BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-357-565-035	Rev. No.	0		Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN			14/8/13
TITLE	OIL FILTRATION PLANT			NAME	TDT	SKS	SS
				DATE	14/08/13	14/08/13	14/08/13
				GROUP	TBEM	W.O. No	82003

CUSTOMER	**BIHAR STATE ELECTRICITY BOARD (BSEB)**
PROJECT	**220 /132 kV PUSAULI SUB-STATION & DEHRI EXTN.**

CONTENTS

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS

Distribution	To	TBEM	TBMM	TBQM	Vendor
	Copies	1	1	1	4

SECTION - 1

Intent, Design criteria, System design and scope

1.1 Intent of specification

1.1.1 This specification is intended to specify the requirements for design, engineering, manufacture, assembly, stage testing, inspection, testing before supply, packing, forwarding, delivery at site and complete erection of all equipment and accessories, testing of the system, trial run, commissioning of the system, final painting and carrying out acceptance test at site of **Oil Handling System** along with its accessories and auxiliary equipments / instruments etc. as mentioned in this section and in various other sections of this specification for **220/ 132 kV Pusauli Substation & Dehri Extn. of Bihar State Electricity Board (BSEB).**

1.1.2 The requirements specified under SECTION 2 and SECTION 3, of the specification shall be considered as part of this section. In case of variance between various sections, the requirements of Section 1 shall prevail.

1.1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respect to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser / Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his/their judgment is not in full accordance with the specifications.

1.1.4 The bidder shall be deemed to have understood completely all the tender drawings and documents and quoted accordingly. Contract shall be on lump sum basis for the package. Within the scope of the contract, no variation shall be admissible to Contractor so far the inputs remain unchanged.

1.1.5 In case of any deviation, the bidder shall indicate separately the deviations clause-wise with respect to the specification in the 'Schedule of Deviation' as described in Section 5. Deviations in any other form including clarifications / assumptions / etc will not be considered and it will be construed that the bid conforms strictly to the specification.

1.1.6 This specification makes it obligatory for the contractor to arrange / obtain necessary approval / clearance from statutory organizations wherever applicable for the plant / machinery / sub-systems under the scope specified

1.1.7 The system shall be designed to suit the extreme of outside conditions as given in "Section 3" of the specification.

1.1.8 The term 'Owner' appearing in this specification shall refer to Bihar State Electricity Board (BSEB), the term 'Purchaser' shall refer to Bharat Heavy Electricals Limited (BHEL) and the term 'Contractor' shall refer to the successful Bidder.

1.2 Introduction

1.2.1 Oil Handling System shall comprise of following:

i. **Ultra High Vacuum type Transformer Oil Filtration plant of minimum 4000 LPH capacity** shall be for treatment of new oil and reconditioning of used oil in EHV class transformer, shunt reactor and other oil filled equipments in order to achieve properties of treated oil within specified limits with rated capacity. It shall be for outdoor services entirely self contained, completely weather proof and shall be of mobile design complete with pneumatic tyre wheels with spring under the heavy base steel frame and tow bar suitable for rolling the machine on ground / along public roads. This shall also be fitted with over run brakes. The purification of oil required in case of Transformer/Reactors shall be by circulating the oil through vacuum filtration & purification machine.

The equipment shall be in a weather proof sheet steel enclosure and mounted on a trailer to be moved on roadway within the station. The enclosure is to be insulated and ventilated such that the plant can be operated at ambient temperatures of 0^{o}C to 50^{o}C. The plant has to be fully automatic and suitable for continuous operation.

1.3 Design Criteria

i. The plant shall be capable of treatment of new oil (as per IEC 296/ IS: 335 and reconditioning of used oil as per IS: 1865/IEC: 422 for oil in service) at rated capacity on single pass.

ii. Treated Oil shall acquire following characteristics after circulating through fully operational filter plant:

Table 0-1 Table for Oil Properties

Oil Properties	Before Treatment	After Treatment 1st Pass
Moisture Content (ppm.)	**100**	**3 (maximum)**
Dissolved Gases (% by Volume)	**10**	**0.1 (maximum)**
Dielectric Strength (kV)	**20**	**70 (minimum)**
Filtration Degree	**--**	**0.5 micron (or less)**

iii. The weight of oil and volume of oil in transformer is approx. 55,000 Kg and 61,000 Lt. respectively.

