

**PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI**

Specification No. TRE/19118/01

Page 1 of 9 Pages

Rev. 00 Dt.: 01-01-16

**SPECIFICATION FOR OIL PURIFICATION & FILTRATION PLANT
- TWO STAGE (CAPACITY 6000 LPH)**

1.0 GENERAL:

This specification covers design, manufacture testing, package and dispatch of high vacuum insulating oil treatment (Filtration, deaeration and dehydration) plant suitable for 1800 m altitude & ambient of -12 deg C and outdoor application.

1.1 PERFORMANCE REQUIREMENT :

1.1.1 The Ultra High Vacuum type oil treatment plant of capacity 6000 LPH shall be mobile and shall be suitable for treatment of new oil and reconditioning of used oil in EHV class transformer, shunt reactor and other oil filled equipment in order to achieve properties of treated oil within specified limits at the rated capacity. The plant shall conforming to IS-6034.

1.1.2 The plant shall be capable of treatment of new oil (as per IEC 60296/IS:335) and reconditioning of used oil (as per IS: 1866/IEC:60422 for oil in service) at rated capacity on **" SINGLE PASS BASIS"** as follows :

- i) Removal of moisture from 100 ppm to 5 ppm
- ii) Removal of dissolved gas content from 10% by Volume to less than 0.1% by volume.
- iii) Improvement of dielectric strength break down voltage from 20 KV to 70 KV (min)
- iv) Vacuum level of degassing chamber at rated flow and at final stage :
Not more than 0.15 torr (0.2m bar) max.

(Degassing chambers of different degree of vacuum should have sufficient surface areas to achieve the final parameters. A detailed justification as to how end parameters shall be met with detailed calculation and test reports in support of the same shall be submitted along with the offer.

- v) Filtering capacity : Max. particle size less than 0.5 micron in the filtered oil.
- vi) (a) Processing temperature - 40 °C to 60 °C
- (b) Maximum allowed temp.
in oil to prevent oxidation - 60 °C.
(when oil is at atmospheric pressure)

1.1.3 Bidder is to furnish along with the bid detailed calculation to establish the sizing and capability of the vacuum pumping system with respect to moisture and gas removal as above.

1.1.4 Bidder is to submit along with the bid test reports, test methodology to prove the capability of the plant offered.

1.1.5 The plant shall also have two independent vacuum pumping systems one for evacuating the transformer for vacuum filling of oil in transformer and the other for degassing chamber. The blank off vacuum of each pumping system shall be 10^{-4} torr or less.

1.1.6 The plant shall be provided with control and indication panel with full automation.

PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI

Specification No. TRE/19118/01

Page 2 of 9 Pages

Rev. 00 Dt.: 01-01-16

1.1.7 The plant shall be fitted with hoses for connection of oil lines and vacuum lines to transformers and reactors. Hoses shall have leakage rate of 10^{-2} torr ltr/sec. (max.)

1.1.8 The Ultra high vacuum type oil purification plant shall be complete with oil pumps for drawing oil from transformer and reactors. Oil heater (maximum heating rate = 2.0 W/cm^2 of adequate rating suitable filter or centrifuge as required to ensure oil quality, degasifier complete with vacuum pumps, oil extraction pump etc. of adequate capacity such that throughout from the purification plant is of guaranteed purity.

1.1.9 The plant shall also be suitable for cleaning and degassing of the oil stored in the storage tanks.

1.1.10 All equipments required as above shall be mounted on a tow-able road worthy trailer unit with 4 nos. pneumatic tyres. The equipment shall be suitable for outdoor use. The equipment shall also have adequate number of jacking pad so that it can be kept on jack.

1.2 **DESIGN & CONSTRUCTIONS :**

The features and construction details of each 6000 litres per hour (LPH) capacity mobile outdoor type oil filtration & purification plant shall be in accordance with the requirements stated hereunder :

1.2.1 **OIL PUMP (INLET SIDE)**

1.2.1.1 Two (2) nos. electrically driven oil pumps with one (1) working and one (1) standby shall be provided. Selection switch is to be provided for selection of either of pumps. The **pumps shall be single stage positive displacement gear type**. The pump motor shall have insulation class-F with IP-55 protection. Suitable mechanical seals shall be provided to ensure vacuum tightness. A built in pressure relief valve to re-circulate the oil to suction side in case of accidental pressure rise shall be provided. Suction lift of the pump shall be at least 5 meters of transformer oil at atmospheric pressure & temperature. A separate by pass valve is provided across the gear pump so that the flow rate through the filter can be adjusted as required.

1.2.1.2 The pumps shall be provided with an interlock with delay such that if there is no oil flow for 30 sec. through the heater, the pump shall trip automatically & also if the pump is not operating the heater will not be energized.

