PRICE SCHEDULE

Enquiry ref. No: Date:
Offer ref no. Date:

Sl. No	Description	1 Set =?	Qty	Unit Price
01	Oil Centrifuge Assy consists of			
	a) OIL PURF. SKID 2400LPH-COMP SS-DCS Mat code TC9754367450	---	10 Nos	
	b) TERMINAL PLATE FOR ALL OPU MOTORS Mat code TC9754367469		10 Set	
	c) BEARINGS DE & NDE ALL OPU MTR Mat Code TC9754367302	Vendor specific	20 Set	
	d) SPARE IE2 MTR FOR CENTRIFUGE AND PUMP Mat code TC9754367280	2 motors	20 Set	
	e) Cooling Fan for all OPU motors Mat code: TC9754367361		20 Set	
	f) End shield cover for all OPU motors Mat code: TC9754367191		20 Set	
02	Type test of one no of Oil Purification unit as per approved test procedure		2 No.	

NOTE:

1. Only Sl. No 01, 02 is to be considered for price evaluation
2. Any additional requirements, which are essential for proper functioning of Oil Centrifuge but not indicated in specification, are included in the main offer.

Vendor's Signature **Vendor's Company seal**

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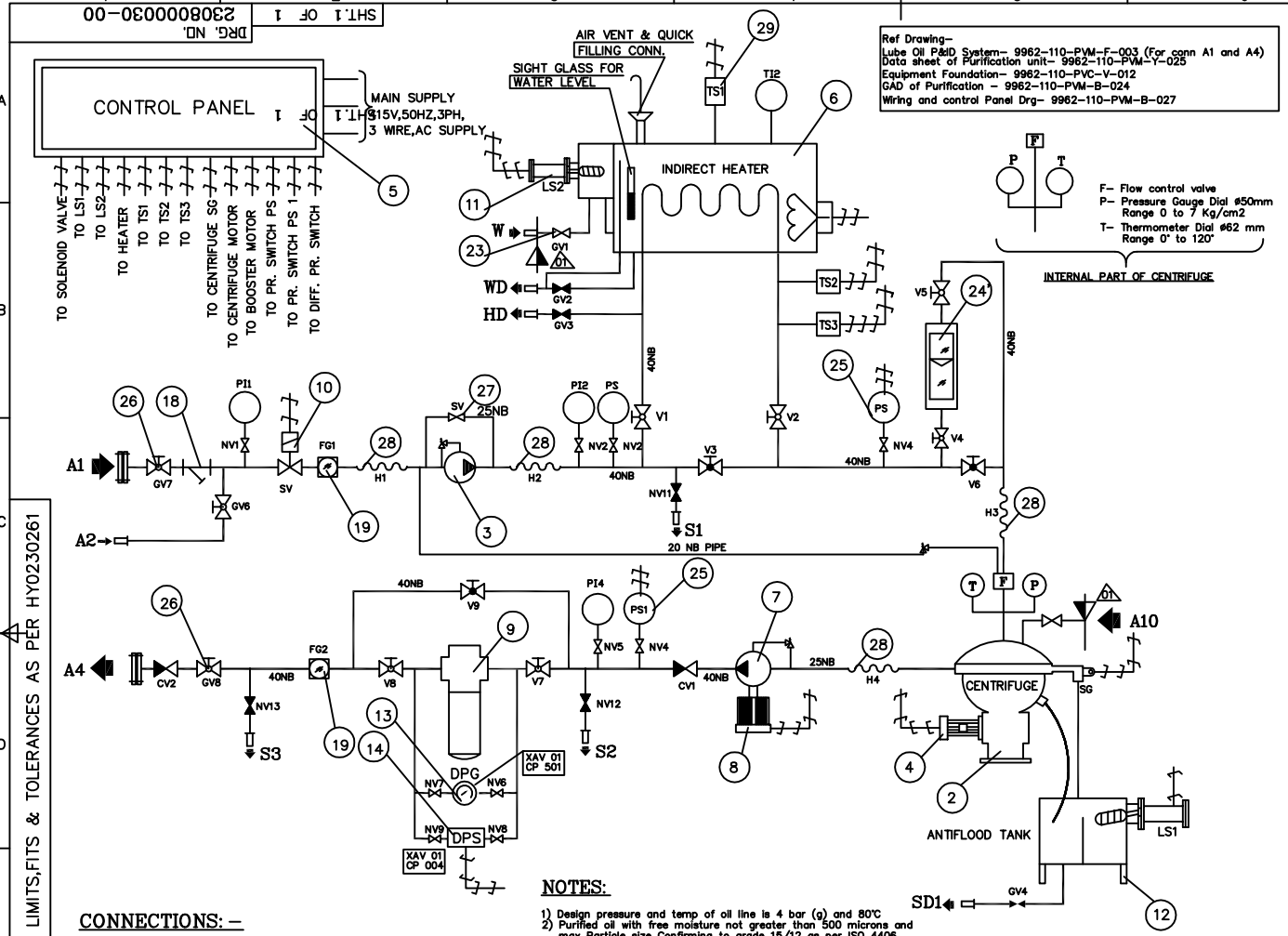
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 2308000030-00 SHT.1 OF 1



Ref Drawing–
Lube Oil P&ID System– 9962-110-PVM-F-003 (For conn A1 and A4)
Data sheet of Purification unit– 9962-110-PVM-Y-025
Equipment Foundation– 9962-110-PVC-V-012
GAD of Purification – 9962-110-PVM-B-024
Wiring and control Panel Drg– 9962-110-PVM-B-027

S.No	QTY	DESCRIPTION	MATL.	TAG NO.
29	1	THERMOSTAT (WITH THERMOWELL)	–	TS1
28	4	METALLIC HOSE 1 1/2" NB	SS	H1–4
27	1	BALL VALVE 25 NB SW	SS 01	BV1 01
26	2	GLOBE VALVE R 1 1/2"	SS 01	GV7–8
25	2	PRESSURE SWITCH	–	PS&PSI
24	1	FLOW METER 40 NB – FLANGED.	–	–
23	6	GLOBE VALVE R 3/4"	SS 01	GV1–6
22	11	NEEDLE VALVE R 1/2"	SS 01	NV1–11
21	9	BALL VALVE 40 NB SW	SS 01	V1–9
20	2	CHECK VALVE 40 NB SW	FS	CV1–2
19	2	FLOW GLASS 40 NB FLANGED	CS	FG1–2
18	1	STRAINER 'Y' TYPE 40 NB	SS 01	–
17	5	PRESSURE GAUGE–DIAL ø150,–1 TO +6KG/CM2	–	PI 1–5
16	3	THERMOMETER – DIAL ø150 – 120°C	–	TI 1–3
15	2	THERMOSTAT (WITH THERMOWELL)	–	TS2–3
14	1	DIFF.PRESSURE SWITCH	–	DPS
13	1	DIFF.PR.GAUGE – DIAL ø150,0–4 KG/CM2	–	DPG
12	1	ANTIFLOOD TANK	CS FAB.	–
11	2	AUTO FLOAT LEVEL SWITCH	–	LS1–2
10	1	SOLENOID VALVE	SS	SV
9	1	POLISHING FILTER	–	–
8	1	MOTOR (FLAME PROOF) FOR BOOSTER PUMP B3, 2.2KW, 1500RPM(SYN), 3 PHASE ,415V±10%,50HZ±5%COMBINED VOLTAGE & FREQ. ±10%, AC SUPPLY, IP 55, AMBIENT TEMP.50°C, INSULATION CL'F' WITH TEMP.RISE LIMITED TO CL 'B'.	–	–
7	1	BOOSTER PUMP – GEAR TYPE	–	–
6	1	HEATER INDIRECT TYPE – 60KW (24+24+12) (HEATER TUBES ARE IN SS304 & HEATING ELEMENTS ARE IN NICROME CONFORMING TO IS 4159 WITH SS SHEATHING)	TP304 TUBES	–
5	1	CONTROL PANEL	–	–
4	1	MOTOR (FLAME PROOF) FOR CENTRIFUGE B5, 4 KW, 1500RPM(SYN), 3 PHASE ,415V±10%,50HZ±5%COMBINED VOLTAGE & FREQ. ±10%, AC SUPPLY, IP 55, AMBIENT TEMP.50°C, INSULATION CL'F' WITH TEMP.RISE LIMITED TO CL 'B'.	–	–
3	1	FEED PUMP – BUILT ON	–	–
2	1	CENTRIFUGE WITH SS BOWL	–	–
1	1	BASE FRAME / TROLLEY TYPE (AS PER ENQUIRY)	CS FAB.	–

List of consumables
4 L for centrifuge sealing (drinking water)
200–300 L for Heater (DM water)
Instrument air 1 m3/hr and 4–5 bar

Provision will be provided for Off command from DCS.
Fault alarm and OPU operation will be reflected in DCS
All instruments shall be weatherproof.
Only signals can be exchanged to DCS.

CONNECTIONS: –

A1 – Oil inlet(Dirty) – 40NB hose connection.
A2 – System filling conn. – 40NB hose connection.
A4 – Oil outlet(Clean) – 40NB hose connection.
A10 – Feed for liquid seal – 10NB hose connection.
W – Heater water inlet – 20NB hose connection.
WD – Heater water drain & overflow – 20NB hose connection.
HD – Heater oil drain – 20NB hose connection.
SD1 – Anti flood tank drain – 20NB hose connection.
SD2 – Anti flood tank drain – 20NB hose connection.
S1 – Sampling conn. – 15NB hose connection.
S2 – Sampling conn. – 15NB hose connection.
S3 – Sampling conn. – 15NB hose connection.

NOTES:

1) Design pressure and temp of oil line is 4 bar (g) and 80°C
2) Purified oil with free moisture not greater than 500 microns and max Particle size Confirming to grade 15/12 as per ISO 4406
3) Fresh drinking tap water for heater as per manufacturer standard.
4) DM water shall be used for sealing of centrifuge bowl.
5) Hydro test pressure for oil line shall be 6kg/cm2 (g) for 30min.
6) Suction of the purification unit is flooded. Discharge head of pump shall be 1.5kg/cm2 (g)
7) Common hooter shall be provided in case of any trip in the skid.
8) Off command will be interfaced with DCS.
9) Pipe material shall be as per SS–304. MOC of all valves shall be SS internals.
10) All intruuments will be weather proof.
11) Purification unit have capacity to purify 20% of the total oil charged in the system per hour.
12) All drains will have hose nipple and caps.
13) Counter flanges with nuts,bolts & gaskets shall be provided for oil inlet & outlet by vendor
14) All instruments shall be provided with needle valve.

REV.	DATE	ALTERED	CHD/APPD
ZONE			

NTPC DRG. No. 9962-110-PVM-F-009 REV. 0
PROJECT: 1 X 660MW PANKI THERMAL POWER EXTENSION PROJECT.
UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.
NTPC LTD. (A GOVERNMENT OF INDIA ENTERPRISE)
DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA
BHARAT HEAVY ELECTRICALS LTD.
BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
TITLE: P&ID / FLOW DIAGRAM FOR LUBE OIL PURIFICATION SYSTEM FOR TBFP
2308000030-00
SHT.3 OF 6 REV. 0

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COMPUTER FILE NAME: 2308000030-300-R00.DWG
REF. DRG. NO.
SIGN AND DATE
INVENTORY NO

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

WRITE UP ON OIL PURIFICATION SYSTEM

Ref: Purification oil system P&I Diagram 9962-110-PVM-F-003

FUNCTION

During the course of operation lube oil circulated in the system may contain particles/sediments and moisture content from the gland seal. The sediment and moisture can hamper the condition of turbine bearings. To maintain the quality of oil circulated in the system for lubrication of bearings conditioning has to be carried out one shift a day.

The system shall remove moisture from the oil (1.5% by volume) so that the oil at the outlet of purifying system does not contain any free moisture. . All suspended particles shall be removed down to maintain the impurities within permissible limits conforming to grade 15/12 as per ISO 4406 when oil temp is 65°C. This will be demonstrated with inlet oil quality confirming to code 21/18 as per ISO: 4406. Moisture less than 500 ppm for an inlet ppm of 15000.

SYSTEM DESCIPTION

The oil purification unit will handle turbine oil (Servo prime 46 of IOC make). The oil purifier will be located on the ground floor below the oil level in the Turbine oil tank. The purification process will operate on a by-pass system, handling complete oil of the lube oil system of TDBFP & will be working one shift a day(8 Hrs) while the turbine is running. A dirty oil pump (having capacity 10% higher than purifying unit) will draw the lubricating oil from the Turbine oil tank & send it to the centrifuge through the oil heater . Similarly one clean oil pump (having capacity 10% higher than purifying unit) will deliver the purified oil back to the turbine oil tank through the polishing filter.

Main parts of Oil Purification unit

Centrifuge Bowl

A suitable vertical centrifuge made of high grade stainless steel will carry out primary separation of the impurities in the lubrication oil. Heavier phase discharge from the centrifuge (Mainly water) will go to waste through a small tank, level of which may be utilized for signalizing flooding of centrifuge due to loss of water seal or due to clogging in the heavy phase drain pipe or in the event of excessive water in the oil.

Oil Heater

Turbine oil will be heated up to the necessary centrifuging temperature by passing it through an electric heater located immediately upstream of the centrifuge. The heater will be indirect type, in which the electric immersion heater elements are used to heat a batch of water, which in turn heats the oil passing through the coils immersed in this bath. Heater will be cut in steps.

WRITE UP ON OIL PURIFICATION SYSTEM

Feed and Booster Pump

The pumps shall be of positive displacement type complete with necessarily relief valves at the discharge. Each pump shall be having capacity 10% higher than the purifying unit capacity. The motor shall be sized 1.25 times of shaft BKW of the pump & centrifuge.

Polishing Filter

The purified oil coming out of the centrifuge bowl shall pass through a polishing filter capable of handling the required output before returning it to the turbine oil tank. This filter shall eliminate all suspended solids down to maintain the impurities within permissible limits conforming to grade 15/12 as per ISO 4406 when oil temperature is 65°C.

Interconnecting pipes and valves

All pipes and valves will be of Stainless steel material.

CONTROLS, INSTRUMENTATION AND PANELS:

The oil purification plant shall be complete with all the instruments and controls, for efficient operation of the plant. The various instruments, control lamps, enunciators etc will be brought to a control panel on a common skid mounting. The panel will be complete with all wiring tubing and the various instruments and switches will be displaced on it in a neat manner.

The following interlocks are provided in the panel

1) Liquid seal breakage alarm / trip
2) High oil & heater temperature alarm / heater trip
3) Centrifuge and booster pump motor over load trip
4) Low oil temperature alarm
5) Low heater water level alarm / heater trip
6) Open Bowl/separator Cover
7) Polishing filter choke-up alarm trip

As per the standard practice, necessary provision shall be provided in control panel to enable off control of Oil purification unit through DCS/control room.