iv. During processing, Oil temperature shall be in the range of 40 to 60 ^{O}C. and processing temperature shall be automatically controlled. The vacuum level in the De-gassing chamber in single pass at rated flow at final stage shall be not more 0.15 torr (0.2 mbar).

v. The plant shall also have two independent vacuum pumping system, one for evacuating / vacuum filling of oil in Transformer and the other for degassing chamber. The blank off vacuum for each pumping system shall be 10^{-3} torr or less. One additional vacuum measuring instrument with all accessories shall be supplied separately.

vi. The independent vacuum pump would be provided for creating and holding the transformer /reactor under vacuum for vacuum drying of windings and filling when required.

vii. Vacuum level required for transformer evacuation for the purpose of oil filling is 0.76 torr (1m bar) for transformer oil heated up to 70-80 ^{o}C.

viii. The Oil treatment plant shall be fitted with hoses for connection of oil lines and vacuum lines to transformer. Hose pipes for oil service shall be suitable for transformer oil application up to temperatures of 100^{o}C, full vacuum and pressure. Trailer also shall be capable of accommodating these hoses and cable during transport in station.

ix. The plant shall be suitable for cleaning and de-gassing of oil stored in storage tanks too.

x. An indicating panel with indicating lights showing which equipment are running is to be provided.

xi. In case of Heaters, to ensure that no overheating / localized heating occurs, the density of heat in the heater tank shall not exceed 2W/cm^{2}.

1.4 Scope of supply

The scope of the work under the contract shall be deemed to include all such items, which although not specifically mentioned in the bid documents and/or in the bidder's proposal, but are required to make the equipment/ system complete for its safe, efficient, reliable and trouble free operation.

1.4.1 Main Equipment

(i) One **(1)** set, **Ultra High Vacuum type oil filtration plant** complete with

a. **2 X 100% oil re-circulation pumps** of adequate capacity. One shall be working while the other shall be standby.

b. One **(1)** No. **Heater tank** containing three stage heating facility suitable for heating up incoming oil to desired temperatures before de-gasification.

c. One **(1)** Set of a suitable combination of **Roots blower and Rotary vane vacuum pump** with **inter-stage condensing units** to achieve desired level of High vacuum in the de-gassing chamber.

d. One **(1) No**. Self-priming type **outlet pump** suitable for supplying oil to the transformer.

e. One **(1)** Set of **piping** with accessories for interconnecting both independent vacuum systems and for operating the plant.

f. One **(1)** Set of suitable **cooling arrangement** for the plant.

g. One **(1)** Set of **Hoses** for the following operations

- Oil Suction
- Oil Discharge
- Transformer vacuum connection
- Compressed Air supply

The vacuum and oil hoses of sufficient length to reach between the oil system and transformer connections shall be supplied with plant

h. One (1) no. **Control cum Annunciation panel** with the following minimum annunciation / alarms (audio / video)

- High temperature at heater outlet.
- High differential pressure across filters.
- Oil pump-1 trip.
- Oil pump –2 trip.
- Vacuum pump –1 trip.
- Vacuum Pump-2 trip.
- Loss of vacuum in degassing chamber.
- Loss of vacuum in transformer evacuation line.
- No oil flow through heater.
- High oil level in de- gasser.
- Cooling Water pump trip.

i. One (1) Set of **Transformer evacuation system** complete with Roots & Rotary vacuum pumps and accessories.

j. One (1) set of **instruments** constituting the following minimum of requirement:

i. Compound gauge at oil pump discharge.
ii. Compound gauge at filter inlet.
iii. Compound gauge at filter outlet.
iv. Pressure gauge at discharge pump outlet.
v. Pressure gauge at compressor outlet.
vi. Pressure gauge at air receiver.
vii. Pressure gauge at de-gassifier.
viii. Vacuum gauge at transformer evacuation line.
ix. Vacuum gauge in between roots vacuum pump & rotary vane vacuum pump.

x. Panel mounted vacuum indicators at de-gassifier.
xi. Panel mounted vacuum indicators at transformer evacuating line.
xii. Sight glass at de-gassifier.
xiii. Temperature indicator cum controller at heater inlet.
xiv. Temperature indicator cum controller at heater outlet.
xv. Voltmeter.
xvi. Oil flow meter (positive displacement type.)
xvii. Ammeter.