1.2.3 **MAGNETIC STRAINER :**

1.2.3.1 The plant shall be provided with a suitable magnetic strainer with wire mesh to filter all particles of sizes above 0.5 mm & all magnetic particles. The strainer shall be installed at the suction of the oil pump described above.

**PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI**

Specification No. TRE/19118/01

Page 3 of 9 Pages

Rev. 00 Dt.: 01-01-16

1,2,4 **HEATER :**

- 1.2.4.1 A oil heater for heating up inlet oil shall be provided at the discharge side of the oil pump.
- 1.2.4.2 The oil heater vessels shall be of Mild steel welded construction & insulated with glass/mineral wool.
- 1.2.4.3 The vessel shall be constructed for ultra high vacuum & pressure application.
- 1.2.4.4 Electric heater shall be provided inside the heater vessel to heat up oil from lowest ambient temperature to temperature required for filtration/degasification operation in single pass. The heater shall also be rated for heating the inlet oil from lowest ambient temperature to 70 °C in single pass during filling up of transformers. Two separate temperature setting with thermostatic controllers shall be provided for this purpose.
- 1.2.4.5 The heating shall be indirect type and specific heat load shall not exceed 2.0 W/cm² in order to avoid local overheating.
- 1.2.4.6 The total heating capacity shall be divided into three independent thermostatically controlled heating stages evenly balancing the three phases of power supply. The control switches and knob shall be housed on a control panel.
- 1.2.4.7 An additional present temper proof safety thermostat set at the highest set at the highest Temperature shall be provided on the heater to put off the heater and give audio and visual alarm to take care of accidental overheating.
- 1.2.4.8 The heater body shall be so designed as to allow replacement of heating elements without draining of oil. Suitable pressure relief valve, vent and drain valves & two (2) dial type temperature gauges at inlet & outlet of heater shall be provided.

1.2.5 **FILTER :**

- 1.2.5.1 Cartridge filter as may be required to ensure maximum particle size to less than 0.5 micron in the filtered oil shall be provided.
- 1.2.5.2 The filter body shall be fabricated of mild steel & designed for leak tightness at full vacuum & high pressure. The oil will flow from dirty oil chamber to clean oil chamber through filter elements.
- 1.2.5.3 Cartridge type element used shall be suitable for transformer oil in service and submicronic filtration. The media shall be non hygroscopic and of high dirt holding capacity.
- 1.2.5.4 The filter elements shall be easily removable for replacement when required. Compound gauge to indicate pressure across the filter vent and drain with valves & other necessary accessories shall be mounted on the filter for each operation.

PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI

Specification No. TRE/19118/01

Page 4 of 9 Pages

Rev. 00 Dt.: 01-01-16

1.2.6 **FILTER PRESS :**

- 1.2.6.1 For treating dirty oil, filter press of adequate rating may be supplied for supplementing the capacity of filter elements. These units shall be designed for quick and easy replacement of media. A sludge outlet for receiving the solid impurities and cleaning the filter plate without opening the unit shall be provided. The unit shall also be provided with vent and drain valves, pressure gauge at inlet and outlet and other necessary accessories.

1.2.7 **EXTERNAL SOLENOID OPERATED VALVES :**

- 1.2.7.1 Two valves should be provided at the inlet and outlet of the plant. The moment inlet and outlet pumps are switched on these valves open thus making way for oil to pass. In case of power failure, oil from the transformer will not enter the plant and the vacuum system.

1.2.8 **DEGASSING CHAMBER :**

- 1.2.8.1 The degassing chamber shall be of welded construction and shall be suitable for operation under full vacuum. The fill of Raschig rings and trays for distribution shall be designed for efficient distribution of oil over large areas. Incoming transformer oil should be spread over these rings in the form of film and over a longer surface area, thus achieving better degassing and dehumidification.
- 1.2.8.2 The degassing chamber shall be either single stage or multi stage type suitable for ensuring the desired oil properties. Arrangement for condensing back lighter fraction (Aromatics) of the insulating oil into the system shall be provided.
- 1.2.8.3 The degassing channels shall have adequate height to allow long enough free fall for complete degassing. Design shall be such as to minimize foam formation.
- 1.2.8.4 The degassing chambers shall be provided with suitable level monitor for oil or foam level in the chamber and shall trip the inlet gear pump when the level rises above the designed maximum level in order to prevent foam/oil to enter the vacuum pumping system. The oil inlet pump starts again automatically once the oil level in the degassing chamber falls below the present oil level.
- 1.2.8.5 Necessary illuminated sight glass shall be provided through which oil flow through the degasser can be viewed clearly.
- 1.2.8.6 The degasser shall be provided with vacuum gauges, vacuum breaking valves, main and auxiliary vacuum connections and other necessary accessories.
- 1.2.9 **VACUUM PUMPING SYSTEM :**
- 1.2.9.1 The pump shall be provided with a suitable vacuum pumping system for creating adequate high vacuum in the degassing chambers. The pumping system shall consist of suitable combination of **Roots Blowers and Rotary vane vacuum pumps** with inter stage condensing units. The pump motor shall have insulation class-F with IP-55 protection.

**PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI**

Specification No. TRE/19118/01

Page 5 of 9 Pages

Rev. 00 Dt.: 01-01-16

1,2,9,2 The Roots blowers shall be reputed make. Suitable built in labyrinth packing system, slinger rings, oil return chamber shall be provided between bearings and working chamber to prevent penetration of lubricating oil to the working chamber. The pumps motor shall be dynamically balanced. The pumps shall be suitable for starting evacuation form atmospheric pressure and shall be applied with necessary over flow valve.

1.2.9.2 The rotary vane vacuum pumps shall be installed after the roots blower. An automatic bypass valve across the roots blowers shall permit operation of rotary vane pump alone to operate when so required. The rotary vane pumps are provided with gas ballast valve to prevent contamination of vacuum pump oil with moisture. The vacuum pump shall also be provided with suitable non-return valve device such that in the event of power failure the vacuum in the degassing chamber shall be maintained and the vacuum pump oil is not sucked back into the degassing chamber. A high vacuum safety valve (piston type) to prevent back streaming of oil and air intrusion shall be provided. The pump motors shall be have return stop device.

Necessary water cooled condensing unit to condense the lighter fraction (Aromatics) and return the same to the transformer oil shall be provided to reduce the loss of aromatics. Condensing units shall also be suitable for operation with broken ice for remote location operating where cooling water connection is not available.

1.2.10 VACUUM PUMPING SYSTEM FOR TRANSFORMER EVACUATION :

1.2.10.1 An independent vacuum pumping system shall be provided for evacuation the transformer for oil filling. The pump motor shall have insulation class-F with IP-55 protection. The vacuum level required for **transformer evacuation for oil transfer is about 0.1 torr or less** for transformer oil heated to 70-80 °C., The pumping system shall be identical to that of the degassing vacuum system. The capacity shall be adequate for evacuation of transformer in one hour. The vacuum system for degasser and transformer evacuation of transformer in one hour. The vacuum system of degasser and transformer evacuation shall be inter connected in such away that it shall be possible to use either or both the system for any of the purpose. **"A reinforced hose of 10 meters length should be provided. The houses must be for vacuum leakage rate of 10^{-2} torr litre/sec".**

1.2.11 OIL EXTRACTION PUMP :

1.2.11.1 Suitable pumping system shall be provided for extracting oil from degasser under vacuum and supplying to transformer/reactor etc. at discharge pressure of 1.5 kg/cm² at the outlet hose nozzle of the plant, the pump shall be either glandless centrifugal type with canned motors or a combination of gear pump and centrifugal pump with mechanical seals suitable for extracting oil from high vacuum degassing chamber. The oil extraction pump shall be located at a suitable level below the degasser chamber so as to ensure adequate suction head for the pump. The pump shall be supplied with double check valve assembly and solenoid operated non return valve. In order to stop reverse flow of oil in case of power failure, the pumping system shall preferably be self priming type alternatively priming device with safety interlock to protect pump against dry running shall be provided. Sampling valves shall be provided at the discharge of extraction pump for testing of oil properties. A re-

**PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI**

Specification No. TRE/19118/01

Page 6 of 9 Pages

Rev. 00 Dt.: 01-01-16

circulation line with valves shall be provided to re-circulate a part of the purified oil to the inlet point if necessary during operation. The pump motor shall have insulation class-F with IP-55 protection.

1.2.12 HOSES FOR TRANSFORMER OIL, VACUUM AIR AND WATER :

1.2.12.1 Separate reinforced rubber hoses shall be provided for each operation of oil suction. Oil discharge transformer vacuum connection compressed air supply cooling water supply and return. The hoses shall be at least 15 meters long each and shall be compatible with hose quick connect couplers for connection to installations under operation.

1.2.12.2 Hose pipes for oil service shall be suitable for transformer oil applicable up to temperature of 100 °C. full vacuum and pressure up to 2.5 kg/cm². All oil hoses shall be built up around an earthed core or have built in earthed conductor to avoid static electricity accumulation. Inlet and outlet nozzles of purification plant and corresponding hoses shall be of 50/40 NB size respectively in order to avoid error in connecting.

1.2.12.3 Vacuum hoses shall be of braided nitrile rubber suitable for full vacuum without collapsing and kinking.

1.2.12.4 Mobile hose racks shall be provided to accommodate the hoses.

1.2.13 (A) Oil sampling valve

(B) Material of construction and painting

Suitable valve shall be provided for taking sample during filtration.

