	2-Furfural content	IEC 61198 or ASTM D5837	25 Microgram/litre (Max.)
C1.	Performance		
1.	Oxidation stability -Total acidity -Sludge - Dielectric dissipation factor (tan delta) at 90deg C	IEC 61125 (method c) Test duration 500 hour IEC 60247	Max 0.3 mg KOH/g Max 0.05 % Max 0.05
2.	Gassing	IEC 60628A or ASTM D2300	No general requirement
3.	Oxidation stability (Rotating Bomb test)	IEC : 61125(Method B) / ASTM D2112 (e)	220 Minutes (Min.)
D1.	Health, safety and environment (HSE)		
1.	Flash point	ISO 2719	(Min.)135degC
2.	PCA content	BS 2000 Part 346	Max 3%
3.	PCB content	IEC 61619 or ASTM D4059	Not detectable (Less than 2mg/kg)

13.2 i) Prior to filling in main tank at site and shall be tested for

1. Break Down voltage (BDV) : 70kV (min.)

2. Moisture content : 30 ppm (max.)

3. Tan-delta at 90 °C : Less than 0.01

4. Interfacial tension : More than 0.035 N/m

ii) Prior to energisation at site oil shall be tested for following properties & acceptance norms as per below generally in line with IS :1866 / IEC 60422 :

1. Break Down voltage (BDV) : 70 kV (min.)

2. Moisture content : 10 ppm (max.)

3. Tan-delta at 90 °C : 0.01 (max.)

4. Resistivity at 90 °C : 6×10^{12} ohm-cm (min.)

5. Interfacial tension : 0.035 N/m (min.)

6. *Oxidation Stability (Test method as per IEC 61125 method C, Test duration: 500 hour for inhibited oil)

a) Acidity : 0.3 (mg KOH /g) (max.)

b) Sludge : 0.05 % (max.)

c) Tan delta at 90 °C : 0.05 (max.)

7. * Total PCB content : Not detectable (2 mg/kg total)

* For Sr. No. 6 & 7 separate oil sample shall be taken and test results shall be submitted within 45 days after commissioning for approval of TANTRANSCO.

13.3 At manufacturer's works the quality of oil used for first filling, testing and impregnation of active parts shall meet at least parameter as mentioned in serial

no. 1 to 5 of clause 13.2 ii) above. The oil test results shall form part of equipment test report. Oil sample shall be drawn before and after heat run test and shall be tested for dissolved gas analysis. Oil sampling to be done 2 hours prior to commencement of temperature rise test. Keep the pumps running for 2 hours before and after the heat run test. Take oil samples during this period. For ONAN/ONAF cooled transformers, sample shall not be taken earlier than 2 hours after shut down.

The acceptance norms with reference to various gas generation rates shall be as per IEC 61181.

13.4 Sufficient quantity of oil necessary for maintaining required oil level in tank, radiators, conservator etc till the completion of warranty period shall be supplied.

13.5 Particles in the oil

The particle analysis shall be carried out in an oil sample taken after completion of the oil purification at site. The procedure and interpretation shall be in accordance with the recommendation of CIGRE report WG-12.17 - "Effect of particles on transformer dielectric strength".

13.6 Moisture content in the solid insulation

Bidder may follow either method-1 or method-2 below to ensure dryness of solid insulation

Method-1: An Oil/paper moisture equilibrium chart shall be applied for the analysis of the moisture-in-oil results obtained from an oil sample taken after complete winding drying and oil filling in the tank at site. In order to ensure that equilibrium conditions are properly assessed, the sample shall be taken not earlier than 7 days after completing the oil and impregnation treatment. Recording the temperature of transformer oil during sampling is essential.

With this sample it shall be demonstrated that the moisture content in the paper insulation body of the Transformer is less than at least 0.5%.

Method-2: Dummy insulation test block shall be inserted in the active part of Transformer at factory and same shall be used to detect the volume moisture content.

Before application of vacuum and oil filling in the Transformer, it will be ensured that moisture content in the dummy insulation test block is less than 0.5%.

* The insulating oil, supplied with the transformer, shall be of EHV grade conforming to IS:335 of latest issue. No inhibitors shall be used in the oil. All the tests, specified in the standard, shall be carried out for confirmation of the quality on the oil samples, drawn at the following stages.

- i) Prior to filling of the transformer
- ii) Before carrying out the Heat-Run test
- iii) After carrying out the Heat-Run test
- iv) Before energizing the transformer at site

* Oil shall be filtered and tested for breakdown voltage (BDV) and moisture content before filling. The design and all materials and processes used in the manufacture of the transformer shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

* The insulating oil shall be subjected to testing at the manufacture's works/reputed laboratory before supply, in the presence of Inspecting personnel.