In addition to the above whatever necessary instruments (Float switch, dial thermometers etc) as may be required for system design and smooth / efficient functioning of plant in line with description as given in clause 1.2, but not specifically mentioned herein, shall also be supplied by the bidder at no extra cost to the Purchaser. Such items shall be clearly brought out in the offer.

k. One (1) set of miscellaneous valves/magnetic strainer/Filter press/Oil Flow meter/Flow switch/Pressure switches/Panel mounted vacuum measuring device for de-gassing chamber/vacuum gauges for vacuum lines/regulation and safety thermostats/thermometers etc and other minor items required for desired operation of the purification plant.

l. Suitable length of power cable to reach the power points installed for this purpose on or adjacent to the transformers and other units requiring treatment shall be supplied with treatment plant

m. One (1) lot of all **chemicals and consumables** required for commissioning of oil filled equipments i.e. Transformers at the station.

n. The contractor shall also supply the **first fill of lubricants** for the equipment under the scope.

1.4.2 Tools & Tackles

One complete set of tools, tackles and other minor items required for maintenance / upkeep and overhaul of the plant and also for replacement of various equipment/components at site shall be supplied under this contract.

1.5 Scope of Services

1.5.1 The scope of services includes commissioning of the system, conducting performance test to the satisfaction of the owner/purchaser and handing over of the fully operational system to the Owner/ purchaser.

1.5.2 It is the responsibility of the supplier to train at least two (2) site engineers of Purchaser/Owner in efficient handling of the plant. Handing over of the plant shall be deemed complete only upon certification from Purchaser/Owner to this effect.

1.5.3 The bidder shall ensure that sufficient quantities of commissioning spares are made available for timely completion of commissioning of the system. The bidder shall furnish a list of commissioning spares that shall be brought by him. The unused commissioning spares shall be returnable to the bidder.

1.5.4 After commissioning of the transformers and reactors the filtration plant shall be completely refurbished by the contractor for future use by the employer and handed over to the purchaser/ owner. The scope of refurbishing shall include:

1 Functional checking of the plant.

2 Supply and refitting at site of any damaged part of plant, which may require replacement such as gaskets, 'O' rings, Cartridge filter element, Filter press, Oil hoses, Vacuum hoses.

3 Touch up painting of the plant.

4 Submission of a detailed list of sub-suppler(s)'s/ dealer(s)'s addresses for various spare parts purchase. The addresses mentioned therein should be preferably be of the same place (region) or of nearby places for the convenience of the Owner.

1.5.5 During commissioning and at the time of refurbishing the plant the contractor shall bring his own tools and tackles (on returnable basis) which may be required for maintenance, overhaul, and replacement of various equipment/components to be supplied under this contract.

1.6 Approval of documents

1.6.1 Quality Plan

Quality plans have to be submitted to purchaser. These shall be approved by Purchaser/owner.

1.6.2 Field Quality Plan

Contractor shall submit the field quality plan for approval of Purchaser / Owner. Various checks required beginning receipt & storing of material to commissioning of system shall be mentioned in field quality plan.

1.6.3 Drawings and Data Sheets

1.6.3.1 Drawings / Technical Datasheets have to be submitted to purchaser. These shall be approved by purchaser/owner.

1.6.3.2 Bidder to furnish detailed calculations to establish the size, and capabilities of vacuum pumping system with respect to moisture and gas removal as desired in design criterion.

1.6.3.3 Schematic diagram of the oil filtration plant showing all the components.

1.6.3.4 Outline drawings indicating the principal dimensions and weight of the plant.

1.6.3.5 Technical data sheets for all major components with characteristic curves of the pumps showing total dynamic head pump input power, efficiency and NPSH against capacity.

1.6.3.6 Diagram showing the type of lubrication system, cooling system etc.

1.6.3.7 Complete descriptive and illustrated literature on the plant being supplied.

1.6.3.8 Design calculations.

1.6.3.9 Complete illustrative description with salient features and operating / troubleshooting instructions.

1.7 Inspection

Inspection shall be carried out by purchaser/owner based on approved QAP, Drawings, GTP & relevant standards. Supplier to submit BHEL/ customer QAP for approval by BHEL/ customer within 15 days of placement of purchase order.

SECTION 2

Equipment Specification

Customer contract specification is enclosed herewith that shall be strictly adhered to by the contractor.