1.2.13.1 Oil heater, filter vessel, degasser shall be of mild steel construction. The internal and external surface including oil heater, filter vessel, degassifier and structural steel work to be painted shall be shot or sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surface in contact with insulating oil shall be painted with two coats of heat resistant oil insoluble, insulating varnish/paint.

1,2,13,2 All internal painted steel surface shall be given a primary coat for zinc chromate second coat of oil and weather resistant varnish of a colour distinct from primary and final two coats of glossy oil and weather resisting paint.

1.2.13.3 All paints shall be carefully selected to withstand heat and extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

1.2.13.4 BOLTS & NUTS :

All bolts and nuts exposed to weather shall be not dip galvanized/cadmium plate and passivated/zinc plated and passivated.

1.2.13.5 Material of construction for vacuum pumps air compressor, air drying plant, air receiver shall be steel of suitable grade.

**PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI**

Specification No. TRE/19118/01

Page 7 of 9 Pages

Rev. 00 Dt.: 01-01-16

1.3 INSTRUMENTATION AND CONTROL :

- 1.3.1 Following minimum instruments shall be provided on the purification plant.
- 1.3.1.1 Compound gauge at oil pump discharge.
- 1.3.1.2 Compound gauge at filter inlet.
- 1.3.1.2 Compound gauge at filter outlet.
- 1.3.1.3 Pressure gauge at discharge pump outlet.
- 1.3.1.5 Pressure gauge at compressor outlet
- 1.3.1.6 Pressure gauge at air receiver.
- 1.3.1.7 Pressure gauge at degassifier
- 1.3.1.8 Vacuum gauge at transformer evacuation line.
- 1.3.1.9 Vacuum gauge in between roots vacuum pump and rotary vane vacuum pump.
- 1.3.1.10 Mc leod Vacuum Gauge at degasser and transformer evacuating line.
- 1.3.1.11 Sight glass as degassifier.
- 1.3.1.12 Temperature indicator (Dial type) at heater inlet.
- 1.3.1.13 Temperature indicator (Dial type) at heater outlet.
- 1.3.1.14 Voltmeter.
- 1.3.1.15 Oil flow meter (positive displacement type)
- 1.3.1.16 Ammeter.

1.3.2 CONTROL PANEL :

A centralized electrical panel with auxiliary step down transformer, contactors, back up protection fuses, indicating lamps etc. to be provided with following minimum audio and visual alarms:-

- (a) High temperature at heater outlet
- (b) High differential pressure across filters
- (c) Oil pump trip
- (d) Vacuum pump trip
- (e) Loss of vacuum in degassing chamber
- (f) Loss of vacuum in transformer evacuation line
- (g) No oil flow through heater
- (h) High oil level in degasser.

All controls and annunciation equipment should be suitable for 240 V AC.

- 1.3.3 Suitable interlock as described against each equipment shall be provided for safe and trouble free operation.
- 1.3.4 All instrument control hardware and alarms shall be mounted on a suitable control panel. A mimic diagram with indication lamps showing on off status of various equipment shall be provided on the control panel.
- 1.3.5 The plant shall be fully equipped with adequate instrumentation having provision of manual operation if required. All necessary control and indicating panels shall be provided.

**PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI**

Specification No. TRE/19118/01

Page 8 of 9 Pages

Rev. 00 Dt.: 01-01-16

- 1.3.6 The plant shall be complete with all necessary hose, cable etc. of adequate length for necessary connections to transformers/reactor and also to utility connections to be provided near such installations for this purpose.
- 1.3.7 It shall be possible to sue the oil transfer pump for the purpose of loading oil to transformers or reactors from tankers and vice versa by by-passing to purification plant, if required.
- 1.3.8 There shall be independent vacuum pump for creating and holding the transformer/reactor winding under vacuum for vacuum drying and filling of winding when required. The vacuum pump shall have capacity to develop and maintain adequate vacuum in the oil space of the maximum sized equipment (90, 000 liter) within about one hour time.

1.4 **ELECTRICAL SYSTEM**

- 1.4.1. The plant shall receive 415v, 3-phase, 50 Hz, 4 wire power supply through flexible cable in the cable in the distribution panel located on the plant. The incoming of the distribution panel shall be switch fuse unit.
- 1.4.2 One length of 50 meters of core 1100 grade flexible cable with crimped lugs at one end shall be provided for connection of the unit to the mains. The length of the cable will be covered in a suitable drum.
- 1.4.3 Provision for earthing the plant at the operating locations with earthing terminals for safety shall be provided.
- 1.4.4 The plant shall be suitably illuminated and ventilated for comfort of operator.