PRE-QUALIFICATION CRITERIA

Enquiry Items of Lube Oil System

S.No.		BHEL Requirement	Vendor's Confirmation	Deviation, if any	**Remarks**
1		All the suppliers need to submit this document i.e. titled pre-qualification criteria and furnish required information along with offer.			
2	a)	Name, address, e-mail id, contact no.etc. of manufacturer of enquiry item			
	b)	Name, address, e-mail id, contact no.etc. of authourised agency / trading house quoting on behalf of manufacturer In case offer is received from authourised agency / trading house, the following requirements shall be full filled. i) Valid letter of authorisation and copy of agreement to be enclosed with offer. ii) The offer shall be either from the authorised agency or from the manufacturer directly. In case of BHEL receiving offer from both, then offer from manufaturer will only be considered. Offer from an unauthorised agency / entity on behalf of any vendor shall be summarily rejected. iii) Name, address, e-mail id, contact no.etc. of entity on whom order to be released in case of L1 shall be clearly indicated.			
3		Supplier to confirm/provide the following criteria/documents for evaluation of offer.			
		(a) The supplier should have the proven experience in manufacturing and supply of offered model as per enquiry requirement.			
	i	Application: Lube Oil System			
	ii)	Proven track Record of equipment: Enquiry item shall be identical and similar in terms of flow, Operating pressure, Mechanical Design, Materials etc as compared to at least TWO unit of the proposed model designed, engineered, manufactured, tested and supplied from the proposed manufacturing plant in the last **TEN** years and the reference unit shall have completed **ONE** year of satisfactory operation at site as on bid due date.			
	iii)	All the facilities reqired for manufacturing and testing of Enquiry Item as per applicable standards shall be available with manufacturer.			
	iv)	Vendor shall furnish the details of Service after Sale facilities available in India with references of executed project. Spare shall be readily available at propretary suppliers/ distributors in India.			
		All the above criteria 3(a) (i) to 3(a) (iv) must be combinedly met by the vendor against a single supply reference.			
		(b) The supplier meeting all the above criteria as per clause 3 (a), shall furnish details of such supplies in the annexure II (Proven Track Record). Suppliers shall furnish up to 03 numbers of latest customer reference details. **Note : Details furnished in any other format shall not be considered.** All the documents shall be furnished only in English. Documents furnished in other langauges will not be considered for further evaluation.			
		(c) BHEL reserves the right to cross verify with the above such customers including overseas customers with a copy to the supplier and satisfy itself with reference to the claims of the supplier. If the information furnished by the supplier is not found satisfactory, the offer will be technically rejected.			
		(d) 1. vendor details, i.e. name, address, BHEL/EIL/IOCL/Consulatnt/ Customer enlistment letter. 2. One PTR of compressor to be provided by BHEL indicating that the items have been procured from proposed vendors and supply has been completed. PTR shall include the following minimum: - Approved GAD and BOM indicating item details and vendor details. - Unpriced PO copy issued by BHEL to the vendors for the listed items.			
4		The vendors should furnish the detailed process of manufacturing and testing procedures along with the offer.			
5		List of BHEL qualified bidders shall be forwarded to BHEL's End Customer for their review and approval. The list finalized by BHEL's End Customer shall be final and binding.			
6		BHEL team may carry out vendor evaluation/assesment(incase of a new vendor)by a visit to vendor works for qualifying /rejecting the technical bid based on the findings of the visit.			
7		Vendors to submit their bid in 2 - part system i.e. Part-I shall consists of Pre-Qualification Criteria along with the required documents and Techno-Commercial Bid.Vendor shall submit duly filled supplier questionarie. Part-II shall consists of Price Bid. Offers failing to meet prequalification part will not be considered for further evaluation.			

Vendor's Signature with Seal

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TURBINE OIL PURIFICATION PLANT FIXED TYPE FOR BFPDT

1.0.0 **SCOPE:**

This specification is intended to cover the design, manufacturing, fabrication, assembly, testing at manufacturer works, packing (for safe transport) & delivery, including guarantee tests (Type Test for particle as well as for moisture content) of one (1) unit for each project & commissioning at site (if applicable). Turbine oil purification plant shall be designed with all necessary accessories, complete in all respects for efficient, trouble free & continuous operation at project site. Items though not specifically mentioned in the specification but needed to complete the equipment and systems to meet the intent of specification, shall also be included unless otherwise specifically mentioned under exclusions. The flow diagram for oil purification unit shall be as per BHEL schematic drawing specified in variant table.

2.0.0 **GENERAL INFORMATION:**

The system shall remove moisture from the oil (1.5% by volume) so that the oil at the outlet of purifying system *does not contain any free moisture* **(R03)**. All suspended particles shall be removed down to maintain the impurities within permissible limits conforming to grade 15/12 as per ISO 4406 when oil temp is 65°C. This shall be demonstrated with inlet oil quality confirming to code 21/18 as per ISO: 4406. The oil purification unit shall handle turbine oil (Servo prime 46 of IOC make). The capacity of the centrifuge shall be per variant table at the operating temperature of 65°C. The oil purifier shall be located on the ground floor below the oil level in the Turbine oil tank.

The design, manufacture & testing of the equipment shall confirm to latest edition of all standards & codes as applicable & required.

The purification process shall operate on a by-pass system, handling only a portion of the turbine oil & will be working continuously while the turbine is running. A dirty oil pump (having capacity 10% higher than purifying unit) shall draw the lubricating oil from the Turbine oil tank & send it to the centrifuge through the oil heater. Similarly one clean oil pump (having capacity 10% higher than purifying unit) shall deliver the purified oil back to the turbine oil tank through the polishing filter. Make up oil shall be filled manually in the Turbine Oil tank as and when necessary.

3.0.0 **INSTALLATION:** Sheltered / Tropical-humid climate:

4.0.0 **EQUIPMENT, MATERIAL & SERVICES TO BE FURNISHED BY THE CONTRACTOR:**

Scope of Supply

The scope shall be as per schematic diagram provided by BHEL along with the enquiry.

The equipment covered by this specification shall comprise of the following:

i) One (1) centrifuge oil purifier with drive.
ii) One (1) dirty & one (1) clean oil pump with drive.
iii) Indirect type oil heater.
iv) Polishing filter

Revisions	Prepared	Approved	Date
Refer to record of revisions	M. ASIM	M.V.S.RAJU	10.05.13

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v) All controls, instruments, control wiring, power cables inside the plant including the control panel.
vi) Common fabricated base plate for entire plant with anchor bolts, sleeves, parts to be embedded in concrete. However, the owner as per the requirement of the contractor shall furnish equipment foundation.
vii) Armored cable 1.5 mm2 x 3 core with plug socket of 20 M length
viii) Suitable lifting and handling arrangement for the centrifuge, filter, tank, pumps etc.
ix) One set of special erection & maintenance tools. (List of erection and maintenance tools to be furnished by supplier at offer stage)
x) Commissioning spares (List of Commissioning spares to be furnished by supplier at offer stage)
xi) First Fill of Consumable, Oils and Lubricants (List of Consumable, oils & lubricants to be furnished by supplier at offer stage)
xii) Loose supply items which are supplied along with purification unit with proper identification.
xiii) Foundation items for fixing the purification unit. (Anchor bolts, sleeves etc.)
xiv) One spare filter element for polishing filter.
xv) Two nos. of spare flat belt.
xvi) Spare 1 set of Gasket & O-rings as applicable.
xvii) Conversion spare from purifier to clarifier.

4.1.0 **SPARE PARTS:**

Complete list of spare parts recommended by the manufacturer for Three years operation with itemized list and quantity shall be submitted with the proposal for the total system.

List of spare parts along with their drawing and catalogues and procedure for ordering spares shall be listed in O& M manuals.

4.2.0 **COMMISSIONING (if Applicable):**

Vendor to quote commissioning charges along with offer. The rate should be per day basis.

5.0.0 **DESIGN & CONSTRUCTION:**:

General:

The design, manufacture & testing of the equipment shall conform to latest edition of all standards & codes, as applicable & required.

All the pressure piping shall be designed & constructed in accordance with ANSI standard B 31.1 for Pressure piping. The material shall be SS300 series. Each line size is to be specified in schematic diagram provided by vendor. Line size calculations shall be furnished for our review.

All materials issued shall be new & of tested quality & first class in all respects.

5.1.0 **CENTRIFUGE:**

1) A suitable vertical centrifuge shall carry out primary separation of the impurities in the lubrication oil. The centrifuge bowl shall be of separator type having ample size to give the required optimum performance. It shall be vapor tight type construction to prevent oil fumes of vapors from escaping into turbine room. Heavier phase discharge from the centrifuge (Mainly water) shall go to waste through a small tank, level of which may be utilized for signalizing flooding of centrifuge due to loss of water seal or due to clogging in the heavy phase drain pipe or in the event of excessive water in the oil.

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2) The rotating assembly of the centrifuge unit shall be carefully balanced to minimize unbalance and shaft vibration while operating at the rated speed. The centrifuge bearings shall be designed for at least 25000 Hrs of continuous operation. All influent lubricating oil contact parts of the purifier shall be made of high grade stainless steel AISI-316 or equivalent. The bowl shall be assembled and dispatched. Sufficient care to be taken to avoid any transit damage to the bowl assembly.

3) Centrifuge shall be assembled as a single unit and shall be ready to use. The inlet & outlet connection with counter flanges shall be as per ANSI B16.5 and the size is in-line with the schematic diagram provided by BHEL along with enquiry.

4) Centrifuge shall be supplied as purifier assembly.

5) Conversion spare from purifier to clarifier is part of equipment & should be supplied along with centrifuge unit.

5.2.0 **OIL HEATER:**

1) Turbine oil shall be heated up to the necessary centrifuging temperature by passing it through an electric heater located immediately upstream of the centrifuge. The heater shall be indirect type, in which the electric immersion heater elements are used to heat a batch of water, which in turn heats the oil passing through the coils immersed in this bath. Heater shall be cut in cut off type. The oil shall be heated to 65°C in one pass through heater *(Min temp at inlet of heater 35°C)* **(R03)**

2) The heating elements shall be readily accessible for inspection and easily removable for maintenance or replacement.

5.3.0 **DIRTY AND CLEAN OIL PUMPS:**

The pumps shall be of positive displacement type complete with necessarily relief valves at the discharge. Each pump shall be having capacity 10% higher than the purifying unit capacity. The motor shall be sized 1.25 times of shaft BKW of the pump & centrifuge, and the motor rating shall be considered as per IS 325.

Suction temp. of fluid handled : 65ºC (Normal Operation) -Oil Viscosity 18 cst
: 10ºC (During starting)- Oil Viscosity 280 cst
Suction head : Atmospheric (Flooded suction)

*The design of the pumps shall be as per standards of "Hydraulic Institute of USA" or approved equivalent. The materials for various components shall be as recommended in the standard. The casing and base plate shall be of cast iron construction, the rotor and shaft shall be of carbon steel. High tensile steel bolts and nuts shall be used for the casing.***(R03)**

5.4.0 **POLISHING FILTER:**

1) The purified oil coming out of the centrifuge shall pass through a polishing filter capable of handling the required output before returning it to the turbine oil tank. This filter shall eliminate all suspended solids down to maintain the impurities within permissible limits conforming to grade 15/12 as per ISO 4406 when oil temperature is 65°C. Vapor cloud in the oil by stripping action. It shall not however remove any rust inhibitor or oxidation inhibitor in the process**.**
The particles size rating at outlet of filter shall not be more than 3 microns**.** Furnish beta efficiency of filter element**. (R03)**

2) One spare filter element shall be provided along with oil purification unit.

3) The filter vessel shall be designed for the maximum working pressure and fabricated in accordance with the ASME code for unfiltered pressure vessel. It

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shall be provided with a small relief valve to protect from over pressure due to thermal expansion etc.

Interconnecting pipes and valves (R03)

All relief valves shall be provided with hand levers to permit manual operation.
Strainers with stainless steel elements shall be provided. Screen **(R04)**
Opening area shall be at least four times the pipe cross-sectional area.
Material of construction of interconnecting piping shall be complete
Stainless steel.
MOC of valve material shall be as per material code description in variant table.**(R06)**

5.5.0 **DRIVE MOTOR:**

General specification for the Electrical drive motor shall be as per BHEL specification TC54368 **for IE2 motor and TC54373 for IE3 motor (R01)** or as per specification mentioned in enquiry.

5.6.0 **CONTROLS, INSTRUMENTATION AND PANELS:**

1) The oil purification plant shall be complete with all the instruments and controls, for efficient operation of the plant. The various instruments, control lamps, enunciators etc shall be brought to a control panel on a common skid mounting. The panel shall be complete with all wiring tubing and the various instruments and switches shall be displaced on it in a neat manner. The make of the instruments shall be as per Customer/ BHEL "A" class approved vendor directory. Vendor shall select the sub-vendors strictly as per clause ***13.00*** of this specification. However, project specific vendor list is final.

2) The following interlocking arrangement shall be provided.

i) The inlet valve to the centrifuge unit shall be solenoid operated and shall be interlocked with a level switch on the anti flood tank. In the event of the flooding of the centrifuge the interlock shall operate to close the inlet solenoid valve automatically and the same time to trip the motor of the pumping unit and centrifuge.
Flooding of the centrifuge may be caused by any one of the following malfunctions.
1. Loss of water seal of centrifuge causing over flow of oil to the anti flood tank.
2. Presence of excessive water in the oil, which may cause insufficient separation of oil. This can be sensed by a rise in water level in the anti flood tank.
3. Clogging of the heavy phase drain pipe and possible over flow of water to the light Phase section. This can also be sensed from a raise in anti flood tank water level.

ii) In case the centrifuge drive is belt operated, a belt failure limit switch shall be provided which will initiate closing of the inlet solenoid valve and tripping of the centrifuge and pump motors in the event of belt failure.

iii) The heating element of the heater shall be switched off in the event of low water level in the heater.

iv) Two numbers of thermostats are to be mounted on the oil piping downstream of each electric heater. The thermostats shall operate in its differential temperature for suitable for best separation. Dirty and clean oil pump trip due to over load and flooding of centrifuge shall also be provided.

v) Prevention mechanism shall be made to prevent mixing of oil in water line

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vi) The system of annunciating the loss of water seal, plugging of polishing filter, over load trip of centrifuge drive and over load trip of electric heaters shall be provided with a visual alarm as well.

vii) The heater circuit shall be interlocked with pump motor circuits to shut off the heaters when the pumps are not being operated. **(R03)**

viii) The following interlocks are provided in the panel

1) Liquid seal breakage alarm / trip
2) High oil & heater temperature alarm / heater trip
3) Centrifuge and booster pump motor over load trip
4) Low oil temperature alarm
5) Low heater water level alarm / heater trip
6) Open Bowl/separator Cover
7) Polishing filter choke-up alarm trip

Necessary provision shall be provided in control panel to enable on-off control of Oil purification unit through DCS/control room. Parameter like oil temp display, anti-flood tank level high, filter choking and feed pump on shall be provided from DCS**.(R06)**
Refer attached C&I customer specification. Annex 1

3) **Power Supplies:**
Redundant power packs/ supplies for powering the control systems.

4) **Electric Power Supply System:**

1. Sets of Microprocessor based modular 24VDC power supply system shall be used for powering the control systems including its network devices.

2. Supplier shall provide power supply distribution panes / cabinets for sub-distribution of Main UPS/ utility feeders on as required basis. The power supply distribution box shall included change over circuitry switch fuse units, MCBs. Terminal blocks etc. suitable for application.

3. The control system shall perform all functions such as auto / manual operation of valves, pumps, drives, local / remote selection of operation, status indication, annunciation, interlock and protection of pumps/ drives etc.
For successful implementation of the same, the contractor shall furnish all the required details / drawing /data / information like list of drives to be controlled, write-ups for controls, interlock and protection of supplier's equipment, recommended control loops.
4. Supplier shall provide all necessary assistance for proper commissioning of his equipment.