8. Transformer Oil Filtration Plant

8.1 Performance Requirements

8.1.1 The ultra High Vacuum type oil treatment plant of capacity 2KL/4KL per hour will be mobile and will be suitable for treatment of new oil and reconditioning of used oil in EHV class transformer, shunt reactor and other oil filled equipments in order to achieve properties of treated oil within specified limits at the rated capacity.

8.1.2 The plant will be capable of treatment of new oil (as per IEC 296/IS:335 and reconditioning of used oil as per IS: 1865/IEC:422 for oil in service) at rated capacity on single pass basis as follows:

(i) Removal of moisture from 100 ppm to 3 ppm (maxm.)

(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 KV to 70 KV (min)

(iv) Vacuum level of degassing Not more than 0.15 torr (0.2mbar) Chamber at rated flow and max. At final stage.

(degassing chambers of different degree of vacuum will have efficient surface areas to achieve the final parameters. A detailed justification as to how end parameters will be met with detailed calculations and test reports in support of the same will 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 40^0C to 60^0C

(b) Maximum allowed temp. in oil to prevent oxidation (when oil is at atmospheric pressure) 60^0C

8.1.3 Contractor shall furnish detailed calculation to establish the sizing and capability of the vacuum pumping system with respect to moisture and gas removal as above.

8.1.4 Contractor shall submit test reports, test methodology to prove the capability of the plant offered.

8.1.5 The plant will 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 will be 10^{-3} torr or less.

8.1.6 The plant will be provided with control and indication panel with full automation.

8.1.7 The plant will be fitted with hoses for connection of oil lines and vacuum lines to transformers and reactors. Hoses will have leakage rate of 10-12 torr ltr/ sec (max.)

8.1.8 The plant will be suitable for cleaning and degassing of the oil stored in the storage tanks.

8.1.9 All equipments required as above will be mounted on a towable road worthy trailer unit with 04 nos. pneumatic tyres.

8.2 Design & Construction

The features and construction details of each 2KL/4KL per hour capacity mobile outdoor type oil filteration & purification plant will be in accordance with the requirements stated hereunder.

8.2.1 Oil Pump (Inlet Side)

8.2.1.1 Two (2) nos. electrically driven oil pumps with one (1) working and One (1) standby will be provided. Selection switch will be provided for selection of either of pumps. The pumps will be single stage positive displacement gear type. Suitable mechanical seals will be provided to ensure vacuum tightness. A built in pressure relief valve to recirculate the oil to suction side in case of accidental pressure rise will be provided. Suction lift of the pump will be atleast 5 meters of transformer oil at atmospheric pressure and temperature. A seperate by pass valve is provided across the gear pump so that the flow rate through the filter can be adjusted as required. The pump should be controlled by frequency drive .This should help to set the the flow rating of filter pLant from 1000-200LPH / 2000-4000 LPH .

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

8.2.2 Magnetic Strainer

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

8.2.3 Heater

8.2.3.1. An oil heater for heating up inlet oil will be provided at the discharge side of the oil pump.

8.2.3.2. The oil heater vessel will be of Mild Steel welded construction and insulated with glass/ mineral wool.

8.2.3.3 The vessel will be constructed for ultra high vacuum and pressure application.

8.2.3.4 Electric heater will 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 will also be rated for heating the inlet oil from lowest ambient temperature to 70^0C in single pass during filling up of transformers. Two separate temperature setting with thermostatic controllers will be provided for this purpose.

8.2.3.5 The heating will be indirect type and specific heat load will not exceed 2.0 watt/ cm^2 in order t avoid local overheating.

8.2.3.6 The total heating capacity will be divided into three independent thermostatically controlled heating stages evenly balancing the three phases of power supply. The control switches and knobs will be housed on a control panel.

8.2.3.7 An additional preset temper proof safety thermostat set at the highest temperature will be provided on the heater to put off the heater and give audio and visual alarm to take care of accidential overheating.

8.2.3.8 The heater body will be so designed as to follow replacement of heating elements without draining of oil. Suitable pressure relief valve, vent and drain valves and two (2) dial type temperature gauges at inlet and outlet of the heater will be provided.

8.2.4 Filter

8.2.4.1 Cartridge filter as may be required to ensure maximum particle size of less than 0.5 micron in the filtered oil will be provided.

8.2.4.2 The filter body will be fabricated of mild steel and designed for leak tightness at full vacuum and high pressures. The oil will flow from dirty oil chamber to clean oil chamber through filter elements.