2.0 **SPARE PARTS**

Party shall quote recommended spare parts for trouble free operation of the Plant for a minimum of five years including following items:

- | | |
|---------------------------------|-------|
| 1. Filter cartridges | 1 set |
| 2. Bearing of the pumps | 1 set |
| 3. Gaskets | 1 set |
| 4. Leap seals | 1 set |
| 5. Filter press (if applicable) | 1 set |
| 6. Rotary seal (if applicable) | 1 set |
| 7. Valve gasket | 1 set |
| 8. Rubber hose | 1 set |
| 9. Pressure gauge | 1 set |
| 10. Heater Element | 1 set |
| 11. From control switch | 1 set |
| 12. Valves | 1 set |

3.0 **INFORMATION TO BE FURNISHED ALONGWITH THE OFFER :**

The party shall submit the following data along-with the offer.

- 1) Three sets of descriptive leaflet, catalogue and technical literature of the Model.

PRODUCT PURCHASING SPECIFICATION
TRANSFORMER ENGINEERING DEPARTMENT
BHEL, JHANSI

Specification No. TRE/19118/01

Page 9 of 9 Pages

Rev. 00 Dt.: 01-01-16

- 2) Technical data of the plant indicating quantity, description, rating, capacity of the plant, outline dimensional drawing with tyres undercarriage and overall Weight etc. shall be supplied.
- 3) Total power requirement for the plant in KW.
- 4) Heating density (w/cm²) of oil total cooling water required for the plant.
- 5) Guaranteed performance technical data to be submitted

4.0

TRAINING :

The supplier shall provide training to Customer at site on intimation by BHEL for commissioning, operation and maintenance of the plant for a maximum of 3 man-days per plant per site, and shall obtain certificate from customer regarding impart of training. Supplier should quote the charges, if any, in the offer separately.

5.0

INSPECTION, TESTING AND DISPATCH :

5.1

After receipt of letter of indent/purchase order from BHEL, the supplier shall furnish a detailed quality assurance plan (QAP) in the desired format for approval by customer. It will be sole responsibility of the supplier to get the approval of QAP before execution of the order. QAP shall include tests/checks for all major components and fittings used in the plant, all stage and process checks and final inspection and testing. At least, the following requirements will be included in QAP.

- (a) Tests/test certificates on inlet gear pump, vacuum, outlet pump motors, gauges, instruments and fittings.
- (b) Tests/test certificate for raw materials like structural steel and pipe etc.
- (c) Vacuum and pressure test on all vessels such as filters, degassing chamber and heating vessel etc.
- (c) Vacuum leakage test of complete plant.
- (e) Capacity (flow rate) test of the plant.
- (f) All electrical and interlock test including insulation test of switch panel.
- (g) Performance test of the plant as per para 1.1 above.

5.2

The supplier shall furnish all test certificates as per the approved QAP. The oil purification and filtration plant shall be inspected and tested at manufacturer's works in presence customer representative. An advance notice of at least 15 days should be given to arrange for inspection. Plants shall be dispatched only after clear cut CHP (Customer Hold Point) and MICC (Material Inspection Clearance Certificate) from customer.

Five sets of inspection and test reports, operation and maintenance manual shall be sent along with dispatch document. One set shall be kept inside the equipment.

5.3

The supplier shall furnish a list of all fittings and components in the dispatch details giving description and quantity of each item (Quantity of each item shall be mentioned). All items shall be properly packed to avoid damage in transit.



KISHANGANGA H.E PROJECT

(PTS)

29. OIL HANDLING SYSTEM

29.1. Scope of Work

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, site storage and preservation, installation, commissioning, performance testing, acceptance testing, training of Owner's personnel, handing over to Owner and guarantee for two years of oil handling system as per the specifications hereunder, complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

The scope of work shall be a comprehensive functional system covering all supply and services including but not be limited to following:

29.1.1. Vacuum type insulating oil handling system

- i) Two (2) 6000 LPH or higher mobile tyre mounted insulating oil purifying plants complete with transformer evacuation system, oil hoses, vacuum hoses, hose couplings and other accessories to complete the system.
- ii) Two (2) five (5) cubic meter/min or higher capacity regenerative air dryers.
- iii) Two (2) 3000 LPH or higher mobile tyre mounted insulating oil transfer pump with oil hoses, hose coupling and other accessories etc.,
- iv) Two (2) mobile tyre mounted large insulating oil tanks of capacity 25000 litres each or 120% of oil requirement of one GSU transformer whichever is higher.

29.1.2. Lubrication oil handling system

- i) Two (2) 1000 LPH or higher mobile tyre mounted centrifuge type lubrication oil purifying plants complete with oil hoses, hose couplings and other accessories to complete the system.
- ii) Two (2) nos. mobile tyre mounted lubricating oil tanks of capacity 6000 litres.

Any other item(s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard(s) / best international practices.

29.2. Specific Parameters and Layout Conditions

29.2.1. Insulating oil handling system

Suitable arrangement/ provision shall be made in the system/ system components such that the plant can be docked near each of the transformer units for the intended purpose. The Contractor shall ensure adequate coordination while designing the system to ensure compatibility of inlet outlet



ports between the transformers and oil handling equipment.