* Sufficient quantity of oil necessary for first filling of all tanks, coolers and radiators shall be supplied in sealed non returnable containers, suitable for out door storage.

* The tenderer shall furnish the following information in his offer to enable the purchaser, to procure, if decided to go for separate procurement.

- i) Recommended Technical parameters of the oil.
- ii) List of manufacturers of oil, who are preferred by the tenderer for the transformers offered by them.

* Where the supplier prefers to despatch the transformer without oil, due to limitations in the handling and transport facility, the transformer tank shall be filled with dry Nitrogen or equivalent inert gas. A gas cylinder, with suitable reducer connection and pressure gauge, shall be supplied to monitor the pressure of the gas in the tank during transit and storage at site, till completion of oil filling. These accessories shall become the property of the Purchaser.

* 5 Nos. of oil sampling bottles shall be provided. (Not in ETC contractor's scope)

14.0 Oil filling

14.1 Procedures for site drying, oil purification, oil filling etc shall be submitted for approval and complete instructions shall form part of the manual.

14.2 The duration of the vacuum treatment shall be demonstrated as adequate by means of water measurement with a cold trap or other suitable method but shall generally not be less than 72 hours. The vacuum shall be measured on the top of the Transformer tank and should be less than 1mbar.

14.3 Oil filling under vacuum at site shall be done with transformer oil at a temperature not exceeding 65°C. Vacuum shall not be broken until the Transformer is oil filled up to the Buchholz relay. Whenever the active insulation or any paper insulated HV connections, especially those from the windings to the bushings are exposed, these shall be re-impregnated under vacuum along with the complete Transformer. For this purpose the Transformer shall first be drained to expose all insulation material.

14.4 The minimum safe level of oil filling (if different from the Buchholz level) to which the Transformer shall be oil filled under vacuum, shall be indicated in the manual.

14.5 The Ultra High Vacuum type oil treatment plant of suitable capacity (preferably 4500 to 6000 litres per hour) suitable for treatment of oil in EHV class Transformer shall be used in order to achieve properties of treated oil. The plant shall be capable of treatment of new oil (as per IEC 60296 and reconditioning of used oil (as per IS: 1866/IEC: 60422 for oil in service) at rated capacity on single pass basis as follow:

- (i) Removal of moisture from 100 ppm to 3 ppm (max.)
- (ii) Removal of dissolved gas content from 10% by Vol. To 0.1% by vol.
- (iii) Improvement of dielectric strength break down voltage from 20 to 70 KV
- (iv) Vacuum level of degassing chamber not more than 0.15 torr/0.2 mbar at rated flow and at final stage. Machine shall have minimum of two degassing chambers and these should have sufficient surface areas to achieve the final parameters.
- (v) Filter shall be capable of removing particle size more than 0.5 micron in the filtered oil.
- (vi) Processing temperature shall be automatically controlled and have an adjustable range from 40°C to 80°C.

15.0 Terminal Arrangements

15.1 Bushings

15.1.1 The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137/DIN 42530.

15.1.2 Bushing for voltage of 800 kV shall be of porcelain type and hermetically sealed oil filled condenser type.

- 12. Bus post insulators
- 13. Disc insulator and hardware
- 14. Conductor(s)

29.0 Pre-Shipment Checks at Manufacturer's Works

- 29.1 Check for inter changeability of components of similar transformers for mounting dimensions.
- 29.2 Check for proper packing and preservation of accessories like radiators, bushings, dehydrating breather, rollers, buchholz relay, fans, control cubicle, connecting pipes, conservator etc.
- 29.3 Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.
- 29.4 Gas tightness test to confirm tightness and record of dew point of gas inside the tank.
- 29.5 Derivation of leakage rate and ensure the adequate reserve gas capacity.

30.0 Inspection and Testing at Site

The Contractor shall carry out a detailed inspection and testing programme for field activities covering areas right from the receipt of material stage up to commissioning stage. An indicative programme of inspection as envisaged by the Purchaser is given below. However, it is contractor's responsibility to draw up and carry out such a programme duly approved by the Purchaser. Testing of oil sample at site shall be carried out as per Cl.13.0 above.

30.1 Receipt and Storage Checks

- 30.1.1 Check and record condition of each package, visible parts of the transformer etc. for any damage.
- 30.1.2 Check and record the gas pressure in the transformer tank as well as in the gas cylinder.
- 30.1.3 Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general.
- 30.1.4 Check and record reading of impact recorder at receipt and verify the allowable limits as per manufacturer's recommendations.