8.2.4.3 Cartridge type element used will be suitable for transformer oil in service and submicronic filtration, the media will be non hygroscopic and of high dirt holding capacity.

8.2.4.4 The filter elements will be easily removable for replacement when required. Compound gauge to indicate pressure across the filter vent and drain with valves and other necessary accessories.

8.2.5 Coarse Filter

8.2.5.1 For treating dirty oil, coarse filter of adequate rating may be supplied for supplementing the capacity of filter elements. These units will 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 will be provided. The unit will also be provided with vent and drain valves, pressure gauges at inlet and outlet and other necessary accessories.

8.2.6 External Solenoid Operated valves

8.2.6.1 Two valves will 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.

8.2.7 Degassing chamber

8.2.7.1 The degassing chamber will be of welded construction and will be suitable for operation under full vacuum. The fill of raschig rings and trays for distribution will be designed for efficient distribution of oil over large areas. Incoming transformer oil will be spread over these rings in the from of film and over a longer surface area thus achieving better degassing and dehumidification.

8.2.7.2 The degassing chamber will 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 will be provided.

8.2.7.3 The degassing channels will have adequate height to allow long enough free fall for complete degassing. Design will be such as to minimize foam formation.

8.2.7.4 The degassing chambers will be provided with suitable level monitor for oil or foam level in the chamber and will 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 preset oil level.

8.2.7.5 Necessary illuminated sight glass will be provided through which oil flow through the degasser can be viewed clearly.

8.2.7.6 The degasser will be provided with vacuum gauges, vacuum breaking valves, main and auxiliary vacuum connections and other necessary accessories.

8.2.8 Vacuum Pumping System

8.2.8.1 The pump will be provided with a suitable vacuum pumping system for creating adequate high vacuum in the degassing chambers. The pumping system will consist of suitable combination of Roots Blowers and Rotary vane vacuum pumps with interstage condensing units.

8.2.8.2 The Roots blowers will be of reputed make. Suitable built in labyrinth packing system, slinger rings, oil return chambers will be provided between bearings and working chambers to prevent penetration of lubricating oil to the working chamber. The pumps motor will be dynamically balanced. The pumps will be suitable for starting evacuation from atmospheric pressure and will be applied with necessary overflow valve.

8.2.8.3 The rotary vane vacuum pumps will be installed after the roots blower. An automatic by pass valve across the roots blower will 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 will also be provided with suitable non-return valve device such that in the event of power failure the vacuum in the degassing chamber will 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 will be provided. The pump motors will have return stop device.

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

8.2.9 Vacuum Pumping System for Transformer Evacuation

8.2.9.1 An independent vacuum pumping system will be provided for evacuating the transformer for oil filling. The vacuum level required for transformer evacuation for oil transfer is about 0.76 torr (1 m bar) for transformer oil heated to 70-800C. The pumping system will be identical to that of the degassing vacuum system. The capacity will be adequate for evacuation of transformer in one hour. The vacuum systems for degasser and transformer evacuation will be inter connected in such a way that it will be possible to use either or both the

systems for any of the purpose. A reinforced of 10 mts. Length will be provided. The hoses will be for vacuum leakage rate of 10^{-2} torr litre/ sec.

8.2.10 Oil Extraction Pump

8.2.10.1 Suitable pumping system will 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 will 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 will be located at a suitable level below the degasser chamber so as to ensure adequate suction head for the pump. The pump will be supplied with double check valve assembly and solenoid operated non-return valve. In order to stop reverse flow of the oil in case of power failure, the pumping system will preferably be self priming type alternatively priming device with safety interlock to protect pump against dry running will be provided. Sampling valves will be provided at the discharge of extraction pump for testing of oil properties. A recirculation line with valves will be provided to recirculate a part of the purified oil to the inlet point if necessary during operation.The outlet pump should be control by frequency drive to give controlled output from range 1000-2000 LPH/2000 – 4000 LPH .

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Customer	Bihar State Electricity Board
b)	Project Title	220/ 132kV Pusauli Substation & Dehri Extn.
c)	Location	BIHAR (PUSAULI)
d)	Transport Facilities	ROAD/ TRAIN Nearest Airport Varanasi

1.0 GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

a) Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes unless included in the list of exclusions.

b) Material and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.

c) Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

f) The Bidder shall clearly indicate in the bid, the specific standards in accordance with which the works will be carried out.

g) The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art, and in accordance with purpose for which they are intended and ensure satisfactory performance throughout the service life.

h) All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same materials and workmanship as the corresponding parts of the equipment. Where feasible, common components, units shall be employed in different pieces of equipment in order to optimize the spare part stock-up and utilization.