The oil hoses and vacuum hoses for each plant shall be of sufficient length and size to filter the oil of any transformer unit.

29.2.2. Lubrication oil handling system

The oil hoses shall be of sufficient length and size to connect lubrication oil purifying plant to various equipment / components / systems.

Suitable piping both embedded and exposed, fittings, fixtures etc. shall be coordinated with the Turbine, Governor and Generator manufacturers/ sub-contractors for dockable type arrangement and provision shall accordingly be incorporated.

29.3. Rating and Functional Characteristics

29.3.1. Insulating oil handling system

- The purifier shall be capable of processing the oil on single pass basis at rated flow to the following specification:
 - Moisture content : Less than 5 PPM
 - Gas content : Less than 0.1% by volume
 - Dielectric strength : 70 kV across 2.5 mm gap
 - Filtration : Less than 1 micron
 - Power factor Tan Delta at 90 °C : 0.002

29.3.1.1. Transformer evacuation system

- Capacity to have an ultimate blank-off of 10^{-4} Torr or less.
- Evacuation to the level of 0.1 Torr or less when connected to main transformer tank.

29.3.2. Lubrication oil handling system

The purifier shall be capable of processing the lubricating oil on not more than two (2) passes basis at rated flow to the following specification:

- Free water : 100% reduction
- Moisture content : Less than 50 PPM
- Filtration : Less than 1 micron



29.4. Performance Guarantee

The oil handling system along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. The Contractor shall guarantee the reliability and performance of the individual equipment as well as of the complete system.

29.5. Design and Construction

29.5.1. Standards

The system and equipment shall be designed, built, tested and installed to the latest revisions of the following applicable standards. In the event of other standards being applicable they will be compared for specific requirement and specifically approved during detailed engineering for the purpose:

Standards	Description
IS 6034	Insulating oil conditioning plants - specification
ASTM A516	Standard specification for pressure vessel plates, carbon steel, for moderate and lower temperature service
ASME Section VIII	Code for unfired pressure vessels

29.5.2. Oil Purifiers

The systems shall have its own control panel with suitable pressure gauges, push-buttons for starting and stopping with a flow-meter, a volume-meter with manual zero reset etc., other controls and monitoring with necessary protection. The insulation of motors shall be of Class-F with IP 55 protection class.

29.5.2.1. Insulating oil purifiers

The insulating oil purifiers shall be of filtration and vacuum de-hydration type. Unit shall consist of coarse filter, oil transfer pump, thermostatically controlled ceramic heaters, filtration section, deoxidizing column, vacuum pumps, discharge pump, two stage degassing system, transformer evacuation system, thermometers, pressure / vacuum gauges, flow meter, valves, piping, control panels with on-line process monitoring facilities and other accessories necessary for satisfactory operation of purifiers. The insulating oil purifiers shall be suitable for indoor and outdoor duties.

29.5.2.2. Lubricating oil purifiers

The purifying unit shall be a complete self-contained and enclosed unit with motor-driven pumps or pump of suitable rating, centrifuging chamber and other appurtenances to make the system complete and functional.



The lubricating oil may contain free and dissolved moisture of the order of 1000 to 2000 PPM initially which needs to be reduced in the range of 50 PPM. Besides moisture, the oil may contain suspended impurities such as cotton waste, welding slag and spatters, metallic chips, small sand particles, iron fillings, pebbles, dust and pipe scales. The offered equipment shall not be damaged by the flow of oil containing these impurities. The oil may also contain grease and kerosene, which shall also be required to be removed.

29.5.3. Oil tanks

The oil tanks shall be cylindrical, of welded steel construction and shall be designed and fabricated from plate steel conforming to ASTM A516 Grade-60 in accordance with part UW of the ASME Code for Unfired Pressure Vessels, Section VIII, for the design. It shall be horizontally mounted on wheels equipped with inspection manholes, gauge glasses or other means for indicating liquid level, overflow and vent lines and drains. The tank shall also be provided with suitable saddles so that it can be rested on ground after removing from the trolley.

All tank vents shall be fitted with dehydrators to prevent the entry of moisture into the tanks.

The thickness of tank plate shall be of sufficient size for temperature effect and pressure due to oil. However, it shall not be less than 8 mm for shell and 10 mm for dish end. The oil tanks shall be vacuum tested and for leakage as well.

29.5.4. Oil transfer pump

The oil pumps shall be of vacuum tight positive displacement gear type with horizontal driving shaft directly connected to its electric motor through a flexible coupling and complete with a check valve, shut-off valves, safety relief valve, high temperature shutdown etc..

Each pump shall be tyre mounted and shall be equipped with pressure relief valve to protect the pump against excessive pressure in case of throttling in the discharge line. The relief valve shall be set for a pressure, which will not overload the motor when operating at full load.