30.2 Installation Checks

- 30.2.1 Inspection and performance testing of accessories like tap changers, cooling fans, oil pumps etc.

30.2.2 i) Check the direction of rotation of fans and pumps.

ii) Check the bearing lubrication.

30.2.3 Check whole assembly for tightness, general appearance etc.

30.2.4 Oil leakage test

30.2.5 Capacitance and tan delta measurement of bushing before fixing/connecting to the winding, contractor shall furnish these values for site reference.

30.2.6 Leakage check on bushing before erection.

30.2.7 Measure and record the dew point of gas in the main tank before assembly.

30.3 Commissioning Checks

30.3.1 Check the colour of silicagel in silicagel breather.

30.3.2 Check the oil level in the breather housing, conservator tanks, cooling system, condenser bushing etc.

30.3.3 Check the bushing for conformity of connection to the lines etc,

30.3.4 Check for correct operation of all protection devices and alarms :

(i) Buchholz relay.

(ii) Excessive winding temperature.

(iii) Excessive oil temperature.

(iv) Low oil flow.

(v) Low oil level indication.

(vi) Fan and pump failure protection.

30.3.5 Check for the adequate protection on the electric circuit supplying the accessories.

30.3.6 Check resistance of all windings on all steps of the tap changer.

Insulation resistance measurement for the following:

(i) Control wiring.

(ii) Cooling system motor and control.

(iii) Main windings.

(iv) Tap changer motor and control.

30.3.7 Check for cleanliness of the transformer and the surroundings.

30.3.8 Phase out and vector group test.

30.3.9 Ratio test on all taps.

30.3.10 Magnetising current test.

30.3.11 Capacitance and Tan delta measurement of winding and bushing.

30.3.12 Frequency response analysis (FRA). FRA equipment shall be arranged by purchaser.

30.3.13 DGA of oil just before commissioning and after 24 hours energisation at site.

30.3.14 Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.

30.3.15 Continuously observe the transformer operation at no load for at least 72 hours.

30.3.16 Contractor shall prepare a comprehensive commissioning report including all commissioning test results and forward to Purchaser for future record.

31 Technical Parameters

Technical Parameters: 500 MVA Single Phase Auto Transformer

31.1 Rating- H.V. / I.V : 500 MVA / 500 MVA
LV (Tertiary) : 167 MVA, however continuous thermal rating shall be at least of 5 MVA active loading

31.2 Cooling : i) ONAN/ONAF/ (OFAF or ODAF)
OR
ii) ONAN/ONAF1/ONAF2

31.3 Rating at different cooling : 60%/80%/100%

31.4 Type of Transformer : Auto transformer

31.5 Voltage ratio : $\frac{765}{\sqrt{3}}$ / $\frac{400}{\sqrt{3}}$ 33 kV

31.6 Frequency : 50 Hz

31.7 Phases : Single

31.8 Impedance

At principal tap, rated MVA of HV & IV & at 75deg C between

- HV-IV : 14.0% (IEC tolerance applicable)

- HV/LV : 195.0 %

- IV/LV : 180.0 %

31.9 Air core reactance of HV : 20% (minimum)

31.10 Service : Outdoor

31.11 Duty : Continuous

40.5.5. TYPE TEST FOR BOUGHT OUT COMPONENTS :

Tenderers are requested to furnish along with tender copy of type test certificates for the bought out components in full shape as conforming to relevant IS/IEC standards of latest issue obtained from a Government./ Government Recognized Laboratory. The above test certificates should accompany the drawings of the material/equipments, duly signed under seal by the institution who have issued the type test certificate.

Otherwise the above type test certificates shall be furnished before the offer of inspection for the first lot of materials/ equipments at no extra cost to Corporation and no relaxation to Corporation's Delivery clause will be given on this accounts.

The above type test should have been conducted not earlier than five years (5 Years) as on the date of tender opening. Non submission of above type test certificates within the stipulated time will entail cancellation of Purchase Order without any further reference to supplier.

The original type test certificate shall be furnished for verification on request. The details of type test if already conducted should be furnished in the Section.-G.

40.5.6. The supplier shall also furnish test certificates to the effect that the withstand capability of the insulation between the core and all core bolts , side plates & structural frame has been tested with 2000 Volts AC for one minute after assembling the core and prior to the despatch of the transformer .

40.6. TESTS AT SITE

After erection at site and prior to commissioning, the transformer shall be subjected to the following tests by the Supplier in the presence of the purchaser.