2.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

a) The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc.

b) The equipment shall be able to withstand forces due to wind load, short circuit, system over voltages, fluctuations, frequency variations etc., all forces considered together or the short circuit of the equipment.

3.0 STANDARDS

a) The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under respective Chapters of this Specification. The Bidder shall note that standards mentioned in the specification are not. The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

b) Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.

c) In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Employer's approval.

4.0 ENGINEERING DATA AND DRAWINGS

4.1 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalized by the Purchaser at the time of award.

The Contractor shall necessarily submit all the drawings/ documents unless anything is waived.

4.2 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Purchaser. The contractor shall also submit the softcopy of the above documents
in addition to hardcopy.

4.3 **Drawings**

4.3.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Drawings submitted by the Contractor shall be clearly marked with the name of the

Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. BSEB has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.5 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Contractor after final process including review and approval by the Purchaser shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Purchaser in Writing.

5.7 **Approval Procedure**

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ Purchaser on initial	As per agreed by schedule submission
ii)	Resubmission (Whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution Copies (5 hard copies per	2 weeks from the date of approval

	substation and one scanned Copy (pdf format) for Corporate Centre)	
v)	Furnishing of distribution copies of test reports	
(a)	Type test reports	2 weeks from the date

(One scanned softcopy in of final approval pdf format per substation plus one for corporate centre & one hardcopy per substation)

(b)	Routine Test Reports (One copy for each substation)	-do-
vi)	Furnishing of instruction/ operation manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule
(vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre& per substation)	On completion of entire works

NOTE:

(1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Purchaser or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

(3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.

(4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Purchaser.

(5) The manufacturer shall furnish to the Purchaser catalogues of spare parts.

(6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

6.0 MATERIAL WORKMANSHIP

6.1 General Requirement

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same

must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

6.1.2 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

6.2 Provisions for Exposure to Hot and Humid climate

6.2.1 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a) Installed outdoor: IP- 55

b) Installed indoor in air conditioned area: IP-31

c) Installed in covered area: IP-52

d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.

e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part-I) / IEC-60947 (Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

7.0 QUALITY ASSURANCE PROGRAMME

7.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the supplier's Works or at his Sub-contractor's premises or at the Purchaser's site or at any other place of Work are in accordance with the specifications, the supplier shall adopt suitable quality assurance programme to control such activities at all points necessary. The detailed programme shall be submitted by the contractor after the award for reference. A quality assurance programme of the supplier shall generally cover the following:

(a) His organization structure for the management and implementation of the

proposed quality assurance programme:

(b) Documentation control system;

(c) Qualification data for bidder's key personnel;

(d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

(e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;

(f) Control of non-conforming items and system for corrective actions;

(g) Inspection and test procedure both for manufacture and field activities.

(h) Control of calibration and testing of measuring instruments and field activities;

(i) System for indication and appraisal of inspection status;

(j) System for quality audits;

(k) System for authorizing release of manufactured product to the Purchaser.

(l) System for maintenance of records;

(m) System for handling and delivery; and

(n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

BSEB/ BHEL or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the supplier/his vendor's quality management and control activities.

7.2 Quality Assurance Documents

The supplier would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of BSEB/ BHEL inspection of equipment/material

8.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

8.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

8.2 The reports for all type tests as per technical specification shall be furnished by the supplier alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in BSEB shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by BSEB or representative authorized by BSEB or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 5 (five) years

prior to the date of bid opening. In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to BHEL.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

The Contractor shall intimate the Purchaser the detailed program about the tests at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the contractor.

8.3 The Purchaser reserves the right to witness any or all the type tests. The Purchaser also reserves the right to waive the repeating of type tests partly or fully and in case of waiver, test charges for the same shall not be payable.

The Purchaser shall bear all expenses for deputation of purchaser's representative(s) for witnessing the type tests under this clause except in the case of re-deputation if any, necessitated due to no fault of the purchaser.