5) Supplier should note that he has to supply system complete in all respect with all software, hardware, accessories, interfacing equipment required etc. whether specifically stated herein or not, to make the system operation and fully meeting the functional, parametric, hardware, software, interfacing, quality assurance & testing requirement within the quoted price.

6) Spare capacity for the system:
10% redundancy of all the binary outputs for drives in functional group.
10% redundancy of CLCS drives in functional group shall be provided.

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7) Measuring Instrument:

1. Pressure gauge:
   All pressure gauges shall be glycerin filled.
   Dial Size shall be min 150 mm.
   Shall be provided with 3-way manifold for PG and 5-way manifold for DPG.**(R04)**

2. Temperature Indicator
   Mercury in steel dial thermometer
   Dial Size shall be min 150 mm.
   Over range test pressure shall be 1.5 times the max design pr at 38 deg C

Control Panels (R03)

General

a) All panels shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.

b) Unless otherwise specified cable entry for panels shall be through bottom via gland plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

c) Panels shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.

d) Panel shall have eyebolt on top for lifting.

e) Mounting, wiring, powering of all items to be mounted / installed on desks irrespective of the source of procurement shall fall in the scope of erection of Bidder, this shall include free issue items furnished by Owner.

f). Control Supply health indication to be provided.
g). 10% spare terminal shall be provided in the panel.
h). Panel & door material / thickness: 2 mm- CRCA.
i). Gland Plate Material & Thickness- CRCA- 3mm.
j). Door lock shall be CAM lock type.
k). Bus bar material: Aluminum, 25x10.
l) Ammeter and voltmeter shall be provided in power supply.

Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.

b) Two spray coats of epoxy primer surface shall be applied to all exterior and interior surfaces,

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each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalysed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colours for exterior and interior surfaces shall conform to the following shades:

i) Exterior: Opaline green shade 275 of IS: 5 or equivalent international code.
ii) Interior - Brilliant White.

c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following:

a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.

b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross-identification.

c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals.Open-ended terminal lugs shall not be used.

d) Internal wiring shall be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

e) Common connections shall be limited to two wires per terminal.

f) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.

g) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

h) Wire sizes used for internal wiring shall not be lower than the followings :
Control wiring (switches, pushbuttons etc.) : 1.5 Sq.mm
Power supply/receptacle/illumination wiring : 2.5 sq. mm or higher as per Load 4-20mA DC current and low voltage signal upto 48V DC : 0.5 Sq. mm

All switchgears, MCCs, DBC, panels, modules, local starters and bush buttons shall have prominent engraved identification plates.

b). Local push button station shall have metal enclosure of die cast aluminum or roller sheet of 1.6 mm thickness & shall be of DOP IP55. Push buttons shall be of latch type with mushroom knobs.

c). All non current carrying metal works of boards/ panels shall be effectively bonded to earth bus of galvanized steel, extending throughout the switch board/ MCC/ DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.

d). Control circuits shall operate at suitable voltage of 110 V AC or 220 V DC / 110 V DC. Necessary control supply transformers having primary and secondary fuses shall be provided for each MCC, 2x100% per bus section.

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5.7.0 **MATERIALS OF CONSTRUCTION (MOC):**

S.N.	Item Description	MOC
1	Centrifuge bowl & body	12% Chrome steel- AISI316
2	Disc Stack, gravity disck, distributor & top discharge	AISI 316
3	Heater element	Nichrome
4	Heater sheeting	12 % Chrome steel
5	Heater bath	Carbon steel with silver heat resistant paint.
6	Cast iron components	IS 210 Grade 20 or equivalent
7	Insulation	Glass wool
8	Tanks	Mild steel as per IS 2062 or equivalent
9	Heater tubes in tank	Stainless steel AISI 304
10	Instruments	As per Annexure II

6.0.0 First Fill of Consumable, Oils and Lubricants:

All the first fill and one year's topping requirement of consumable such as grease, oil, lubricants, servo fluids, gases and essential chemical etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.

7.0.0 **Noise:**

Max noise level shall not be more than 85 db A. when measured (min 6 points around each equipment) at 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level.

8.0.0 **INSPECTION AND TESTING AT MANUFACTURER'S SHOP:**

1) All materials used for manufacture of the equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the purchaser before the final shop inspection. In case the correlating test certificates are not available, the supplier shall arrange to carry out necessary tests as required by the code at his own cost.

2) The pressure vessels shall be hydro statically tested at not less than 1 ½ times design pressure prior to painting and lining. The pressure vessels shall be kept pressurized for at least 30 min. at this test pressure and shall be demonstrated to be free from visible leaks.

3) The performance of the complete assembly oil purifier unit shall be tested at the manufacturer's works in the presence of purchaser's representative. The performance test procedure shall be reviewed by customer & approved by purchaser.

4) The capacity of oil purification unit to be shown during inspection at 65° C.

5) The Inspection shall be carried out as per the BHEL / Customer (NTPC) approved vendor quality plan.

9.0.0 PROTECTION AND PRESERVATIVE COATING REQUIREMENTS:

1) Painting shall be as per NTPC approved painting schedule.
2) All coated surfaces shall be protected against abrasion impact, discoloration any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage The parts which are likely to get rusted due to exposure to whether, should also be properly treated and protected in a suitable manner. All primers / paints / coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. Preservative shop coating:
3) All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces that will not be easily accessible after the shop assembly shall be treated before hand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and pre heated in the shop. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.
4) All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of Customer / BHEL.
   All piping shall be cleaned after shop assembly by shot blasting or other means approved by the customer / BHEL. Lube oil piping shall be pickled.
5) The Painting of all electrical equipment shall be epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 micron (with minimum total DFT of 100 micron). However in case electrostatic process of painting is offered fir any electrical equipment; minimum paint thickness of 50 micron shall be acceptable for finish coat.
6) Cleaning and painting procedure for entire oil purification system. The painting shall be RAL 9002 (Grey).

10.0.0 RATING PLATES

Each item of Oil purification unit shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service/conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required. The nameplates or labels shall be white non-hygroscopic material with engraved black lettering.

11.0.0 DOCUMENTATION:

1) The list of engineering data would be a comprehensive one including all engineering data / drawings / information for all brought out items and manufacturing items

2) All the drawings/ documents submitted by the vendor during detailed engineering stage shall be stamped "For Approval" or "For Information" prior to submission.

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3) After the approval of the drawing, further work by the vendor shall be in strict accordance with these approved drawings and no deviations shall be permitted without the written approval of customer.

4) All manufacturing, fabrication and execution of work in connection with the equipment / system. Prior to the approval of the drawings. Shall be at the vendor's risk. The vendor is expected not to make any changes in the design of the equipment / system, once they are approved by customer. However, if some changes are necessitated in the design of equipment / system at a later date. The vendor may do so, but such changes shall promptly be brought to the notice of customer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the technical specification. The no of copies / prints/CD/manuals to be furnished as follows:
   - Drawings, Data sheets, Design calculations for Information / approval ….. 3 prints & 1 CD
   - Final Drawings, Data sheets, Design calculations for Information / approval …. 5 prints & 1 CD
   - Performance and functional guarantee test reports …. 8 prints & 1 CD

   O&M manual with project drawings, data sheets, performance and functional guarantee test reports. 10 Prints & 1 CD

11.1.0 DRAWINGS, DATA TO BE FURNISHED:

Following drawings & data are to be submitted with proposal:

1) The offer cannot be considered without submission of these documents. Vendor has to categorically state that his offer is confirming compliances to this specification in Toto.
2) Preliminary outline drawing indicating principal dimensions and weights of the equipment offered & location of pipe connections.
3) Preliminary foundation drawing indicating loading data.
4) Flow diagram
5) Schematic diagram of the electrical connections.
6) Complete descriptive illustrated literature including manufacturer's name, size & description of the various equipments bought out sub deliveries.
7) Vendor has to submit the oil purification system data sheet as per clause 12.00.00 of this specification
8) Quality plan

11.2.0 Drawings and data to be furnished after receipt of order for approval by purchaser within two weeks of letter of intent.

1. Certified foundation drawings indicating loading data (Static & dynamic) for the assembly in order to enable the purchaser to design the concrete foundation as per manufacturer's requirements (GA with NTPC Drawing No.).
2. Flow Diagram (having NTPC drawing no.)- indicating the pressure temperature and flow at various junctions such as before and after heaters, solenoid valves, before and after centrifuge, feed & discharge pump.
3. Control Panel drawing (having NTPC Drawing no.)
4. Technical Data Sheet (TDS) as per annexure II having NTPC Drawing No.
5. All Motors data sheets, Speed torque characteristic curve of motor and performance curve of motors.
6. Type test procedure- As per annexure 1.
7. TYPE TEST REPORT
8. Data sheet & Catalogue of all instruments highlighting the offered model no.

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9. Write up indicating function of all components/ operating control philosophy of the system
10. Data sheet & write-up describing operating / control philosophy and function of all the components and system
11. Part list indicating details of material construction of main parts along with their ASTM equivalent
12. List of all tripping condition with tripping set point.
13. Regulating ring size with respect to different oil densities.
14. Instrument schedule to be submitted
15. Supplier shall provide KKS codes for all instrument and drives in the scope of work.
16. Cross sectional drawings showing the construction of centrifuge, pump, filters etc.
17. Logic diagrams, Electric schematic instrumentation list with bill of materials & probable sub vendors shall also be submitted.
18. Cleaning and painting procedure adopted by vendor.
19. Before dispatch clearance is requested all test reports, Inspection reports, material certificates, performance test reports etc., to be furnished.

12.00.00 **DATA SHEET:**

The following data sheet of Oil purification plant to be filled and sent along with offer

12.01.00 **GUARANTEED PERFORMANCE DATA:**

12.01.01 Unit oil purification plant :
12.01.02 Rated capacity in LPH :

12.01.03 Guaranteed size of solids in the oil purified oil at the outlet of the polishing filter at rated capacity in microns. Specify also the maximum water content in %

12.01.04 Guaranteed size of solids in the oil purified oil at the outlet of centrifuge but ahead of the polishing filter at rated capacity in microns. Specify also the maximum water content in %

12.01.05 Guaranteed % of oil drained through heavy phase drain

12.01.06 Maximum permissible delivery pressure at the outlet of the polishing filter in Kg/cm2(g)

12.01.07 Centrifuge temperature in Deg Cent

12.02.00 **OIL PUMPS:**

12.02.01 Number of pumps
12.02.02 Capacity in LPM
12.02.03 Total head in Kg/cm2(g)
12.02.04 Maximum permissible suction lift at rated capacity in

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MLC

12.02.05 Pump speed in RPM

12.02.06 Power required at the rated operating conditions in KW

12.02.07 Efficiency of the pumps at the operating conditions

12.03.00 **TECHNICAL PARTICULARS:**

12.03.01 **Centrifuge:**

12.03.01.1 Manufacturer

12.03.01.2 Type and model number

12.03.01.3 Codes / Standards followed for design and manufacture of the unit

12.03.01.4 Bowl capacity in Lts

12.03.01.5 Bowl diameter in mm

12.03.01.6 Speed of Centrifuge in RPM

12.03.01.7 Vapour tight assembly

12.03.01.8 Type of transmission from drive motor to centrifuge

12.03.01.9 Bearings

12.0 Type and number
12.03.01.9.1

12.03.01.9.2 Type of lubrication needed

12.03.01.9.3 Make and model number

12.03.01.10 Method of balancing and its standard

12.03.01.11 Heavy phase drain through anti-flood tank

12.03.01.12 Method of signaling loss of water seal in centrifuge and/or excessive water in oil and/or chocking of heavy phase drain pipe

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12.03.01.13 Weight of the rotating assembly in Kgs.

12.03.01.14 Power required at the rated operating condition in KW

Time gap after pump trip

12.04.00 **OIL HEATER:**

12.04.01 Manufacturer

12.04.02 Type & model number

12.04.03 Rated capacity in LPH.

12.04.04 **WATER BATH:**

12.04.04.01 Dimensions in mm

12.04.04.02 Water content in Liters

12.04.04.03 Provision of Gauge glass

12.04.04.04 Type of insulation and its standard

12.04.05 **Heating elements:**

12.04.05.01 Number of elements and KW rating per each element

12.04.05.02 Material and type of construction of the heating elements

12.04.05.03 Power supply, Voltage, Phase & Frequency

12.04.05.04 Provision of metallic sheeting

12.04.05.05 Provision of Ceramic terminal blocks

12.04.05.06 Number of Thermostats and out “in” and out “out” temperature of each thermostat

12.04.05.07 Cutting in and cutting out contacts of thermostat rated at

12.04.05.08 Type and number of parallel paths of oil heating coil

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12.04.05.09	Total heating surface area in Sq. M of oil heating coil
12.05.00	**OIL PUMPS:**
12.05.01	Manufacturer
12.05.02	Type & model number
12.05.03	Size of suction in mm
12.05.04	Size of discharge in mm
12.05.05	Relief valve (At pump discharge) set pressure in $Kg/cm^2(g)$
12.05.06	Type of transmission between motor shaft and pump shaft
12.06.00	**POLISHING FILTER:**
12.06.01	Manufacturer
12.06.02	Type & model number
12.06.03	Rated capacity in LPH
12.06.04	Normal pressure drop at rated capacity in Kg/cm2(g)
12.06.05	Maximum pressure drop at rated capacity in Kg/cm2(g)
12.06.06	Filter surface area in M2
12.06.07	**Filtering elements:**
12.06.07.01	Type
12.06.07.02	Material
12.06.07.03	Reusable after cleaning
12.06.08	**Filter vessel:**
12.06.08.01	Outer diameter in mm
12.06.08.02	Height in mm
12.06.08.03	Plate thickness in mm

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12.06.08.04	Provision of relief valve	
12.06.08.05	Design pressure in Kg/cm2(g)	
12.07.00	**Drive motors:** The motor data sheet to be filled & submitted as specified in motor specificationTC54191	
12.07.01	Manufacturer	
12.07.02	Nameplate rating	
12.07.03	Speed in RPM	
12.07.04	Insulation class	
12.07.05	Enclosure (IP)	
	Paint shall for Motors	RAL 5012 (Blue) for indoor and outdoor appplication
12.08.00	Material of construction (Specify Grade / Code / Std etc.	
12.08.01	Centrifuge bowl and internals	
12.08.02	Centrifuge frame and cover	
12.08.03	Centrifuge shaft	
12.08.04	Heating element	
12.08.05	Element sheathing	
12.08.06	Heater bath	
12.08.07	Oil heating coil	
12.08.08	Oil tanks	
12.09.00	**Weights and dimensions:**	
12.09.01	Weight of the complete oil purification plant in Kgs	
12.09.02	Weight of the polishing filter in Kgs	

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12.09.03 Weight of the centrifuge unit in Kgs

12.09.04 Weight of empty oil heater in Kgs

12.09.05 Weight of flooded oil heater in Kgs

12.09.06 Dimensions of the complete unit oil purification plant

12.09.06.01 Length in mm

12.09.06.02 Width in mm

12.09.06.03 Height in mm

12.10.00 Instruments, controls & panels furnished as required

12.11.00 Piping, hangers, supports, valves, fittings, specialties etc furnished as required

12.12.00 Insulation furnished as required

12.13.00 Cleaning & painting will be done as required

13.0.0 **LIST OF ACCEPTABLE SUB-VENDORS:**
(However, project specific vendor list is final)