29.5.5. Pipes, fittings and hoses

All pipes shall be seamless steel tubes. Fittings shall be forged or compression type steel fittings with cutting ring seal. Plug type valves with oil-resistant seats shall be used throughout the system. Hoses shall be steel-armoured, oil resistant and of suitable lengths. The hoses shall be provided with leakage-proof, quick-connect couplings.

The hoses shall be able to withstand the required pressure and temperature of oil during the filtration process.



Suitable mobile hose racks shall be provided to accommodate the hoses. All pipes, fittings and hoses shall be properly labelled and distinctively marked.

29.5.6. Air dryers

The air dryers shall be of regenerative type to fill the dry air in transformers when required. Each air dryer shall be provided with at least 150m cables.

29.6. Drawings, Documents and Design Calculations

29.6.1. Design memorandum

The Contractor shall submit to Owner a design memorandum prepared in accordance to clause 1.6 "Record and Documentation" of "Section 1- General Technical Requirements."

29.6.2. Drawings and documents

The Contractor shall submit all the drawings and documents in accordance with requirements stipulated in "Section 2 - Technical Documents" of "General Technical Specification (GTS)".

These drawings and documents shall include at least the following:

- Schematic drawings of the oil handling plant with all piping systems, control systems and instrumentation with reference of the relevant Indian/international standards followed for the design and construction of the plant and its components/material.
- General arrangement plan, section of main and sub-assemblies with detailed dimensions of the parts and the size of each and every part of the equipment to be supplied under this specification.
- Complete list of accessories and auxiliaries with their make and accompanied with catalogue/pamphlets/literature/write-ups.
- Complete list of instruments offered with their make and accompanied with catalogue/pamphlets/literature/write-ups.

29.6.3. Design calculation

The Contractor shall submit the design calculation in accordance to Clause 2.6 of "General Technical Specification (GTS)" covering at least the following, for review / acceptance.

- Calculation for selecting the pumping capacity of the pumps including vacuum pumps, oil tank and plant capacity.
- Size of De-gassing chamber.
- Methods/ principal adopted for determination of oil characteristics.



KISHANGANGA H.E PROJECT

(PTS)

- Capacity of the heater for both lubricating oil and insulating oil handling system,
- Total power requirement individually for the insulating oil and lubricating oil purifying system and of oil transfer pumps.
- The Contractor shall also provide other calculations as required by the Owner for his approval of the Contractor's design.

29.7. Delivery, Installation and Commissioning

The Contractor shall follow the requirements of Delivery, Installation and commissioning elaborated in clause 1.7 "Delivery, Installation and commissioning" of "Section 1 - General Technical Requirements."

29.7.1. Specific packaging, handling and storage requirements

Prior to shipping, all threaded openings shall be closed with standard pipe plugs. Flanged openings shall be protected with blind flanges with gaskets bolted in position.

29.8. Spare Parts

Recommended spare parts shall be supplied in accordance to clause 1.8 "Spare Parts" of "Section 1 - General Technical Requirements". Specified spare parts to be supplied under this section are as follows:

S. No.	Description	Quantity
1	Connecting hose with couplings of each type and size	2 nos. of standard lengths of each used type
2	Oil pump of all type	1 set of each used type
3	Complete set of seals and gaskets for the system	2 sets
4	Complete set of filters for the system	2 sets
5	Complete set of valves for the system	2 sets

29.9. Tools and Instruments

The Contractor shall supply all necessary tools and instruments etc. for installation, repair and maintenance in accordance to clause 1.9 "Tools and Instruments" of "Section 1 - General Technical Requirements".

**KISHANGANGA H.E PROJECT**

(PTS)

29.9.1. Special tools

The Contractor shall propose the list of special tools including their make and detailed specification as recommended by manufacturer(s), to be accepted by the Owner.

29.10. Quality Assurance and Testing

The Contractor shall follow the quality assurance and testing requirements specified separately in "Quality assurance and Testing Specifications (QTS)".

**29. OIL HANDLING SYSTEM****29.1. Type Tests**

The contractor is required to carry out all type tests as per relevant IEC/International Standard on one apparatus of each type of similar rating and shall submit the reports to the employer. The type test may not be mandatory if similar equipment has been type tested and test certificates for relevant tests are accepted by the employer.

Following Items Test reports shall be submitted

- ◆ Insulating oil purifier and its major components,
- ◆ Lubricating oil purifier,
- ◆ Air dryers.

29.2. Shop Tests

The components of Insulating Oil Purifier, Lubricating Oil Purifier and Air Dryers shall be routine tested as per relevant IEC with latest amendments. All shop tests shall be carried out at the manufacturer works.