For outdoor receptacles, motors, cable glands, lighting fixtures, ACSR/AAC conductor, IPS aluminum tube and junction boxes, type test reports are not required to be submitted for the makes indicated at Annexure-E / BSEB approved list of sub vendors. For the new makes (other than those indicated at Annexure-E /BSEB approved list of sub vendors), type test reports as per relevant standard shall be submitted for purchaser's approval.

8.4 The Purchaser, his duly authorized representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

8.5 The Contractor shall give the Purchaser /Inspector fifteen (15) days written notice for on-shore and six (6) weeks' notice for off-shore material being ready for joint testing including contractor and BSEB. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser /inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

8.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

8.7 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Purchaser /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Purchaser.

8.8 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser /Inspector or to his authorized representative to accomplish testing.

8.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

8.10 The Purchaser will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

8.11 The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Purchaser.

9.0 TESTS

9.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed is given in respective chapters and

shall be included in the Contractor's quality assurance programme.

9.2 Commissioning Tests

9.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.

9.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

9.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

10.0 PACKAGING & PROTECTION

10.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.

10.2 All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All end of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

11.0 PAINTING

11.2 Two coats of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

11.3 The exterior and interior color of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. Unless specifically mentioned under respective sections of the equipments. Glossy white color inside the equipments /boards/panels/junction boxes is also acceptable. The exterior color for panels shall bematching with the existing panels in case of extension of a substation. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

11.4 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

12.0 HANDLING, STORING AND INSTALLATION

12.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, and square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

12.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall transport, erect, test and commissionthe equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

12.3 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. All indoor equipments shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipments are
to be stored indoors only.

Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations.

12.4 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

12.5 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

12.6 Contractor shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

12.7 The Contractor shall be fully responsible for the equipment/ material until the same is handed over to the Purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material after erection until taken over by Purchaser, as well as protection of the same against theft, element of nature, corrosion, damages etc.

12.8 The Contractor shall be responsible for making suitable handling of equipments during delivery at site.

12.9 The words 'erection' and 'installation' used in the specification are synonymous.

12.10 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

12.11 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances as given in clause 4.7.1 the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

12.13 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

SECTION – 4

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

1. COMPLETE UNIT

1.1.	Name of the manufacturer		
1.2.	Country of Origin		
1.3.	Dimensions & Weight of Unit		
1.3.	Details of Trolley		
1.4.	Dimensions of hoses		
1.5.	Characteristics of oil after single pass		
		Untreated Oil	**After Single Pass**
1.5.1.	Dielectric strength (BDV)		
1.5.2.	Water contents Max. PPM		
1.5.5.	Smallest dust particle that can be removed		
1.5.6.	Gas content		
1.6.	Temp. at which degassing is recommended		

2. FILTER

2.1.	Rated output of filters	
2.2	Type of filtering medium	
2.3.	Smallest dust particles that can be removed in single pass	
2.4.	Whether provided with filer press	
2.5	Materials used for filter tank/Body	

3. HEATERS

3.1.	Type of heaters	
3.2.	Full load heater rating in kW	
3.3.	No. of groups in which heaters are divided	
3.3A.	Nos. of heater in each group	
3.4.	Rating of each heater unit	
3.5.	Selector Switch provided (Yes/No)	
3.6.	Max. temperature of oil	
3.7.	Range of thermostats	
3.8.	No. of thermostats	
3.9.	**Heater tubes**	
3.9.1.	Material	
3.9.1A.	Heating density	
3.9.1B	Replacement of heating element without draining of oil	
3.9.2.	Numbers	
3.9.3.	Length	
3.9.4.	Outside diameter	
3.9.5.	Tube well thickness	
3.9.6.	Surface area of heater tubes	
3.9.7.	Per unit area loading of heater	

	tubes	

4. OIL INLET PUMP

4.1.	Make and quantity	
4.2.	Type	
4.3.	Capacity	
4.4.	Motor make and type	
4.5.	Rating / Qty	
4.6.	Type of starter	
4.7.	Min. Suction head at rated output (meters)at atmospheric temp. and pressure.	
4.8	Vacuum leak rate	

5. OIL DISCHARGE PUMP

5.1.	Make and quantity	
5.2.	Type	
5.3.	Capacity &discharge pressure.	
5.4.	Motor make and type	
5.5.	Motor rating	
5.6.	Type of starter	
5.7.	Min. discharge head at rated output (meters)	
5.8	Vacuum leak rate	