13.01	Centrifuge	Centrifuge vendor
13.02	Centrifuge Base frame	Centrifuge vendor
13.03	Motor for centrifuge & Feed pump	CGL, BBL, KEC, Siemens, ABB
13.04	Control panel	Centrifuge approved vendor
13.05	Heater, Indirect type	Centrifuge approved vendor
13.06	Pump Screw/ Gear type	GIC, Mumbai Tushaco pumps

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		Allweiler, Germany IMO, Sweden/USA Lestritz, Germany
13.07	Polishing filter	Fairey arlon, holland Pall India pvt.Ltd EPE, Germany
13.08	Anti-flood tank	Centrifuge approved vendor
13.09	Pressure Gauge/ Differential pressure gauge	BALIGA Chennai Budenberg UK ASHCROFT USA/Germany WIKA Germany / PUNE Wise Control Korea Nagano Keiki Japan H Guru South India Bangalore AN Instrument Kolkata GIC (gauge Bourdon) Panvel Manometer Mumbai Goa Thermostatic Goa GLUCK Mumbai Switzer Chennai (only for DP Gauge) PTCI Kolkata Waree Vapi Forbes Marshall Hyderabad Ashcroft Gandhinagar H Guru Rishra / Muzaffarpur Gauge Bourdon (GIC)
13.10	Differential pressure switch	ITT BARTON,USA Herion, Germany SOR, USA Dresser, USA Gauge Bourdon (GIC) Panvel Delta, UK Switzer, Chennai Ashcroft Ghandinagar Barksdale Germany Indfoss, Ghaziabad
13.11	Thermocouple, RTD & Thermo well	Heraus Sensor Germany WISE Control Korea Tempsens Udaipur Pyroelectric Goa Datriv Instrumentation & electrical Mumbai Minco USA OKAZAKI Japan Yamari Japan

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		ABB (SENSYCON) Germany Emerson (Rose Mount) Germany GIC (Thermal instrument) Savantwadi
13.12	Temperature Gauge	Budenberg UK DRESSOR (ASHROFT) USA / Germany Wika Germany / Pune Wise Control Korea Nagano Keiki Japan H Guru South India Banglore AN. Instrument Kolkata NUOVA FIMA Italy Goa Thermostatic Goa GIC (Goa Instrument) Goa PTCI Kolkata Waree Vapi Ashcroft Gandhinagar Forbes Marshall Hyderabad H Guru Rishea/ Muzaffarpur
13.13	Temperature transmitter	EMARSON- USA/ Pawane Yokogawa- Japan Moore- USA FULI ELECTRIC- JAPAN ABB Germany/ Faridabad
13.14	Temperature switch	Ashcroft Gandinagar SOR USA DRESSOR (Aschroft) USA/ Germany ITT Barton USA DELTA CONTROLS UK Switzer Chennai Indfos Ghaziabad Trafag Ranipet Gauge Bourdon (GIC) Panvel
13.15	Strainer Y-type	JNM, Skilt
13.16	Flow Glass	Sigma, Technoflow
13.17	Check valve	Flowline, Expert
13.18	Regulating globe valve	BDK or equvalent
13.19	Needle valve	ASCO or equivalent
13.20	Globe valve	Centrifuge approved vendor
13.21	Rota meter	IEPL Hyderabad TRAC Hyderabad PLACKA Chennai EUREKA Pune Scientific Devices Mumbai

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		Flow Star Faridabad Tokoyo Keiso Japan Small Chemtrol Mumbai
13.21	Solenoid valve:	Technoflow Rotex Vadodra Avcon Mumbai Harion Germany IMI Norgen Germany Jafferson Argentina Asco Chennai/ USA
13.22	Ball valve	BDK, Audco
13.23	Level switch (float/ displacer type)	Endress & Houser Aurangabad Magnetrol Belgium Levcon Kolkata SBEM Pune Chemtrols samil Mumbai Sigma Industries Mumbai D K Instrument Kolkata Pune Techtrol Pune V Automat New Delhi Waree Wapi Level State UK
13.24	PLC System	GE Intellegent Plateforms Bangalore ABB Bangalore Schneider Nasik Rockwell Sahibabad Siemens Nasik
13.25	Impulse Pipes & tubes:	Sumitomo/ Kawasaki/ Nippon Japan TPS Technitube Germany Veluric & manessmann Germany BHEL Tirchy Trouvay & Cauvin France Heavy Metals Ahmedabad Jindal SAW India ISMT Ahmadnagar Sandvik
13.26	Compression Fittings	Parker USA Precision Mumbai DK Tech Korea HY LOK Korea Astech Mumbai Swagelock USA Panam Mumabi
13.27	Instrument Valve:	BHEL Trichy DK Tech Korea HY LOK Korea Excel Hydro Mumbai Instrumentation Ltd. Palghat Swagelock USA

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		HP Valves & Fitting Chennai Vikas Mumbai Hydair Lonawala Lonavala Aura INC New Delhi Baldota Mumbai
13.28	Instrument Cable:	Paramount Khuskhera Polycab Pawane Delton Faridabad KEI Bhiwadi Elkey telelinks Faridabad Cords Bhiwadi Reliance Bangalore Nicco Kolkata TEW & C USA Habla Cables Sweden Kerpen cables Germany Lapp cables Germany Thermo Electra BV Netherland Universal Cable Satna

14.0.0 TEST & GUARANTEE CERTIFICATES

14.0.1 TEST CERTIFICATES: 3 Copies of the manufacturers test certificates for performance of oil purification unit shall be supplied for each item of the consignment quoting BHEL standard number, purchase order number and manufacturer's identification serial number.

14.0.2 GUARANTEE CERTIFICATES:

A guarantee certificate for 24 months of trouble free performance from the date of shipment or 18 months from the date of commissioning whichever is earlier shall be supplied.

If any mal performance or defects occur during the warrantee period, the vendor shall make all necessary alteration, repairs or replacement free of cost.

15.0.0 **PACKING:**

The entire unit shall be properly packed to withstand mechanical damage and rust during transit. The packing shall be seaworthy packing.

16.0.0 **MARKING:**

The manufacturer's serial number and year of manufacture shall be marked at suitable locations viz Name plate

A tag bearing the relevant 12 digit material code shall be attached for each item.

The name plate of the oil purification unit shall contain the following information

- Manufacturer's name or trade mark & serial number
- Capacity of the centrifuge
- Pump discharge pressure
- Performance guarantee figures of moisture content and solid particles

Similar name plate to be provided for other items like Electric heater, polishing filter, oil pumps, electrical motors, Anti flood tank etc.

All the Instruments are to be properly tagged for easy identification

17.0.0 Enclosed:

1. Annexure –I (Type test procedure)
2. Annexure- II (Technical Data Sheet)
3. Annexure- III (Technical Deviation Sheet)

4. Annexure – IV (Check list)
5. Annexure- V (Price schedule)

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18.0.0 **Variant Table**:

Var No.	Description	Model No.	Material Code
01	OIL PURIFICATION UNIT 2400 LPH AS PER 2308000030-00	MMB305 – Alfa Laval OTC 5-91-067	TC9754367019
02	SP SET OF GASKETS FOR 2400LPH OPU		TC9754367027
03	SP SET OF "O" RINGS FOR 2400LPH OPU		TC9754367035
04	SP SET OF BRGS FOR 2400LPH OPU		TC9754367043
05	SP SET OF PF FILT CART FOR 2400LPH OPU		TC9754367051
06	SP DRIVE BELT FOR 2400LPH OPU		TC9754367060
07	SP FEED & DISCH PUMP ROTOR 2400LPH OPU		TC9754367078
08	SP SET OF GLAND COVER,PKG&SHFT SLV OPU		TC9754367086
09	SP SET OF FRICTION PAD SCRU 2400LPH OPU		TC9754367094
10	SP SET OF SPRINGS FOR 2400LPH OPU		TC9754367108
11	SP BREAK PLUG FOR 2400LPH OPU		TC9754367116
12	SPARE GLASS FOR 2400LPH OPU		TC9754367124
13	SPARE BOWL DISC FOR 2400LPH OPU		TC9754367132
14	SPARE SET OF SHEAR COUP FEED PUMP OPU		TC9754367140
15	SP SET OF CONTROL PANEL SPARES FOR OPU		TC9754367159
16	SP DE BRG FOR OPU DRIVE MOTOR		TC9754367167
17	SP NDE BRG FOR OPU DRIVE MOTOR		TC9754367175
18	SP COOLING FAN FOR OPU DRIVE MOTOR		TC9754367183
19	SP END SHIELD COVER FOR OPU MOTOR BRGS		TC9754367191
20	SP TERMINAL BOX FOR OPU DRIVE MOTOR		TC9754367205
21	OIL CENTRIFUGE(FIXED)2400LPH IE2 MOTOR Ref TC54368 for IE2		TC9754367213
22	IE3 MOTOR FOR CENTRIFUGE AND PUMP		TC9754367221
23	BEARNG IE3 MOTR FOR CENTRIFUGE AND PUMP Ref TC54373 for IE3 Mtr		TC9754367230
24	SPACE HEATR IE3 MOTR CENTRIFUGE & PUMP Ref TC54373 for IE3 Mtr		TC9754367248
25	COOLING FAN IE3 MOTR CENTRIFUGE & PUMP Ref TC54373 for IE3 Mtr		TC9754367256
26	OPU FIXED 2400 LPH IE3 MOTOR (Valve body CS internal SS & SS pipe)		TC9754367264
27	SPR FOR applicable IE2 MTR for OPU AS PER TBLE 1		TC9754367272
28	SPARE IE2 MTR FOR CENTRIFUGE AND PUMP Ref TC54368 for IE2		TC9754367280
29	Spare bearing,o-ring,gasket and filters		TC9754367299

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30	BEARINGS DE & NDE ALL OPU MTR		TC9754367302
31	COOLING FAN FOR ALL OPU MTR		TC9754367310
32	TERMINAL BLOCK FOR ALL OPU MOTOR		TC9754367329
33	SET OF COUPLING ALL OPU MOTOR		TC9754367337
35	DE & NDE BEARING OPU IE3 MOTOR		TC9754367353
36	COOLING FAN FOR OPU IE3 MOTOR		TC9754367361
37	TERMINAL BLOCK OPU IE3 MOTOR		TC9754367370
38	OPU FOR GSECL WANAKBORI,IE2 MOTOR		TC9754367388
39	OPU SKID,2400LPH, IE3 MTR, (COMPLETE Valve and Pipe SS)		TC9754367396
40	ALL APP.INSTRUMENT FOR OPU(10% QTY)		TC9754367400
41	Pressure Gauge (10% or2 nos of each type)		TC9754367418
42	OPU-2400 LPH, IE2 MOTOR, COMPLETE SS		TC9754367426
43	OPU-2400 LPH, IE3 MOTOR, COMPLETE SS-FLAMEPROOF-Refer Annex VI		TC9754367434
44	OIL PURF. SKID 2400LPH-SELF CLEAN		TC9754367442
45	OIL PURF. SKID 2400LPH-COMP SS-DCS		TC9754367450
46	TERMINAL PLATE FOR ALL OPU MOTORS		TC9754367469
47			
48			
49			
50			

Table No 1

S.No	Material description	Quantity
1	Bearings	1
2	Cooling fan	1
3	Motor terminal block plates	1
4	Complete set of couplings	1

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	10.05.2013	First Issue		
01	13.02.15	Motor requirement and Variant no up to 28 added		
02	09.04.15	Table No 1 and 2 added		
03	16.11.16	Revision marked as R03	ANSHUL	SUNIL J
04	22.06.17	Revision marked as R04	ANSHUL	SUNIL J
05	27.11.17	Revision marked as R05	ANSHUL	SUNIL J
06	13.12.17	Variant no 42 added. Marked as R06	ANSHUL	SUNIL J

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Annexure 1 (type test procedure for partlicle test)
Objective: Type test procedure is to determine the efficency of particulate seperation in offered Centriuge (Disc) with and without polishing filter at outlet of centrifuge
2. Desired Cleanliness level:
Centrifuge / centrifuge + polishing filter module inlet oil quality- 21/18 as per ISO 4406
Centrifuge / centrifuge + polishing filter module outlet oil quality- 15/12 as per ISO 4406
The sample tesing at lab will be as per approved ISO 4406-1999 procedure either by Microscopic Method or by Automatic particle counter.
3. Standard to be used:
ISO 4406: 1999 (E). This internation standard specifies the codes to be used in defining the solid particle in the fluid used in a given hydraulic fluid power system.
4. Oil to be used: ISO VG 46
5. References:
The following normative documents contains provision which, through reference in this text constitute provision of this international standard.
- ISO 11500-1997, hydraulic fluid power- determination of particulate contamination by automatic counting used the light extinction principle.
-ISO 4407:1991, Hydraulic fluid power- Fluid contamination- determincatio of particulate contamination by the counting method using micoscope
6. Procedure for test at NTPC approved Lab (CMTI: Banglore, or equivalent)
a) Start the centrifue and wait till it attains full speed and oil attains temp. of 65 deg C.
b) start the feed(Clean Oil- Purified to ISO class better than 15/12 after sampling before test) and set the centrifuge for desired capacity and temperature.
c) Add particulate matter (contamination) in tank. (add approx. 1/4 kg of particles in 100 lts. Of oil) and test this sample for information.
d) start the feed through the centrifuge and bypassing the polishing filter.
e) Collect samples from centrifuge inlet sampling point after one minute of mixing dirt and collect sample at outlet of centrfiuge immediately after collecteing inlet sample.
f) now pass the outlet oil through the polishing filtre and collect sample at outlet of polishing filter.
g) Stop centrifuge after collection of sample.
h) place the outlet drum at inlet of centrifuge and repear the above process from 4 to 7 for up to 3-4 passed or till no further reduction of ISO class o outlet oil.
7. Sample Collection
use ultra clean bottle collected from laboratory.

once the oil is collected in the bottle, close the cap immediately, this will help to avoid settling of atmospheric particles in the oil sample.
Seal the sample bottle in presence of all party.
8. Acceptance Criteria:
During sample test, inlet oil quality shall be inferior or equal to ISO 4406 class 21/18 and outlet oil qualtiy shall be superior or equal to ISO 4406 class 15/12
LOG SHEET FOR MEASUREMENT OF PARTICULTE MATTER
Centrfiuge Model No.
design Flow: @ 65 deg C
Machine Sl. No.