- (a) Insulation resistance test.
- (b) Ratio and polarity test on all taps.
- (c) All relevant tests on oil.
- (d) Open circuit and short circuit test.
- (e) Tests on the operation of OLTC.
- (f) Tests on the protective devices and interlocks.
- (g) Measurement of winding resistance at all taps.
- (h) Vector group verification
- (i) Capacitance and Tan-delta measurement on windings and bushings
- (j) Dissolved gas analysis on transformer.(The test figures will form the base values for comparison in future.).

41.0. DRAWING, TECHNICAL LITERATURE AND GUARANTEED TECHNICAL PARTICULARS

AUTO TRANSFORMER ERECTION

1.0 GENERAL:

- 1.1. Unless otherwise stated the work shall be carried out as per Section-K of CBIP guidelines.
- 1.2. The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work on this Contract to be performed at site.
- 1.3 The Contractor, shall nominate a responsible person as its representative at site suitably designated for the purpose of overall responsibility and co-ordination of the works to be performed at site.

2.0. SCOPE OF WORK

- 2.1. The scope of work shall be to make the transformer ready for testing and commissioning and include the following
 - a) Placing of the transformer on the plinth and fixing of wheels and carrying- out stop block welding including moving the transformer to the plinth, where the transformer is supplied and unloaded near the plinth.
 - b) The Contractor has to supply, lay, erect and weld M.S.Channel, Flat of the 50x8 mm. sizes, including green painting and providing with adequate bolts and nuts as applicable.

50x8 mm. Flat with suitable M.S.Channel for earthing with neutral bushing at two different earth points of existing earth pit, Transformer tank, Cooler fan and pumps. D.M.box RTCC panel & other accessories body earthing with required standards.
 - c) Erection of the following, wherever applicable:
 - (i) HV bushing with turrets
 - (ii) LV and neutral bushing with turrets.
 - (iii) Cable boxes
 - (iv) Bushing current transformers

- (v) Conservators
 - (vi) Valves
 - (vii) Radiators
 - (viii) Fans/pumps
 - (ix) Buchholz relay
 - (x) Surge relay
 - (xi) Gaskets
 - (xii) Temperature indicators
 - (Xiii) Erection of separate Neutral CT for each bank of Auto Transformer.
 - (xiv) Others wherever stated
- d) Erection of the Drive Mechanism Box, Marshalling at site with equipment and RTCC Panel in the control room after removing the existing panel, if any.
- e) Filling of transformer oil in the transformer and OLTC under hot oil circulation, vacuum drying wherever applicable/necessary to the required level and circulation of oil till satisfactory results are obtained before commissioning.
- f) i) The Contractor scope of work shall include all the control cables required for the successful commissioning of Auto/Power Transformers including supply, laying, providing suitable glands ferrules, lugs, termination etc., but not limited to the above mentioned for successful commissioning of the transformer as per standard requirement.
- 1) Protection schemes of Auto/Power Transformer including differential protection cable.
 - 2) Indication/Annunciation scheme for cooler fan and pumps.
 - 3) OLTC Remote operation
 - 4) OLTC fan, pump D.M. power supply cable
 - 5) DC cable from control room to Transformer
 - 6) Scada scheme for Remote/Automation operation
 - 7) CTs cable from CT secondaries to Marshalling Box and Marshalling box to LV panel/RTCC panels
 - 8) Any other control cable with required site for successful commissioning of the transformer
 - 9) Interconnection of cables for AC/DC panels to RTCC/LV panels
- ii) All CT cables shall be 4 sq.mm. (minimum) and shall be copper, armoured cables. The other cables that are to be provided shall be 2.5 sq.mm

(minimum), copper multi-strand and armoured cables, separate cables for AC and DC are to be used. The AC supply cables shall be sufficient to cater the load of pumps, fans and the load of pumps, fans and the loads of transformer for the AC panel around in the transformer end.

Additional adequate quantity of cable length shall be provided at the Transformer end and at the RTCC/LV panels ends in case of shifting of anels/ Transformers. All the cables shall be laid end to end without any joints and it should be ensured that the cables so provided shall comply with TANTRANSCO control cable specification and should be strictly adhered all the control cables shall be neatly laid /buried in control cable duct/trench by suitable dressing.

However any additional work and in the schedule of cables shall be discussed with the site Engineers/ TANTRANSCO Engineers before laying of cables and necessary approval shall be obtained before connection to the panels/ Transformer ends.

g) Painting as required will be carried out so as to maintain the finish of the surface of the transformer and accessories prior to the erection of the same at site.

h) Required assistance for testing and commissioning

Any other works not covered in items(a) to (h) but required for satisfactory commissioning of the power transformer shall also to be carried out by the contractor free of cost.