The following tests shall be done on Insulating Oil and Lubricating Oil Purifier

- ◆ Leak Tightness – Pneumatic Test,
- ◆ Leak Tightness Test Under Vacuum,
- ◆ Pressure Test on Pipe with Assembly,
- ◆ Capacity Check,
- ◆ Power Consumption of Motor and Heater,
- ◆ HV and IR Test,
- ◆ Protection and Inter Lock Verification.

The following Performance Test of Transformer Oil Parameters (Single-Pass) shall be done:-

- ◆ Dielectric Strength (BDV),
- ◆ Moisture Content (PPM),
- ◆ Gas Content,
- ◆ Filtration,
- ◆ Dielectric Disputation factor,
- ◆ Neutralizations Value.

The following Performance Test of Lubricating Oil Parameters (Single-Pass) shall be done:

- ◆ Free Water,



- ◆ Moisture Content,
- ◆ Filtration.

The Details of the tests are given in Model Quality Assurance Plan of Oil Handling System.

29.3. Field Tests

All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance tests shall be submitted well in advance, at least six (6) months before start of relevant testing, for approval of the Employer.

Following tests shall be performed:

- ◆ Test to demonstrate operational capabilities of the system as per the intended requirement.

29 OIL HANDLING SYSYTEM**29.0 Guaranteed Technical Particulars**

Item / Clause No.	Parameter	Units	Contractor's Data
1	General		
1.1	Type/ designation		HIGH VACUUM TWO STAGE
2	Insulating oil system		
2.1	Tyre mounted large plant		MOUNTED ON FOUR PNEUMATIC TYRES
	- Type/ designation		HIGH VACUUM TWO STAGE
	- Number supplied	Nos.	TWO
	- Rate of oil flow	Lpm	100(6000 LPH)
2.2	Capabilty of insulating oil purifying plant both small and large, after single pass		
2.2.1	Moisture content	PPM	INITIAL - 50 PPM, FINAL - 5PPM
2.2.2	Filtration	micron	LESS THAN 1 MICRON
2.3	Tyre mounted large insulating oil tanks		
	- Number	Nos.	TWO
	- Capacity of tank	Litre	25000
	Transfer pump		PROVIDED AS PER CLAUSE 29.5.4
	- Type/ designation		GEAR TYPE
	- Number of pumps	Nos.	Two (one for each system)
	- Pumping capacity	Lpm	50LPM (3000LPH)
	- Duty of pump-motors		CONTINUOUS
	- Insulation class and protection class of pump-motors		MOTORS " F " CLASS, IP 55
2.4	Air dryers		
	- Number supplied	Nos.	TWO
	- Capacity of air dryer	m ³ /min.	5
2.5	Oil Hoses	Nos.	OIL INLET: 40NBx10MTRS, OIL OUTLET : 40NBx 10MTRS
	- Type/ designation		NITRILE RUBBER
	- Number	Nos.	INLET HOSE 1 NO, OUTLET HOSE 1 NO



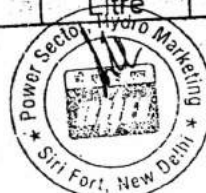
29 OIL HANDLING SYSYTEM

29.0 Guaranteed Technical Particulars

Item / Clause No.	Parameter	Units	Contractor's Data
2.6	Evacuation system for transformer tanks		PROVIDED . MOUNTED WITH THE INSULATING OIL FILTRATION PLANT
	- Type/ designation		ROOTS-ROTARY COMBINATION
	- Number	Nos.	2 SETS. 1 EACH WITH INSULATING & FILTRATION PLANT
	- Pumping capacity of vacuum pumps	Lpm	ROTARY PUMP 1500LTRS/MIN ROOTS PUMP - 500M ³ /HR
	- Duty of pump-motors		CONTINUOUS
	- Insulation class and protection class of pump-motors		IP 55, MOTOR CLASS "F"
	Vacuum Hoses	Nos.	PROVIDED
	- Number		1 NO EACH EVACUATION SYSTEM
	- Type/ designation		NITRILE RUBBER
3	Lubricating oil system		
3.1	Capabilty of lubricating oil purifying plant, after not more than two passes		
3.1.1	Moisture content	PPM	2000 PPM to 50 PPM
3.1.2	Free water reduction	%	Upto 2000 PPM
3.1.3	Filtration	micron	Less than 1 micron
3.1.4	Centrifuge type tyre mounted plant		Mounted on 4 pneumatic tyres
	- Type/ designation		Centrifuge - Vacuum Degasser combination
	- Number supplied	Nos.	Two
	- Rate of oil flow	Lpm	20 LPM (1200 LPH)
	- Pumping capacity	Lpm	20 LPM (1200 LPH)
	- Total heating capacity	kW	24 kW
	- Purifier cleaning effectiveness, particulate matter down to	mm	Less than 1 micron
	- Fineness	mm	1 micron
3.2	Tyre mounted lubrication oil tanks		Two
	- Number	Nos.	8000
	- Capacity	Litre	



29-3



814

12