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Annexure-II

Customer :

Project :

BHEL PO No. :

NTPC Drawing No. :

1.0	Number of Units offered	(BFP Drive Turbine)
2.0	Location	Indoor
2.2	Type of operation	Purifier
2.3	Max. Hydraulic capacity (for turbine oil)	
2.4	Recommended through put for best Performances (for turbine oil)	
2.5	Speed	Centrifuge Motor RPM ____, Bowl Speed RPM _____.
2.6	Particle size distribution in terms of ISO Ration in purified oil at centrifuge system outlet After single pass	ISO 4406 Class 15/12 from initial 21/18
2.7	Particle size in purified oil at outlet of polishing filter	All particle above 5µm size will be removed
2.8	Water content in purified oil at outlet of centrifuge.	Free Water level in treated oil : Max. 0.05% (Provided 1.5% water at inlet)
2.9	Water contact in purification oil at outlet of polishing filter	0.05% Volume/volume
2.10	**OIL TEMPERATURES**	
	2.10.1 Inlet to electric heater	65^0 C (Max), 10^0 C (Min)
	2.10.2 Outlet from electric heater	65^0 C
2.11	Water temperature in the heater tank	90^0 C (not to excess 90^0 C)
2.12	**Bearings** 1. Nos. 2. Type 3. Manufacturer	Ball Bearing

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2.13	Solid holding capacity of the bowl	
3.0	**CONSTRUCTION FEATURE OF CENTRIFUGE**	
3.1	Automatic tripping of all electric motor on actuation of anti-flood device	
3.2	Clearing of centrifuge bowl	Manual
3.3	Type of centrifuge drive	Belt Drive
3.4	If centrifuge is belt driven automatic Tripping of all electric motors on belt failure	Separation trip
4.0	**MATERIALS OF CONSTRUCTION OF CENTRIFUGE (INDICATE STANDARDS) – ASTM Standards**	
4.1	Frame	
4.2	Hood	
4.3	Main Bowl Parts:	
	i) Bowl Bottom	
	ii) Bowl Top	
	iii) Disk	
	iv) Thread Ring	
	v) Lower Centripetal Pump Chamber Cover	
	vi) Spindle	
5.0	**DESIGN/CONSTRUCTION FEATURES OF ELECTRIC HEATER** (H01.01 – pos. no. 23)	
5.1	**Heater Details**	
	5.1.1 Quantity	
	5.1.2 Kilowatts	
	5.1.3 Voltage	Volts (AC) 415V ± 10%
	5.1.4 Frequency	50 Hz
	5.1.5 Phase	3
5.2	i) Number of on thermostats Or Pt – 100 Points on oil line	— (Pt-100, L = 150 mm, ø = 6 mm)
	ii) Range	0 - 199^0 C for oil temp. Control
5.3	Heater control thermostat setting	0 - 120^0 C for water temp. Control

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5.4	i) Rating of thermostat contacts	
5.5	**Heater tube**	
	5.5.1 Material	SS304
	5.5.2 Type	___
	5.5.3 Length	___
	5.5.4 outside Diameter	___
	5.5.5 Tube wall thickness	___
5.6	Surface load of heater	___
5.7	**Tube Sheets**	
	5.7.1 Material	SS304
	5.7.2 Number	___
	5.7.3 Thickness	___
5.8	Tube bundle type	___
5.9	Capacity of heater tank	___

6.0 FEED PUMP

6.1	Quantity	1 (one) No.
6.2	Model No.	___
6.3	Type	Positive displacement (Gear type)
6.4	Capacity	(10% excess capacity)
6.5	Speed	1440 RPM
6.6	Discharge Pressure	__ kg / cm^2 (g)
6.7	Relief valve setting	__ kg / cm^2
6.8	Max. allowable pump working pressure	__ kg / cm^2 (g)
6.9	**Connections**	
	a) Inlet	__ NB
	b) Outlet	__ NB
6.10	**Material**	
	Flange	ASTM ____
	Cover	ASTM ____
	Shaft	ASTM ____
	Body	ASTM ____

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	Bush	ASTM ____
6.11	Drive (AC Motor)	Main Centrifuge Motor
6.12	Motor rating	__kW (Main Centrifuge Motor)
6.13	Bearing	___
6.14	HP rated capacity for feed pump	___hp

7.0 Booster DISCHARGE PUMP

7.1	Quantity	1 (one) No.
7.2	Model No.	___
7.3	Type	Positive displacement (Gear type)
7.4	Capacity	(10% excess capacity)
7.5	Speed	1450 rpm
7.6	Discharge Pressure	__ kg / km^2 (g)
7.7	Relief valve setting	__ kg / km^2
7.8	Max. allowable pump working pressure	__ kg / km^2 (g)
7.9	**Connections**	
	a) Inlet	__ NB
	b) Outlet	__ NB
7.10	**Material**	
	Flange	ASTM____
	Cover	ASTM____
	Shaft	ASTM____
	Body	ASTM____
	Bush	ASTM____
7.11	Motor rating	__kW
7.12	Bearing	
7.13	HP rated capacity	__ hp

8.0 INSTRUMENTS

8.1 PRESSURE GAUGES

	a) Type	Bourdon Type

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b) Number	__ Nos.
c) Location	- -
Dial Size : 150 mm	
Over Range : 150%	
Protection : IP 55	
Connection : ½" NPT(M)	
d) Range	0-6kg/cm2 and -1 to (+) 5 kg km^2
e) Accuracy	± 1% FSD
f) Body Material	Die Cast Aluminium
g) Scale	Liner 270^0 (arc graduated in metric)
i) Zero/Span adjustment	provided
i) Window	Shatterproof glass
k) Model No .	
j) Manufacturer	

8.2 **TEMPERATURE INDICATORS**

a) Type	Mercury in steel Dial Thermometer.
b) Number	__ Nos.
c) Location	__
Dial Size : 150 mm	
Over Range : 125%	
Protection : IP 65	
d) Range	0 to 100^0 C
e) Accuracy	± 1% FSD
f) Body Material	Die Cast Aluminum
g) Sensing Material	Mercury in steel
h) Scale	Liner 270^0 (arc graduated in metric)
i) Over Range	150% FSD
j) Zero/Span adjustment	provided
k) SS thermowell	provided

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l) Manufacturer

j) Window — Shatterproof glass.

h) Model No.

.

i) Thermowel

.

j) Thermowel Process connection: — ¾" NPT M

8.3 **FLOW GLASS** (FG1, FG2 - pos. no 10)

a) Type — Glass tube

b) Accuracy — N.A

c) Location

d) Connections, type & size — __ NB

e) Model No. — __

f) Manufacturer — __

9.0 **LEVEL SWITCH**

a) Number — _ No.

b) Type — Vertical Mounting Type Float Switch

c) Location

e) Model No.

f) Manufacturer

g) No. of contacts & contact rating

10.0 **INDICATING TYPE DIFFERENTIAL PRESSURE GAUGE/SWITCH (ACROSS POLISHING FILTER)**

a) Number — 1 No.

b) Type — Dial Type

c) Location — ACROSS POLISHING FILTER

d) Model No.

e) Manufacturer

f) No. of contacts & contact rating

11.0 **POLISHING FILTER**

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a) Number	01 No.
b) Location	After Booster Pump.
c) Model No	.
d) Make	

12.0 Ball Valves

a)	Size	__ NB
b)	End connection	
c)	Body Material	A 216 GR WCB
d)	Internals	SS 316
e)	Make	

13.0 **Ball Valve**

a)	Size	__ NB
b)	End connection	Treaded.
c)	Body Material	A216 GR WCB
d)	Internals	SS316
e)	Make	

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Annexure-III

Technical Deviation Sheet (TDS Sheet):

S.No	Spec No	Description of Spec	Deviation	Reason

Vendor's Signature

Vendor's Company seal

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Annexure-IV

Check List

(TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITH OUT WHICH OFFER WILL NOT BE CONSIDERED)

S.No.	Description	Vendor's Confirmation (Yes/No)
1	Compliance for BHEL specification TC54367	
2	Compliance for the sub-vendors list indicated as per BHEL specification. For the items, which are not covered in the list or vendors not indicated, vendor has to procure from their standard sub-vendors. Vendor to confirm compliance for the same.	
3	Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required at later stage for complying BHEL specification or for the satisfactory working of the equipment shall be supplied by vendor without any price/delivery implications.	
4	Price Schedule as per Annexure- III enclosed. Also, signed filled copy of Price schedule (without prices) enclosed with technical offer	
5	Filled up equipment data sheet	
6	Proven Track Record	
7	Recommended commissioning spares during commissioning operation. These are to be clearly specified in the offer & the price is to be included in the equipment price	
8	Recommended spares for three years of normal operation: list for all the items with item wise prices. The offer shall be valid for one year after placement of order and these shall be ordered as required later.	
9	Any additional requirements which are essential for proper functioning of the equipment included in the offer.	

a)

Vendor's Signature

Vendor's Company seal

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Annexure-VI

Project- UPRVUNL PANKI 1X660MW

VOL-V (I & C)-Instrumentation spec

VOL-V (I & C)-local control panel

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SQUIRREL CAGE INDUCTION MOTORS IE-3 (Premium Efficiency Class)

(For BFP Drive Turbine)

1. SCOPE:

This standard specifies the requirements of the 3-phase medium voltage squirrel cage Induction motors used for driving Centrifugal / Screw / Gear pumps of lube oil systems of Industrial Turbo sets and BFP drives.

2. TECHNICAL REQUIREMENTS:

2.1 General:

The squirrel cage induction motors shall be of horizontal foot mounted (B3) type or Vertical flange mounted (V1) type construction as per enquiry suitable for bi-directional rotation. Unless otherwise specified the motors are of type IP55 enclosure (as per IS: 4691 & IEC60034-05) with class 'B' insulation and continuous duty (S1). Class 'F' insulation is also accepted with temperature rise limited to class 'B'. The motors shall be suitable for 100% humid (at 40 deg C), salty tropical conditions and highly polluted environment.

2.2 Design Standards:

The motors shall conform to relevant latest amendments of National and International Codes and standards, especially the Indian Statutory Regulations.

- Performance : IS 325 & IS 8789 & IEC:60034
- Dimensions : IS 1231 / IS 2223
- Enclosure and protection : IS 4691 / IEC:60034-05
- Tropicalizing treatment : IS 3202
- Energy Efficient motors : IS 12615 / IEC:60034-30
- Method of Cooling : IS 6362 / (Equivalent IEC: 60034 Std.)

2.3 Design and Constructional Features:

2.3.1 Motors shall work satisfactorily for following supply conditions:

Variation of supply voltage from rated voltage : ± 10%
Variation of supply frequency from rated frequency : + 3% to - 5%
Combined voltage and frequency variation : ± 10%

2.3.2 The Voltage level of motors shall be as follows: (unless otherwise specified)
Up to 200 kW: 3 Phase 415V AC

2.3.3 Rated frequency: 50 Hz

2.3.4 The ambient temperature is 50°C and an altitude not exceeding 1000 meters above mean sea level shall be taken into consideration unless otherwise specified.

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2.3.5 TEMPERATURE RISE 70°C by resistance method for both thermal class 130(B) & 155(F) insulation.

2.3.6 Continuous duty LT motors up to 160 KW Output rating (at 50°C ambient temperatures), shall be Energy Efficient motors, Efficiency class of Premium efficiency (IE3) as per IEC: 60034-30 unless otherwise specified.

2.3.7 Winding and Insulation shall be Non-hygroscopic, oil resistant, and flame resistant.

2.3.8 Motor body shall have two earthing points on opposite sides.

2.3.9 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

2.3.10 The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.

2.3.11 The starting time of the motor shall be less than 3 secs.

2.312 The motor shall be totally enclosed fan cooled (TEFC) unless otherwise specified.

2.4 Performance:

2.4.1 Motor shall be suitable for DOL starting.

2.4.2 The motor shall be capable of start & operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminal.

2.4.3 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. Starting torque should not be less than 120% of FLT. The pullout torque at the rated voltage shall be not less than 205% of the full load torque with no negative tolerance. Unless otherwise agreed, the pullout torque shall not exceed 300% of the rated load torque.

2.4.4 Fault capacity of the system to which motor is connected is about 45 kA RMS 1 second.

2.4.5 Noise level for all the motors shall be limited to 85dB (A) at distance of 1 m as per IS12065 (latest) /IEC60034.

2.4.6 Vibration shall be limited within the limits prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment.

2.4.7 The spacing between gland plate & center of terminal stud shall be as per Table-1.

2.4.8 For motors with starting time up to 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

2.4.9 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance)

a) Below 110 kW: 10.0

(b) From 110 kW & up to 200 kW: 9.0

2.4.10 Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS: 2148 as detailed below

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(a) Fuel oil area: Group - IIB

2.4.11 The starting voltage requirement shall be 85% for motors below 110KW rating and 80% from 110KW to 200KW.

2.5 ACCESSORIES:

Terminals and Terminal box:

2.5.1 All the six terminals should be brought out on the terminal block, which shall be provided with connecting strips and shall amply be rated.

2.5.2 The terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees and location is to be midway on right hand side when viewed from coupling end.

2.5.3 The terminals shall be clearly marked R.Y.B.

2.5.4 The terminal box shall be furnished completely with nickel coated brass double compression glands for termination.

2.5.5 Grounding pads shall be as per relevant standards.

2.5.6 The degree of protection shall be IP55 as per IS4601 & IEC60034-05

2.6 Suitable single phase AC (240 V) space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Space heaters shall be wired up to separate terminal box complete with removable gland plate and suitable terminals & glands for connections of cable & temperature detectors, bearing temperature indicators and moisture detectors terminals, Neutral CT terminals shall also be provided.

2.7 Lower capacity motors (less than 30kW) where separate Anti condensation heaters are not provided, two phases of the winding will be subjected to 240V AC, 50HZ supply continuously whenever the motor is switched off to avoid any ingress of moisture. The supplier in the offer in this regard shall bring out any limitations. For LV Motors: Two point five (2.5) mm2, two (2) core copper conductor PVC insulated, armoured & FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 Part-I).

2.8 RATING PLATES

A rating plate of non-corrosive material upon which shall be engraved Manufacturer's name, Motor type, Motor model, Serial no. of motor, Rating, Voltage, Speed in RPM, Type of duty, Full load current in Amps, type of protection and efficiency class (IE3 / IE4).

These rating plates shall be of White non-hygroscopic material with engraved black lettering.

Stainless steel name plate as per IS 325 (Latest) /IEC 60034 (latest).

2.9 PROTECTION AND PRESERVATIVE COATING REQUIREMENTS:

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2.9.1 All coated surfaces shall be protected against abrasion impact, discoloration any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. The shaft ends of motor shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted due to exposure to whether, should also be properly treated and protected in a suitable manner. All primers / paints / coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be.

2.9.2 Preservative shop coating:

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces that will not be easily accessible after the shop assembly shall be treated before-hand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and pre heated in the shop. The surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer.

All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of Customer / BHEL.

2.10 PAINT AND FINISH

Motor external parts shall be finished and painted to produce a neat and durable surface, which would prevent rusting, and corrosion. The equipment shall be thoroughly degreased, all rust, sharp edges and scale removed and treated with one coat of primer and finished with two coats of RAL 5012 blue paint unless otherwise specified.

Material shall be properly packed to withstand mechanical damage and rust during transit.

2.11 The motor winding shall be tropicalized. The windings shall preferably be vacuum impregnated. Alternately the winding shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmospheres.

2.12 Cooling fan hub shall be threaded for withdrawing.

2.13 Drain plug shall be provided at the bottom of the starter frame.

2.14 The following **cable sizes** shall be considered for selecting suitable cable glands, unless otherwise specified.

Up to 3.7 KW - 3C x 2.5 mm^2 multi stand cu. conductor armored cable.

Above 3.7 KW up to 11KW - 3C x 10 mm^2 Multi stand Al. conductor, Armored cable

Above 11 KW up to 26KW - 3C x 25 mm^2 Multi stand Al. conductor, Armored cable.

Above 26 KW up to 37KW - 3Cx50 mm^2 Multi stand Al. conductor, Armored cable.

Above 37 KW up to 55KW - 3Cx95 mm^2 Multi stand Al. conductor, Armored cable.

Above 55 KW up to 75KW - 3Cx150 mm^2 Multi stand Al. conductor, Armored cable.

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Above 75 KW up to 150KW -2x 3Cx185 mm^2 Multi stand Al. conductor, Armored cable.