2.2. The supplier shall prepare a schedule of the works to be carried out with specific periods for each item of work involved. All assembly and erection drawing shall be made available at site.

2.3. If the commissioning of the transformer is delayed due to incompleteness of erection works, the Corporation has the right to recover an estimated amount for such pending erection works from the contractor besides Levy of L.D. clause.

3.0. REGULATION OF LOCAL AUTHORITIES AND STATUTES

The Contractor shall comply with all the rules and regulations of local authorities during the performance of its field activities. The Contractor shall also comply with the Minimum Wages Act, 1948 and the payment of Wages Act (both of the Government of India) and the rules made there under in respect of any employee or workman employed or engaged by it or its Sub-Contractor.

4.0. OWNER'S LIEN ON EQUIPMENT

The Owner shall have lien on all equipment including those of the Contractor, brought to the Site for the purpose of erection, testing and commissioning of the plant. The Owner shall continue to hold the lien on all such equipment throughout the period of Contract. No material brought to the site shall be removed from the site by the Contractor and/or its Sub-contractors without prior written approval of the Site Engineer.

5.0. INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled inspection, Testing and Inspection Certificates under Technical Specification applicable to the erection portion of the Works. The Site Engineer shall have the right to re-inspect any equipment, even though the same may have been previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Site Engineer rejects any equipment, the Contractor shall make good such rejected equipment etc., either by replacement or modification/repairs as may be necessary to the satisfaction of the Site Engineer. Such re-placements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

6.0. ACCESS TO SITES AND WORKS ON SITE

6.1 The works so far as it is carried out on the Owner's premises, shall be carried out at such time as the Owner may approve and the Owner shall give the Contractor reasonable facilities for carrying-out the works.

6.2 In the execution of the works, no person other than the Contractor or its duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the site except by the special permission, in writing of the Site Engineer or his representative.

7.0. CO-OPERATION WITH OTHER CONTRACTORS

7.1 The Contractor shall co-operate with all other Contractors or tradesmen/ representative(s) of the Owner, who may be performing other works on behalf of the Owner and the workmen who may be employed by the Owner and doing work in the vicinity of the works under the Contract. The Contractor shall also so arrange to perform its work as to minimise, to the maximum extent possible, interference with the work of other Contractors and their work-men. Any injury or damage that may be sustained by the employee(s) of the other Contractors and the Owner, due to the Contractor's work shall promptly be made good by the Contractor at its own expense. The site Engineer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Owner in regard to their work. If the work of the Contractor is delayed because of any acts of omission of another Contractor, the Contractor shall have no claim against the Owner on that account other than an extension of time for completing its works.

7.2. The Site Engineer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's works. The Site Engineer shall determine the corrective measures, if any, required to rectify this situation after inspection of the works and such decisions by the Site Engineer shall be binding on the Contractor.

8.0. DISCIPLINE OF WORKMEN

The Contractor shall adhere to the disciplinary procedure set by the Site Engineer in respect of its/its Sub-Contractor's employees and workmen at site. The Site Engineer shall be at liberty to object to the presence of any representative or employee of the Contractor/its Sub-Contractor at the site, if in the opinion of the Site Engineer such representative/ employee has misconduct himself or is incompetent or negligent or other-wise undesirable. The Contractor shall remove such person(s) objected to, and provide competent replacement in his place.

9.0. PROTECTION OF WORK

The Contractor shall have total responsibility for protecting its works till it is finally taken over by the Site Engineer. No claim will be entertained by the Owner or by the Site Engineer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions, to comply with the specification(s) and drawings. Should any such damage to the Contractor's works occur because of any other party not being under its supervision or control, the Contractor shall make its claim directly to the party concerned without involving the Owner. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's works the same shall be resolved as per the provisions of Clause 6.0 above titled co-operation with other Contractors. The Contractor shall not cause any delay in the repair of such damaged works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the work immediately and no cause thereof will be assigned pending resolution of such disputes.

10.0. EMPLOYMENT OF LABOUR

10.1 The Contractor will be expected to employ on the work only its regular skilled employees with experience in the particular type of work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.

10.2 All traveling expenses including provisions of all necessary transport to and from site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.

10.3 The hours of work on the site shall be decided by the Owner and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day-Monday through Saturday.