6. WATER CIRCULATION PUMP

6.1.	Make & Quantity	
6.2.	Type	
6.3.	Capacity	
6.4.	Motor make and type	
6.5.	Motor rating	

7. VACUUM PUMPING SYSTEM FOR 1ST STAGE OF DEGASSING CHAMBER ROTARY OIL SEALED PUMP

7.1.	Make & Qty.	
7.2.	Motor make and type	
7.3.	Motor rating	
7.4	Pumping speed	
7.5.	Ultimate vacuum with gas ballast opened	
7.6.	Ultimate vacuum with gas ballast closed	

8. 2ND STAGE OF DEGASSING CHAMBER

a) MECHANICAL BOOSER PUMP (ROOTS)

8.1.	Make & Quantity	
8.2.	Motor make & type	
8.3.	Motor rating	
8.4	Pumping speed	
8.5	Ultimate vacuum	

9. VACUUM PUMPING FOR TRANSFORMER EVACUATION SYTEM ROTARY OIL SEALED PUMP

9.1.	Make & Qty.	
9.2.	Motor make and type	
9.3	Motor rating	
9.4	Pumping speed	
9.5	Ultimate vacuum with gas ballast opened	
9.6	Ultimate vacuum with gas ballast closed	

10. 2ND MECHANICAL BOOSER PUMP

10.1	Make & Quantity	
10.2	Motor make & type	
10.3	Motor rating	
10.4	Pumping speed	
10.5	Ultimate vacuum	

11. FINE FILTER

11.1	No. of Filter	
11.2	Active length	
11.3	Max. Filtration of particle Size	
11.4	Type	

12. COARSE FILTER (FILTER PRESS)

12.1	No. of Filter	
12.2	Active length	
12.3	Type	
12.4	Materials/Rating/Life	

13. VAPOUR CONDENSER

131.	Make and quantity	

14. VAPOUR TRAP

14.1	Make & Quantity	

15. THERMOSTAT

15.1	Make & Quantity	
15.2	Type	
15.3	Range	
15.4	Accuracy	

16. THERMOMETER

16.1.	Make & Quantity	
16.2.	Type &size	
16.3.	Range	
16.4	Accuracy	

17. FLOAT SWITCH

17.1.	Make & Qty.	
17.2.	Rating	

18. VACUUM GAUGE

18.1.	Make & Quantity	
18.2.	Type	
18.3.	Range	
18.4.	Location	

19. COMPOUND GAUGE

19.1.	Make & Quantity	
19.2.	Type	
19.3.	Range	
19.4.	Location	

20. DIFFERENTIAL PRESSURE GAUGE

20.1.	Make & Quantity	
20.2.	Range	
20.3.	Location	

21. OIL HOSES

21.1.	Inlet Hose dia and length	
21.2.	Outlet hose dia and length	
21.3.	Type	
21.4	Operating temp. and pressure	

22. FLOW METER

22.1.	Make	
22.2.	Qty	
22.3	Type	

23. VACUUM HOSES

23.1	Hose dia and length	
23.2	Type	
23.3	Nylon Hose dia and length	

24. CONTROL PANELS

24.1	Size	

24.2	Back up Protection	
24.3	Annunciation	
24.4	Indicating lamps	
24.5	Materials used	
24.6	H.V. Test	
24.7	I.R. Test	

25.	Safety Earthing	
26.	Pressure test	
27.	Vacuum leak rate	
28	Noise level	
29.	Details of instrumentation	

SECTION – 5

SCHEDULES TO BE FILLED BY THE BIDDER

Schedule 1 Certificate of Technical deviation

Schedule 2 Details of contact person both technical and commercial

SCHEDULE-1

CERTIFICATE OF TECHNICAL DEVIATION

1) In case, this schedule is not submitted, it will be presumed that the equipment /material to be supplied under this contract is deemed to be in compliance with the specification.

2) If there is NIL deviation, even then the format to be filled as NIL DEVIATION

3) Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.

Signature of the authorized representative of Bidder

Name :

Designation :

Place :

Date :

Company Seal

SCHEDULE-3

DETAILS OF CONTACT PERSON BOTH TECHNICAL AND COMMERCIAL

Name

Address for correspondence

Phone No.

Fax No.

Email

Place Signature of the authorized representative of Bidder

Date

Name----------

Designation----------

Company seal ----------

Note: Continuation sheets of like size and format may be used as per the Bidder's Requirement and shall be annexed to this schedule.