Three (3) core cables .....Stranded aluminium conductor, XLPE insulated, colour coded, laid up, FRLS PVC type ST2 sheathed, GI wire /strip armoured, FRLS PVC type-ST2 jacketed overall, 650 / 1100V grade, heavy-duty cable as per IS:1554 Part-I).

For space heater 2Cx6 mm^2 Aluminum conductor, Armored cable

Special sizes if any will be as per our enquiry.

- For NTPC:

90 kW AC motor: 1x3C x 150sq mm

2.15 Bearing & Lubrication:

Motors shall have greased lubricated ball or roller bearings. In all cases, the bearings shall be chosen to provide a minimum life of 5 Years (40000 hours) at rated operating conditions. Unless otherwise specified the bearings shall be adequate to absorb axial thrust produced by the motor itself or due to shaft expansion. Vertical motors shall be provided with thrust bearings suitable for the load imposed by the driven equipment. In cases such as pumps for hot liquids where the driven machine operates at high temperatures, a shaft-mounted fan shall cool bearings. This shall ensure efficient ventilation of the bearing and disperse the heat transmitted from the driven object by conduction or convection. For motors operating in hazardous areas fans shall be of an anti-static non-sparking material.

Bearings shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust or moisture e.g. labyrinth seal. Where grease nipples are provided, these shall be associated, where necessary with appropriately located relief devices, which ensure passage of grease through the bearing. Pre-lubricated sealed bearings may be considered provided full guarantee is given for 4 to 5 years of trouble free service without the necessity of re-lubrication.

2.16 Cooling system:

All motors shall be self-ventilated, fan cooled (TEFC). Fans shall be corrosion resistant or appropriately protected. They shall be suitable for motor rotation in either direction without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reserve the fan without effecting the balancing of the motor.

Motor shall be capable of 5 equal spaced cold starts per hour under normal conditions, 3 starts in quick succession from cold condition and two hot start in succession with motor initially at normal running condition.

2.17 ROTOR:

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The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and long service life of the bearings. The accepted values of peak-to-peak vibration amplitudes for a motor at rated voltage and speed on a machined surface bedplate with the motor leveled and with a half-key or coupling fitted shall not exceed those given in IS-12075 (latest).

2.18 Grounding

General- Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.

LV Motors-At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.

3. TESTS CERTIFICATE:

3 copies of performance test certificate of motor shall be supplied for each item of the consignment quoting BHEL Standard number, purchase order number and manufacturer's identification serial number.

4. GUARANTEE CERTIFICATE:

4.1 A guarantee certificate for 24 months of trouble free performance from the date of shipment or 18 months from the date of commissioning whichever is earlier shall be supplied.

4.2 If any mal-performance or defects occur during the guarantee period, the vendor shall make all necessary alteration, repairs and replacement free of charge.

5. SCOPE OF SUPPLY:

5.1 Main Supply

5.1.1 Motor with suitable double compression cable glands, lugs and along with shaft keys.

5.1.2 Space heater & RTD for motors with separate terminal box of rating 30 KW and above.

5.2 1 Set of commissioning spares (DE &NDE Bearings) items- Separate Purchase Requisitions is raised if required.

5.3 3 years Normal Operational spares (optional price shall be quoted for validity of 2 years) - Separate Purchase Requisitions will be raised as and when required.

5.3.1 Terminal Box.

5.3.2 Cooling Fan with End shield Cover

5.3.3 DE and NDE side Bearings

6. TESTS:

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6.1 Each motor shall be Routine tested in accordance with IEC 60034-2 latest in presence of purchaser's representative.

Type test of similar frame size motor to be produced at the time of inspection. Tests on completely assembled motor shall be carried out in the presence of BHEL / Customer representative. The results shall be tabulated and signed by both vendor and BHEL / Customer representatives. **Though the motors shall be accepted on the basis of the satisfactory result of the tests at the vendor's works, it shall not absolve the vendor from liability regarding the proper functioning of motor coupled to the driven equipment at BHEL works or at sites.**

6.2 LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last eight (8) years.

6.3 These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last eight (8) years from the date of ordering, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

1. <u>Type tests</u>

i. No load saturation and loss curves up to approximately 115% of rated voltage.

ii. Momentary overload test.

iii. Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., core temp., coolant flow and its temperature shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.iv. Surge withstand test on the sample coil after placing it in stator core at (4U + 5 KV) and with at least five impulse of 1.2/50 micro sec. wave, for HV motors only,where U is the line to line voltage in kV.

v. Surge-withstand test with 0.3/3 micro sec. wave on each type of 6.6/11 kV motor coils with at least five such impulses, followed by one minute power frequency high voltage test on turn to turn insulation, after cutting the coil and bringing out the turns suitably. The power frequency test voltage shall be decided during detailed engineering.

vi. Dimensions (for motors covered by IS 1231:1974 and IS 2223:1983 only).

vii. Measurement of resistance of windings of stator and wound rotor.

viii. Reduced voltage running up test at no load (for squirrel cage motors up to 37kw

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only).

ix. Full load test to determine efficiency, power factor and slip.

x. Insulation resistance test.

xi. Test for vibration severity of motor.

xii. Test for noise levels of motor.

xiii. Test for degree of protection by enclosure.

xiv. Temperature rise test at limiting values of voltage and frequency variations.

xv. Over speed test.

2. Routine Tests

The following shall constitute the routine tests.

i. Insulation resistance test

ii. Measurement of resistance of windings of stator and wound rotor.

iii. No load test

iv. Locked rotor readings of voltage, current and power input at a suitable reduced voltage

v. Reduced voltage running up test (for squirrel cage motor) vi. Open circuit voltage ratio of stator and rotor windings (for slip ring motors);rotor;

vii. High voltage test

7. DOCUMENTATION:

7.1 All the drawings/ documents submitted by the vendor during detailed engineering stage shall be stamped “For Approval” or For Information” prior to submission. After the approval of the drawing, further work by the vendor shall be in strict accordance with these approved drawings and no deviations shall be permitted without the written approval of customer.

7.2 All manufacturing, fabrication and execution of work in connection with the equipment prior to the approval shall be at the vendor’s risk. The vendor is expected not to make any changes in the design of the approval of the drawings equipment, once they are approved by customer. However, if some changes are necessitated in the design of equipment at a later date, the vendor may do so, but such changes shall promptly be brought to the notice of customer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the technical specification.

7.3 LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

- All the motors shall be tested in accordance of IEC 60034-2
- The following type test reports shall be submitted for each type and rating of

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LT motor of above 50 KW only

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
4. Full load test to determine efficiency power factor and slip.
5. Temperature rise test.
6. Momentary excess torque test.
7. High voltage test.
8. Test for vibration severity of motor.
9. Test for noise levels of motor (Shall be limited to 85 dB (A) until otherwise specified)
10. Test for degree of protection
11. Over - speed test.
12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment basic price.

The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

7.4 NUMBER OF DOCUMENTS TO BE SUBMITTED:-

- Drawings, Data sheets, Curves for Information /approval .....3 prints (1 soft copy).
- Final Drawings, Data sheets, Curves for Information / approval .... 3 Prints.
- Performance and functional guarantee test reports .... 3 prints
- O&M manual with project drawings, data sheets, performance and functional guarantee test reports ..... 10 Prints & 1 CD

8. DRAWINGS, DATA TO BE FURNISHED

8.1 Documents to be sent along with offer (2 copies)

(Without following data, offers will not be considered)

8.1.1 The descriptive leaflets / catalogues giving full sectional details of the item.
8.1.2 Motor Overall dimensional drawing along with terminal box details.
8.1.3 Motor cross-sectional drawing showing spare part details.
8.1.4 Filled in motor data sheets as per NTPC format (Page 12 to 15)
8.1.5 Characteristics curve of motor.
8.1.6 Speed torque characteristic curve of motor along with GD^2 Value.
8.1.7 Quality plan
8.1.8 Type test Certificates of similar frame size

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8.2 DOCUMENTS TO BE SENT AFTER PLACEMENT OF ORDER FOR APPROVAL
(3 Hard Copies + 1 Soft copy)

8.2.1 Motor Overall dimensional drawing along with terminal box details.
8.2.2 Motor cross-sectional drawing showing spare part details.
8.2.3 Filled in motor data sheets as per NTPC format (Page 12 to 15)
8.2.4 Characteristics curve of motor
8.2.5 Speed torque characteristic curve of motor along with GD^2 value
8.2.6 Quality plan
8.2.7 Type test Certificates of similar frame size

8.3 DOCUMENT TO BE SUBMITTED AFTER FINAL APPROVAL

8.3.1 Material test certificates.
8.3.2 Guarantee certificates
8.3.3 Motor Overall dimensional drawing.
8.3.4 Filled in motor data sheets.
8.3.4 Quality plan.
8.3.7 Type test report

8.4 DOCUMENT TO BE SUBMITTED ALONG WITH CONSIGNMENT

8.3.1 Material test certificates.
8.3.2 Performance test certificates & Performance curve.
8.3.3 Guarantee certificates
8.3.4 Motor Overall dimensional drawing.
8.3.5 Filled in motor data sheets.
8.3.6 Quality plan.
8.3.7 Type test reports
8.3.8 O&M Manual

9. SPECIAL NOTES:

9.1 Final documents shall be furnished in CD for using in MS – word, AutoCAD & PDF.
9.2 Before forwarding the drawings and documents, vendor shall ensure that the following information is properly entered in each drawing.
9.2.1 Name of the equipment
9.2.2 Equipment tag number
9.2.3 Name of the project
9.2.4 Client / Customer
9.2.5 Drawing / Document title
9.2.6 Drawing / Document number.
9.2.7 Revision and date.
9.2.8 The manufacturer's serial no. shall be marked at suitable location.
9.2.9 A tag number bearing the relevant 12 digit material code shall be attached for each item.

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10. **REFERENCE**

- IS 325: THREE-PHASE INDUCTION MOTORS
- IS 8789: Values of performance characteristics for three-phase induction motors(up to 37 kw)
- IEC:60034: Rotating electrical machines
- IS 1231: Dimensions of Three-phase Foot-mounted Induction Motors
- IS 2223: Dimensions of flange mounted ac induction motors
- IS 4691: Degrees of protection provided by enclosure for rotating electrical machinery
- IS 3202: Code of practice for climate proofing of electrical equipment
- IS 12615, Energy Efficient Induction Motors - Three Phase Squirrel Cage
- IEC:60034-30: Rotating electrical machines - Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)
- IS 6362: Designation of methods of cooling of rotating electrical machines

11. **TABLE 1:**

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS:

S.N.	Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
1	UP to 3 KW	As per manufacturer's practice.
2	Above 3 KW - up to 7 KW	85
3	Above 7 KW - up to 13 KW	115
4	Above 13 KW - up to 24 KW	167
5	Above 24 KW - up to 37 KW	196
6	Above 37 KW - up to 55 KW	249
7	Above 55 KW - up to 90 KW	277
8	Above 90 KW - up to 125 KW	331
9	Above 125 KW-up to 200 KW	203

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

S.N.	Motor MCR in KW	Clearance
1	UP to 110 KW	10mm
2	Above 110 KW and up to 150 KW	12.5mm
3	Above 150 KW	19mm

12. **DATA SHEET** (NTPC FORMAT)**:**

DE-1	LT MOTORS	

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A.	**GENERAL**	
1.	Manufacturer & Country of origin.	
2.	Equipment driven by motor	
3.	Motor type	
4.	Quantity	
B.	**DESIGN AND PERFORMANCE DATA**	
1.	Frame size	
2.	Type of duty	S1
3.	Type of enclosure /Method of cooling/ Degree of protection	
4.	Applicable standard to which motor generally conforms	
5.	Efficiency class as per IS 12615 (latest) / IEC 60034-30 (latest)	IE3 (default)
6.	(a)Whether motor is flame proof	Yes/No
	(b)If yes, the gas group to which it conforms as per IS:2148	
7.	Type of mounting	
8.	Direction of rotation as viewed from DE END	Bi-directional
9.	Standard continuous rating at 40 deg. C ambient temperature as per Indian Standard (KW)	
10.	Deaerated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
11.	Maximum continuous load demand of driven equipment in KW	
12.	Rated Voltage (volts)	415
13.	Permissible variation of :	
	a. Voltage (Volts)	±10
	b. Frequency (Hz)	±5
	c. Combined voltage and frequency	±10
14.	Rated speed at rated voltage and frequency(RPM)	
15.	At rated Voltage and frequency:	
	a. Full load current	
	b. No load current	
16.	Power Factor at	
	a. 100% load	
	b. NO load	
	c. Starting.	
17.	Efficiency at rated voltage and frequency,	
	a.100% load	
	b. 75% load	

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	c. 50% load	
18.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
19.	Minimum permissible starting Voltage (Volts)	
20.	Starting time with minimum permissible voltage	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
21.	Safe stall time with 100% and 110% of rated voltage	
	a. From hot condition	
	b. From cold condition	
22.	Torques :	
	a. Starting torque at min. permissible voltage (kg-mtr.)	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg-m) available at lowest permissible starting voltage	
	e. Rated torque (kg-m)	
23.	Stator winding resistance per phase (ohms at 20 Deg.C.)	
24.	GD^2 value of motors	
25.	No of permissible successive starts when motor is in hot	
26.	Locked Rotor KVA Input	
27.	Locked Rotor KVA/KW	
28.	Vibration limit :Velocity (mm/s)	
29.	Noise level limit (dBA)	
C.	**CONSTRUCTIONAL FEATURES**	
1.	Stator winding insulation	
	a. Class & Type	

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	b. Winding Insulation Process	
	c. Tropicalised (Yes/No)	Yes
	d. Temperature rise over specified maximum ambient temperature of 50 deg C	
	e. Method of temperature measurement	
	f. Stator winding connection	
2.	Main Terminal Box	
	a. Type	
	b. Location(viewed from NDE side)	
	c. Entry of cables(bottom/side)	
	d. Recommended cable size (To be matched with cable size envisaged by owner)	
	e. Fault level (MVA),Fault level duration(sec)	50kA RMS for 0.25 sec
	f. Cable glands & lugs details (shall be suitable for power cable)	
3.	Type of DE/NDE Bearing	
4.	Motor Paint shade	RAL5012(Blue)
5.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	
D.	**List of accessories.**	
1.	Space Heaters (Nos./Power in watts/supply voltage)	
2.	Terminal Box for Space Heater (Yes/No)	yes
3.	Speed switch (Yes/No) No of contacts and contact ratings of speed switch	
4.	Insulation of bearing (Yes/No)	
5.	Noise reducer(Yes/No)	
6.	Grounding pads	
	i) No and size on motor body	
	ii) Nos on terminal Box	
7.	Any other fitments	

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E.	List of curves.	
1.	Torque speed characteristic of the motor	
2.	Thermal withstand characteristic	
3.	Starting. current Vs. Time	
4.	Starting. current Vs speed	
5.	P.F. and Effi. Vs Load	

13. **VARIANT TABLE:**

Var. No.	Description	Material code
01	TEFC SQ. CAGE HOR FOOT MOUNTED (B3) A.C IND. MOTOR FOR L.O.P. RATING: 90 KW, 415 VAC, 1450 RPM EFFICENCY AS PER IE3 IEC60034-30, SCOPE AS PER CLAUSE 5.1, NTPC Project	**TC9754373019**
02	SPARE SET OF BEARINGS (DE+NDE) FOR 90 KW A.C MOTOR- COMMISSIONING SPARE	**TC9754373027**
03	SPARE COOLING FAN FOR 90 KW A.C.MOTOR	**TC9754373035**
04	TERMINAL PLATE FOR IE3 90KW MOTOR	**TC9754373043**
05	SPACE HEATER FOR 90KW IE3 MOTOR	**TC9754373051**
06	TEFC SQ. CAGE HOR FOOT MOUNTED (B3) A.C IND. MOTOR FOR L.O.P. RATING: 110 KW, 415 VAC, 2900 RPM EFFICENCY AS PER IE3 IEC60034-30, SCOPE AS PER CLAUSE 5.1	**TC9754373060**
07	IE3 TEFC(B3)AC IND MTR,90KW,415VAC,2900	**TC9754373078**
08	IE3 TEFC(B3)AC IND MTR,75KW,415VAC,1450	**TC9754373086**

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	01.07.14	First Issue		
01	20.06.16	First revision	Anshul	M.V.S.Raju
02	19.05.17	Second revision	Anshul	Sunil Jiwtode
03	16.12.17	Third revision , Var 08 added	Anshul	Sunil Jiwtode

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Date: 2020.08.17 18:20:27 IST
Reason: CAT I
Location: NTPCEOC

NTPC DRG. No. 9962-001-HY-110-PVM-W-026 | REV. 3

PROJECT: 1 X 660MW PANKI THERMAL POWER EXTENSION PROJECT.