10.4 Contractor's employees shall wear identification badges while on work at Site.

10.5 In case the Owner becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Owner may make such payments and shall recover the same from the Contractor's bills.

10.1 The Contractor shall be provided with free supply of electricity for the purposes of the Contract only, at one point in the project Site. The Contractor, at its own cost shall make its own further distribution arrangement. All temporary wiring shall comply with local regulations and will be subject to Site Engineer's inspection and approval before connection to supply.

11.0. FACILITIES TO BE PROVIDED BY THE CONTRACTOR

11.1 Tools, scaffolding and tackle

11.1.1. The Contractor shall bring to site all the construction/erection equipment tools, tackle, scaffolding etc required for pre-assembly, erection of the equipment covered under the contract. He shall submit a list of all such materials to the Site Engineer before the commencement of pre- assembly at Site.

11.1.2. The following items are generally required

(1) Lifting equipment:

(a) Derrick or mobile crane of adequate capacity.

(b) wire ropes

(c) pulley blocks

(d) chain blocks

(e) Manila ropes,

(f) shackles

(g) sleepers.

(2) Oil purifier with heating and vacuum facilities and hot oil resistant hose pipes.

(3) Vacuum pump

(4) Oil storage tank.

11.1.3. The Owner shall have a lien on such goods for any sum or sums which may at any time be due or owing to it by the Contractor.

11.1.4. After the completion of the Works, the Contractor shall not remove from the Site, the materials such as construction equipment, erection tools and tackle, scaffolding etc. without permission of the Site Engineer.

11.2. First - Aid

The Contractor shall provide necessary first-aid facilities for all its employees, representatives and workmen working at the site. Adequate number of Contractor's personnel shall be trained in administering first-aid.

11.3. Cleanliness

11.3.1. The Contractor shall be responsible for keeping the entire allotted area clean and free from rubbish, debris etc. during the period of Contract.

11.3.2. Waste oil shall be disposed off in a manner acceptable to the Owner. Under no circumstances shall waste oil be dumped into uncontrolled drains.

12.0. FIRE PROTECTION

12.1. All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel shall be available at the Site during the entire period of the Contract.

12.2. The Contractor shall provide enough fire protection equipment of the types and number for the ware-house, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all times.

13.0. SECURITY

The Contractor shall have total responsibility for all equipment and materials in its custody, stored, loose, semi-assembled and/or erected by it at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the work site only with the written permission of the Site Engineer in the prescribed manner.

14.0. MATERIALS HANDLING AND STORAGE

14.1. All the equipment furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage by the Contractor.

14.2. The Contractor shall be responsible for examining all the consignment and shall notify the Site Engineer immediately of any damage, shortage, discrepancy etc. for the purpose of Site Engineer's information only. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and/or in storage and erection of the equipment at site as

well as for preferring all claims with the underwriter(s). Any demurrage, wharfage and other such charges claimed by the transporters, railways etc., shall be to the account of the Contractor.

14.3. The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by it for the purpose of erection and keep all such record open for the inspection of the Site Engineer.

14.4. All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Site Engineer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored.

14.5. The Contractor shall ensure that all the packing materials and protection devices used for the various equipment during transit and storage are removed before the equipment are installed.

14.6. All the materials stored in the open or dusty location(s) shall be covered with suitable weather-proof and flameproof covering material, wherever applicable.

14.7. The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which require indoor storage. Normally, all the electrical equipment such as motors, control gears and consumables shall be stored in the closed storage space.

15.0. CONSTRUCTION MANAGEMENT

15.1. The field activities of the Contractor's working at site, will be co-ordinated by the Site Engineer and the Site Engineer's decision shall be final in resolving any dispute or conflict between the Contractor and other Contractors and tradesmen of the Owner regarding scheduling and co-ordination of work. Such decision by the Site Engineer shall not be a cause for extra compensation or extension of time for the Contractor.

15.2. Time is the essence of the Contract and the Contractor shall be responsible for performance of its works in accordance with the specified construction schedule.

16.0. PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

The Contractor shall be responsible for any damage resulting from its operations. It shall also be responsible for protection of all persons including members of public and employees of the owner and the employees of other Contractors and Sub-Contractors and all public and private property including structures, building, other plants and equipment and utilities either above or below the ground.

17.0. INSURANCE

17.1. In addition to the conditions covered under the Clause, titled Insurance the following provisions will also apply to the portion of works to be done beyond the Contractor's own or its Sub-Contractor's manufacturing Works.