OWNER:

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.

REVIEW CONSULTANT:

NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)

CONSULTANT:

DEVELOPMENT CONSULTANTS PVT. LTD.
KOLKATA

EPC CONTRACTOR:

BHARAT HEAVY ELECTRICALS LTD.

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	ANSHUL	-sd-	05.08.2020
	DESN	ANSHUL	-sd-	05.08.2020
	CHD	SUNIL	-sd-	05.08.2020
	APPD	PRAFULLA	-sd-	05.08.2020

TITLE

TYPE TEST PROCEDURE OF OIL PURIFICATION SYSTEM OF TDBFP

						DEPT.	SCALE
						SIGN	

BHEL DRG NO. HY-TP-4-31101-20225

SHT. 1 OF 34 | REV. 3

PROJECT- 1X660 MW PANKI THERMAL POWER EXTENSION PROJECT

DOC NO – 9962-001-HY-110-PVM-W-026

TITLE- TYPE TEST PROCEDURE OF LUBE OIL PURIFICATION SYSTEM FOR TDBFP

S.No.	Customer Comment	BHEL reply dtd 08.05.2020
1	The comment was to tell that according to diagram submitted, S2 point is before polishing filter whereas . BHEL to check and correct.	Noted and revised in document.
2	Please inform about the time till which module is run in recirculation mode?	There is no definite time period because practically we need to add dirt in small stages in such way we achieve/ create inlet condition of 21/18 class as per ISO 4406 as explained next step of point no. 3 of type test procedure.
3	S2 or S3??	S3
4	Please check with the attached setup diagram.	Revised doc attached

Note: The test procedure is a standard document followed since last 10 years. Request to accept the same.

TYPE TEST PROCEDURE FOR ALFA LAVAL DISC BOWL CENTRIFUGE

1. Objective:

To measure effectiveness of centrifuge / separator w.r.t. reduction of solid contaminants from mineral oil.

Type Test for solid particle reduction size shall be carried out on **Model MMB 305** centrifuge.

2. Scope:

Centrifuge is used for various grades of Turbine lube oils like ISO VG 32, 46, 57, 68 in power plants. The capacity of centrifuge depends on its viscosity at separation temperature.

2.1 Oil Grade: Type test for particle size shall be conducted with **ISO VG 46** oil.

2.2 Location: Type test will be conducted by CMTI, Bangalore @ Alfa Laval India Private Limited, Dapodi , Pune Factory .

2.3 Desired cleanliness level for particle size:

Centrifuge inlet oil quality - 21/18 as per ISO 4406

Centrifuge outlet oil quality after Centrifuge - 15/12 as per ISO 4406 in one pass.

The samples testing will be as per ISO4406-1999 procedure by Automatic particle counter.

Sample testing starts only after calibrating the instruments as per NAS 0 cleanliness level.

For calibration of automatic particle size counter ISO 11171:1999, Hydraulic fluid power calibration of automatic particle size counters for liquids shall be used.

2.4 Standard followed for particle size measurement:

ISO 4406: 1999(E). This International standard specifies the code to be used in defining of solid particles in the fluid used in a given hydraulic fluid power system.

3. Procedure for Particle Size Measurement Test:

- Assemble the centrifuge bowl in purifier mode.
- Set up of the module is made as per attached schematic flow diagram (SMN-0241 R1)

  Oil temperature will be maintained at 65 Deg C.
- Start the feed (Fresh /clean oil) and wait till it reaches full speed. & set the purifier for desired capacity -2400 LPH of ISOVG 46 & temp 65
- Start the module initially in recirculation mode (fresh oil is circulated back to dirty oil tank).
- Add particulate matter (contamination) in dirty oil tank to achieve contamination level of 21/18 as per ISO 4406 by ensuring proper mixing of the particulate matter (contamination). Which can be checked through automatic particle counter.

- Once above-mentioned condition achieves, the module is ready for the Type test.
- The oil flow (capacity) is checked using measuring flask. Desired capacity is measured by collecting the oil in a jar of 5 ltrs. And time taken to fill this jar. At least three readings are taken to adjust the capacity. The capacity is adjusted by flow adjusting inlet valve.
- Collect samples from centrifuge inlet sampling point after one minute of mixing dirt and collect sample at outlet after two minute of mixing dirt
- The samples should be checked for its contamination using CMTI instruments (Automatic particle counter) which are made available at the type test venue. All the sample readings are recorded as per the
  Log Sheet below.
- Stop the centrifuge after collection of samples.

4. Sample collection:

- Use ultra clean bottles.
- Samples will be collected after proper rinsing of clean bottles with respective oil.
- Once the oil is collected in the bottle, close the cap immediately, this will help to avoid settling of atmospheric particles in the oil sample.

Samples will be collected at 2 points.
Dirty Oil Sample @ Centrifuge Inlet (Sample point S1)
Clean Oil Sample @ Centrifuge Outlet i.e. after polishing filter (Sample point S3)

- Valid Calibration certificates of all measuring instruments (/Temperature/Particle count measurement etc.) shall be made available at the time of Type Test.

5. ACCEPTANCE CRITERIA FOR PARTICLE SIZE REDUCTION:

During sample test, Inlet oil quality shall be inferior or equal to ISO 4406 class 21/18 and Cleaned oil outlet quality at outlet of Centrifuge(i.e. after polishing filter) shall be superior or equal to ISO 4406 class 15/12 in one pass.

6. Capacity will measured during testing –

Desired Capacity is measured by collecting the oil jar of 5 Lit & time taken to fill this jar, At least three readings are taken to adjust the capacity. The capacity is adjusted by flow adjusting inlet valve

LOG SHEET FOR MEASUREMENT OF PARTICULATE MATTER

Centrifuge Model no.-
Design Flow -
Oil Grade –
Tank Capacity -
Machine Sr.No. -
Temperature -
Total weight of solid particles added of different sizes to achieve dirty oil particle size class 21/18 -

Sr No	Date	Time	Flow M3/hr or LPH	Temp Deg C	Dirt added at time	Sample Collection time	Contamination Level as per ISO 4406	
							Dirty oil at inlet of centrifuge (S1)	Clean oil at outlet of Centrifuge (i.e. After Polishing filter) (S3)

(NTPC) **(BHEL/TPIA)** **(CMTI)** **(Alfa Laval)**

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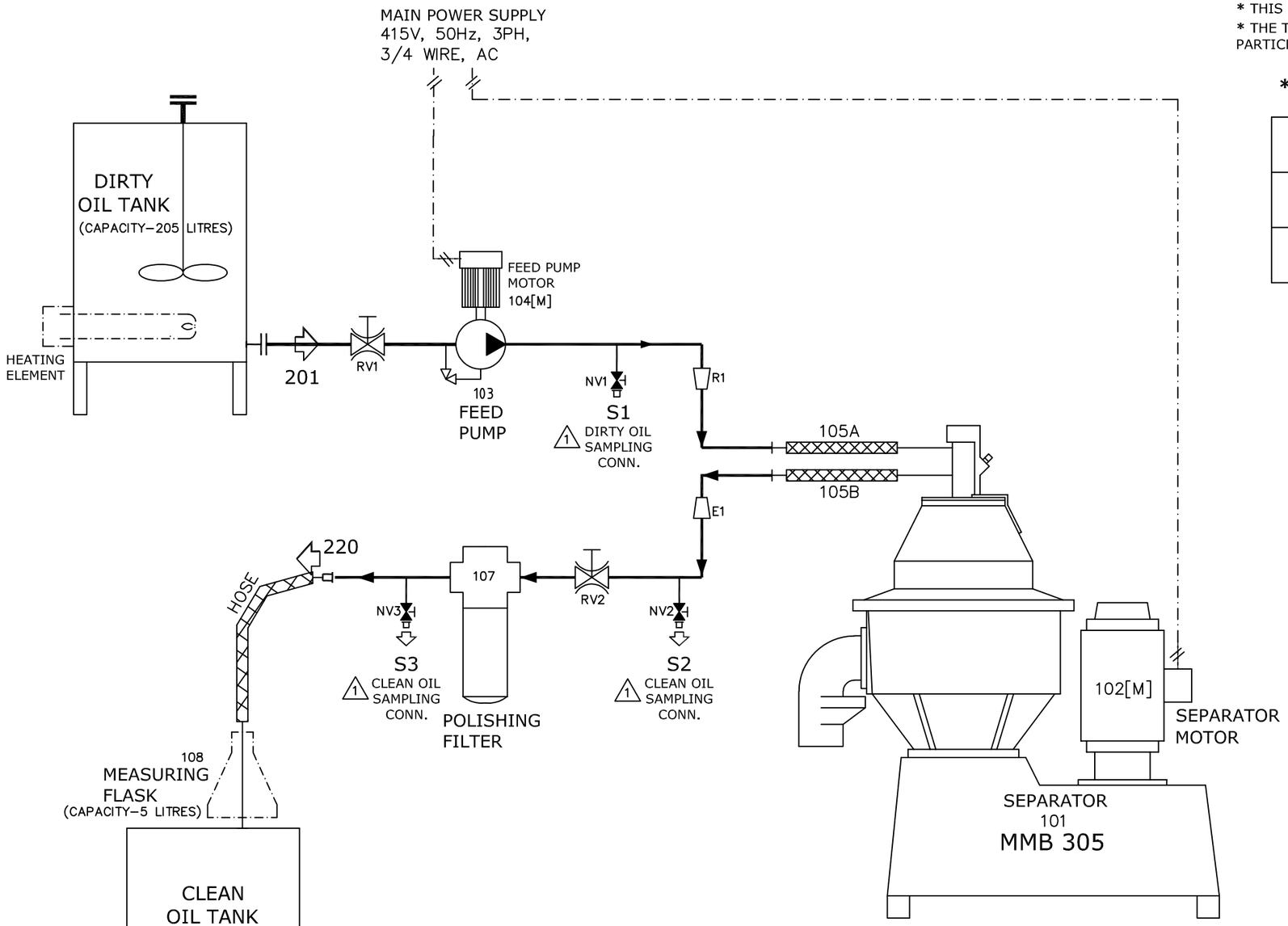

NOTES :
* Liquid : 2400 LPH OF TURBINE LUBE OIL (ISO VG46) AT 65°C SEPARATION TEMPERATURE.
* THIS WAS THE TEST SETUP FOR CONDUCTING TYPE TEST AT CMTI.
* THE TYPE TEST SETUP IS FOR MEASURING THE PERFORMANCE OF SEPARATOR WRT SOLID PARTICLES.

* CONNECTIONS :

CONN.	DESCRIPTION
201	INLET FOR UNTREATED OIL
220	OUTLET FOR TREATED OIL

* IF IN DOUBT ASK.
* * ALL DIMENSIONS ARE IN MM; UNLESS OTHERWISE STATED.

REFER DRG NO.: --

REV	MODIFICATION	MADE BY / DATE	CHK BY / DATE	APPD BY / DATE
1.	AS PER CUSTOMER'S COMMENTS.	ANK/22.01.2016	ANK/22.01.2016	VSB/22.01.2016

TYPE TEST SETUP FOR OIL PURIFICATION UNIT
MMB 305 + PF
Schematic Flow Diagram

ALFA LAVAL INDIA LTD.

DRN	CHK	APPD	DATE	SCALE	DRG.NO.	SHEET NO.	REV.	SIZE
MSG	SMT	VSB	21.05.2015	-	SMN-0241	1 OF 1	1	A3

INTERNATIONAL STANDARD

ISO 4406

Second edition
1999-12-01

Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles

Transmissions hydrauliques — Fluides — Méthode de codification du niveau de pollution particulaire solide

Reference number
ISO 4406:1999(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 4406 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 6, *Contamination control and hydraulic fluids*.

This second edition cancels and replaces the first edition (ISO 4406:1987), which has been technically revised. The new edition introduces a three-part code for contamination levels measured with automatic particle counters calibrated in accordance with ISO 11171. It also introduces equivalent particle sizes for such counters, based on calibration with NIST standard reference material SRM 2806.

The particle sizes to be reported for measurement by using a microscope, $\geqslant 5$ µm and $\geqslant 15$ µm, are unchanged from those specified in ISO 4406:1987.

Defining the automatic particle counter code sizes in this way validates direct comparison of measurements made in accordance with this standard using either measurement method, or between such measurements and data records based on ISO 4406:1987.

Annex A forms a normative part of this International Standard.

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Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. Solid-particle contaminant is always present in the hydraulic fluid, and the amount needs to be determined because the contaminant may cause serious problems.

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Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles

1 Scope

This International Standard specifies the code to be used in defining the quantity of solid particles in the fluid used in a given hydraulic fluid power system.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 4407:1991, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the counting method using a microscope.*

ISO 11171:1999, *Hydraulic fluid power — Calibration of automatic particle counters for liquids.*

ISO 11500:1997, *Hydraulic fluid power — Determination of particulate contamination by automatic counting using the light extinction principle.*

3 Code definition

3.1 General

The purpose of this code is to simplify the reporting of particle count data by converting the numbers of particles into broad classes or codes, where an increase in one code is generally a doubling of the contamination level.

The original code in accordance with ISO 4406:1987 stated the reporting at two sizes, $\geqslant 5$ µm and $\geqslant 15$ µm, but the sizes in this revision have been changed to account for the use of a different calibration standard for optical automatic particle counters. The reported sizes are $\geqslant 4$ µm(c), $\geqslant 6$ µm(c) and $\geqslant 14$ µm(c), the last two of these being equivalent to the 5 µm and 15 µm particle sizes obtained using the ISO 4402:1991 method of calibrating automatic particle counters. ISO 4402:1991 has been replaced by ISO 11171:1999. Throughout this International Standard, the use of µm(c) means that particle size measurements are carried out using an automatic particle counter which has been calibrated in accordance with ISO 11171.

Measurement of particles using an optical microscope as specified in ISO 4407:1991 establishes the size of a particle as being equal to its longest dimension, whereas an automatic particle counter derives the size of an equivalent particle from its cross-sectional area, a value different in most cases from that determined using a microscope. The particle sizes to be reported for measurement by microscope, $\geqslant 5$ µm and $\geqslant 15$ µm, are unchanged from those specified in ISO 4406:1987.