17.2. Workmen's Compensation Insurance

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of its or its Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than

Workmen's Compensation : As per statutory Provisions

Employee's liability : As per statutory Provision

17.3. Comprehensive Automobile Insurance

This insurance shall be in such form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Owner's men and damage to the property of other arising from

the use of motor vehicles during on or off the Site operations, irrespective of the owner-ship of such vehicles. The minimum liability covered shall be as herein indicated :

Fatal Injury : Rs. 100,000 each person

: Rs. 200,000 each occurrence

Property Damage : Rs. 100,000 each occurrence

17.4. Comprehensive General Liability Insurance

17.4.1. The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, its agents, its employees, its representatives and Sub Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause titled Defence of Suits under General Conditions of Contract of this Volume-1A.

17.4.2. The hazards to be covered will pertain to all the works and areas where the Contractor, its Sub-Contractors, its agents and employees have to perform work pursuant to the Contract.

17.5. The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all its liabilities either direct or indirect, in pursuance of the Contract.

18.0. WORK & SAFETY REGULATIONS

18.1. The Contractor shall ensure proper safety of all the workmen, materials plant and equipment belonging to it or to the others, working at the site. The

Contractor shall also be responsible for provision of all safety notices and safety equipment required by the relevant legislations and deemed necessary by the Site Engineer.

18.2. All equipment used in construction and erection by Contractor shall meet Indian/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the Contractor in accordance with manufacturer's operation manual and safety instructions and as per Guidelines/Rules in this regard.

18.3. Periodical examinations and all tests for all lifting/hoisting equipment & tackle shall be carried-out in accordance with the relevant provisions of Factories Act 1948, Indian Electricity Act and associated Laws/Rules in force from time to time. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by Site Engineer or by the persons authorised by him.

18.4. No electric cable in use by the Contractor/Owner will be disturbed without prior permission.

18.5. No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Site Engineer and a permit to work shall be issued by the Site Engineer before any repair work is carried out by the Contractor. While working on electric lines/equipment whether live or dead, suitable type and sufficient quantity of tools will have to be provided by Contractor to electricians/workmen/officers.

18.6. The Contractor shall employ necessary number of qualified, full time electricians/electrical supervisors to maintain its temporary electrical installations.

18.7. In case any accident occurs during the construction/ erection or other associated activities undertaken by the Contractor, thereby causing any minor or major or fatal injury to its employees due to any reason whatsoever, it shall

be the responsibility of the Contractor to promptly inform the same to the Site Engineer in prescribed form and also to all the authorities envisaged under the applicable laws.

18.8. The Site Engineer shall have the right at its sole discretion to stop the work, if in its opinion the work is being carried out in such a way as may cause accidents and endanger the safety of the persons and/or property, and/or equipment. In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove short-comings promptly. The Contractor, after stopping the specific work, can, if felt necessary, appeal against the order of stoppage of work to the Site Engineer within 3 days of such stoppage of work and the decision of the Site Engineer in this respect shall be conclusive and binding on the Contractor.

18.9. The Contractor shall not be entitled for any damages/compensation for stoppage of work due to safety reasons as provided above and the period of such stoppage of work will not be taken as an extension of time for completion of work and will not be the ground for waiver of levy of liquidated damages.

18.10. The Contractor shall follow and comply with all Safety Rules, relevant provisions of applicable laws pertaining to the safety of workmen, employees plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservation. In case of any unconformity between statutory requirement and Safety Rules referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent.

18.11. If the Contractor does not take all safety precautions and/or fails to comply with the Safety Rules as prescribed by the Owner or as prescribed under the applicable law for the safety of the equipment, plant and personnel and the Contractor does not prevent hazardous conditions which may cause injury to its own employees or employees of other Contractors, or Owner or any

other person at Site or adjacent thereto, the Contractor shall be responsible for payment of compensation to the Owner as per the following schedule :-

a) Fatal injury or accident } Rs. 1,00,000/-) These are
causing death } (per person) applicable
for death
injury to
any person
whosoever.

b) Major injuries or accident } Rs. 20,000/-
accident causing 25% or } (per person)
or more permanent disability }
to work men or employees }

Permanent disability shall have the same meaning as indicated in Workmen's Compensation Act. The compensation mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the Workmen's Compensation Act and rules framed there under or any other applicable law as applicable from time to time. In case the Owner is made to pay such compensation, the Contractor will be liable to reimburse the Owner such amount(s) in addition to the compensation indicated above.

19.0. CODE REQUIREMENTS

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant ASME codes, accepted good engineering practice, the Engineer's Drawings and other applicable Indian codes and laws and regulations of the Government of India.

20.0. CHECK OUT OF CONTROL SYSTEMS

After completion of wiring and cabling the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

21.0. CABLING

21.1. All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmetrical bends for fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000 mm or otherwise as directed by the Site Engineer.

21.2. Each cable, whether power or control, shall be provided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.

21.3. Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.

- 21.4. In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made, should the cable develop fault at a later date.
- 21.5. Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to Site Engineer's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable as far as possible to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly out.
- 21.6. The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.

FITTING AND ACCESSORIES TO BE SUPPLIED ALONG WITH EACH UNIT

Conservator with partition for main transformer and OLTC:

1. For main transformer:

- 50 mm oil filling valve.
- 25 mm drain cum sampling valve with dummy plug.
- 50 mm filter valve with dummy plug.
- Lifting hooks.

2. For OLTC conservator.

- 50 mm oil filling valve.
- 25 mm drain cum sampling valve with dummy plug.
- 25 mm shut-off valve.

- Prismatic oil level gauge.
- Surge relay.
- Magnetic type oil gauge with low oil level alarm contacts.
- 3.Two Nos. Silica gel breather associated with oil seal in parallel each one with a valve for main conservator and 1 No. Silica gel breather associated with oil seal for OLTC conservator.
- 4.Buchholz relay double float with alarm and trip contacts with shut off valves on either side of the relay of size 80 mm.
- 5. Pressure relief device (safety valve type) with alarm contacts.
- 6. Pockets for thermometer on tank cover.
- 7. Oil temperature controller with maximum pointer and two sets of contacts, with mercury switches.
- 8. Winding temperature controllers with maximum pointer and four sets of contacts with mercury switches.
- 9.Valves.
 - 1.0. between cooler and tank.
 - 2.0. One 100 mm drain valve with padlocking arrangement, located on the low voltage side.
 - 3.0. Two 50 mm filter valves at diagonally opposite corners with padlocking arrangement for the bottom valve.
 - 4.0. Two sampling valves of 25 mm with provision for fixing PVC pipe.
 - 5.0. One 15 mm air release plug.
- 10.Two Nos. earthing terminals.
- 11.Rating, diagram, terminal marking, schematic wiring and valve position plates, (stainless steel) of not less than 300 x 300 mm.
- 12.Inspection cover.
- 13.Bi-directional rollers with greasing duct and nipple.
- 14.Wiring upto marshalling box with PVC stranded copper cables of 1100 V grade from various points.

15. Lifting and hauling facilities.

Lifting lugs.

Pulling eyes.

Jacking pads at a height of 500 mm.

Latching lugs.

Lifting eyes for the tank cover.

Fixed ladder with anti clamping device.

16. Weather-proof marshalling boxes for housing control equipment and terminal connections.

17. OLTC gear with remote control panel comprising, among other things,

- a. Necessary valves for filling drain and sampling of oil.
- b. Conservator for OLTC.
- c. Equaliser pipe with valve between divertor and main tank.
- d. Drive mechanism box.

18. Local control panel with necessary wiring and with the following:

- 1 Remote/Local selector switch.
- 2 Push button switch; Raise/off/lower.
- 3 Limit switch to prevent motor over-travel in either direction.
- 4 Counter.
- 5 Electrically interlocked reversing contractors.
- 6 Heaters with switch and HRC fuse.
- 7 Master/follower selector switch.
- 8 Interior lighting
- 9 Auxiliary relays.
- 10 Manual operating device.

19. Remote control panel.

1. Control push button switch: Raise/off/lower.
2. Independent/Off/Master/follower selector switch.
3. Lamp indications and initiating contacts as specified.
4. Remote top position indicator. (digital type)
5. Alarm annunciation scheme for trip and non-trip alarm as specified.
6. Local/remote selector switch for OLTC.
7. Provision with dummy plate for fixing differential relay in the panel.

20. Cooling accessories:

- i) Requisite number of radiators with shut-off valves at top and bottom , air release plug, drain plug and lifting eyes.
- (a) Fans and pumps.
- (b) Cooler control cubicle with necessary wiring and with the following:
 - 1. Lamp indications as specified.
 - 2. Initiating contacts.
 - 3. Selector switch for Local/Auto/Remote control
 - 4. Fan control switch for ON/OFF/Test.
 - 5. Pump control switch for ON/OFF/Test.
- (c) Transformer oil required for first filling at site including wastage in pre-commissioning process.

21. Bushings.

22 . Bushing current transformers as specified on HV, IV, & LV.

- 1. Terminal clamps for HV, IV, LV and Neutral.
- 2. One set of spare gaskets for assembling at site.

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