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CAUTION — Particle counts are affected by a variety of factors. These factors include procurement of sample, particle counting accuracy, and the sample container, where used, and its cleanliness. Proper care should be taken during sample procurement to ensure that the sample obtained is representative of the fluid circulation in the system.

3.2 Basis of code

The code for contamination levels using automatic particle counters comprises three scale numbers, which permit the differentiation of the dimension and the distribution of the particles as follows:

— the first scale number represents the number of particles equal to or larger than 4 µm(c) per millilitre of fluid;

— the second scale number represents the number of particles equal to or larger than 6 µm(c) per millilitre of fluid;

— the third scale number represents the number of particles equal to or larger than 14 µm(c) per millilitre of fluid.

The code for microscope counting comprises two scale numbers using 5 µm and 15 µm.

3.3 Allocation of scale numbers

3.3.1 The scale numbers are allocated according to the number of particles counted per millilitre of the fluid sample (see Table 1).

3.3.2 A step ratio of generally two, as given between the upper and lower limits for the number of particles per millilitre in Table 1, has been adopted to keep the number of scale numbers within a reasonable limit and to ensure that each step is meaningful.

3.4 Determination of code using automatic particle counter analysis

3.4.1 Counting shall be undertaken in accordance with ISO 11500 or another recognised method, using an automatic particle counter calibrated to ISO 11171.

3.4.2 A scale number shall be allocated to the number of particles equal to or larger than 4 µm(c).

3.4.3 A second scale number shall be allocated to the number of particles equal to or larger than 6 µm(c).

3.4.4 A third scale number shall be allocated to the number of particles equal to or larger than 14 µm(c).

3.4.5 The three numbers shall be written one after the other and separated by oblique strokes (slashes).

EXAMPLE A code of 22/18/13 signifies that there are more than 20 000 and up to and including 40 000 particles equal to or larger than 4 µm(c), more than 1 300 and up to and including 2 500 particles equal to or larger than 6 µm(c) and more than 40 and up to and including 80 particles equal to or larger than 14 µm(c) in 1 ml of a given fluid sample.

3.4.6 When applicable, include either a "*" (too numerous to count) or a "—" (no requirement to count) notation when reporting the scale number.

EXAMPLE 1 */19/14 means that this sample has too many particles equal to or larger than 4 µm(c) to count.

EXAMPLE 2 —/19/14 means that there was no requirement to count particles equal to or larger than 4 µm(c).

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Table 1 — Allocation of scale numbers

Number of particles per millilitre		Scale number
More than	Up to and including	
2 500 000		> 28
1 300 000	2 500 000	28
640 000	1 300 000	27
320 000	640 000	26
160 000	320 000	25
80 000	160 000	24
40 000	80 000	23
20 000	40 000	22
10 000	20 000	21
5 000	10 000	20
2 500	5 000	19
1 300	2 500	18
640	1 300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2,5	5	9
1,3	2,5	8
0,64	1,3	7
0,32	0,64	6
0,16	0,32	5
0,08	0,16	4
0,04	0,08	3
0,02	0,04	2
0,01	0,02	1
0,00	0,01	0

NOTE Reproducibility below scale number 8 is affected by the actual number of particles counted in the fluid sample. Raw counts should be more than 20 particles. If this is not possible, then refer to 3.4.7.

3.4.7 When the raw data in one of the size ranges results in a particle count of fewer than 20 particles, the scale number for that size range shall be labelled with the symbol $\geqslant$.

EXAMPLE A code of 14/12/$\geqslant$7 signifies that there are more than 80 and up to and including 160 particles equal to or larger than 4 µm(c) per millilitre and more than 20 and up to and including 40 particles equal to or larger than 6 µm(c) per millilitre. The third part of the code, $\geqslant$ 7, indicates that there are more than 0,64 and up to and including 1,3 particles equal to or larger than 14 µm(c) per millilitre, but less than 20 particles were counted, which lowers statistical confidence. Because of this lower confidence, the 14 µm(c) part of the code could actually be higher than 7, indicating a particle count more than 1,3 particles per millilitre.

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3.5 Determination of code using microscope sizing

3.5.1 Counting shall be undertaken in accordance with ISO 4407.

3.5.2 A scale number shall be allocated to the number of particles equal to or larger than 5 µm.

3.5.3 A second scale number shall be allocated to the number of particles equal to or larger than 15 µm.

3.5.4 In order to relate to counts obtained with an automatic particle counter, the code shall be stated in three-part form with the first part given as a "—", e.g. —/18/13.

4 **Identification statement** (reference to this International Standard)

Use the following statement in test reports, catalogues and sales literature when electing to comply with this International Standard:

"Solid contaminant code conforms to ISO 4406:1999, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles.*"

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Annex A
(normative)

Graphical presentation of the code number

For automatic particle counter analysis, the contaminant code is determined by allocating a first scale number to the total number of particles equal to or larger than 4 µm(c), allocating a second scale number to the total number of particles equal to or larger than 6 µm(c) and allocating a third scale number to the total number of particles equal to or larger than 14 µm(c), and then writing these three numbers one after another separated by oblique strokes (slashes). For an example, see 22/18/13 in Figure A.1. For analysis by microscope, use a "—" in place of the first scale number and allocate the second and third numbers based on the counts at 5 µm and 15 µm, respectively.

Interpolation is acceptable, extrapolation is not permissible.

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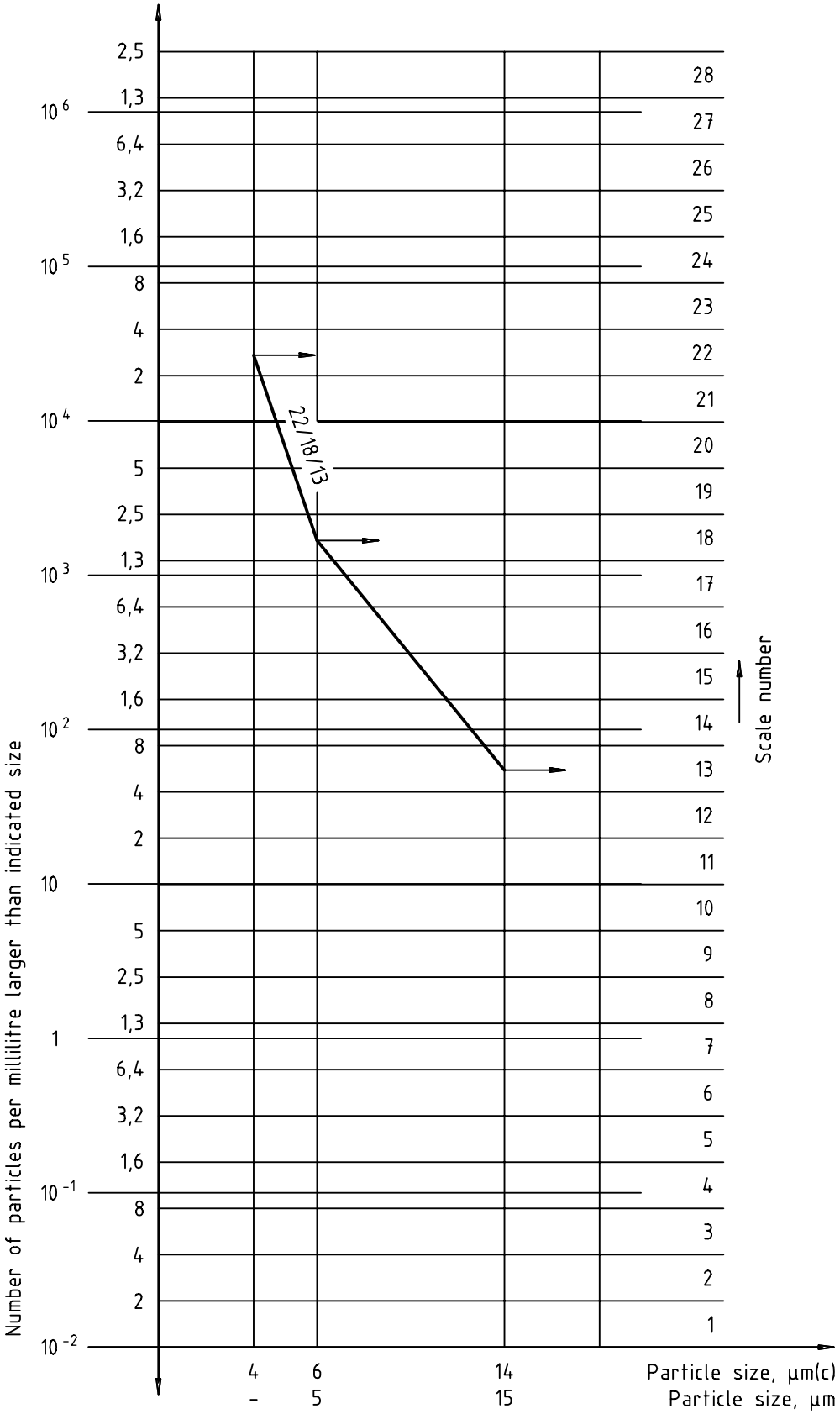

NOTE Quote scale number at 4 µm(c), 6 µm(c) and 14 µm(c) levels for automatic particle counters, and at 5 µm and 15 µm for microscope counting.

Figure A.1

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Bibliography

[1] ISO 4021:1992, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system.*

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ICS 23.100.60; 75.120

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Date: 2020.06.01 09:14:32 IST
Reason: CAT I
Location: NTPCEOC

NTPC DRG. No. 9962-001-HY-110-PVM-F-009 | REV. 8

PROJECT: 1 X 660MW PANKI THERMAL POWER EXTENSION PROJECT.

OWNER: UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.

REVIEW CONSULTANT: NTPC LTD.
(A GOVERNMENT OF INDIA ENTERPRISE)

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD.
KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE: M

	NAME	SIGN	DATE
DRN	ANSHUL		19.05.2020
DESN	ANSHUL		19.05.2020
CHD	SUNIL		19.05.2020
APPD	PRAFUL		19.05.2020

TITLE

P&ID / FLOW DIAGRAM FOR LUBE OIL PURIFICATION SYSTEM FOR TDBFP

						DEPT.	SCALE
						SIGN	

BHEL DRG NO. HY-DG-4-31101-20221

SHT. 1 OF 16 | REV. 8

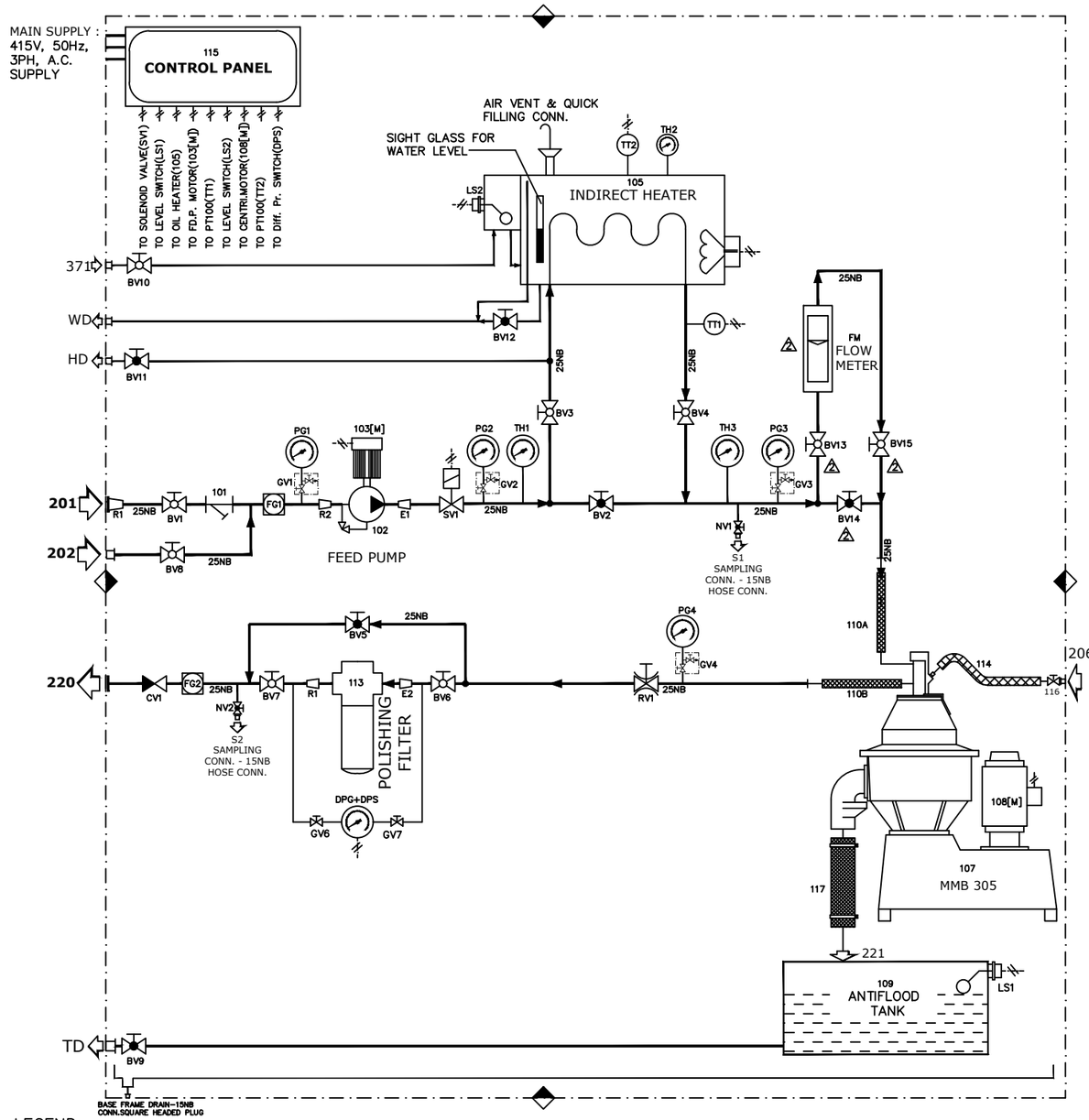
PROJECT- 1X660 MW PANKI THERMAL POWER EXTENSION PROJECT

DOC NO – HY-DG-4-31101-20221

TITLE- P&ID OF LUBE OIL PURIFICATION SYSTEM FOR TDBFP

S.No.	Customer Comment	BHEL Reply
A	comments repeated.BHEL/Alfa to discuss the same with NTPC-C&I before submission of next revision.	Noted. Discussion completed.
	1. Flow meter is to be provided for safe operation and monitoring by the operator. 2. The flow meter has been provided in all previous projects.	Noted. Flowmeter is incorporated in the revised document.
C	How to ensure that separator capacity is 20% of total charge.to explain how this value of 2400LPH has arrived?	Tank charge capacity is 11500 lts (As per spec requirement of 5 min retention time– Ch 2, Sec 2 clause 7.7.8.a). Considering 20% of the total charge capacity OPU is sized as 2400LPH.
D	What is the tripping value of oil & water for heaters to trip??	Tripping value of oil is 75°C and for Water is 90°C. All this parameters are settable and can be set as per the site ambient temperature.
E	As per spec Oil temp should not go above 65 degrees, then why alarm is being generated at higher values.	All the points shown in the write up are settable points and can be altered based on the site ambient condition. As per the Alfa Laval guideline, the separation temperature is 65°C. The tripping for oil high temp is 10°C over the separation temperature. The only point, is that machine will have best separation efficiency at 65°C. Rest everything can be set as per ambient temperature.

ISO A2_L PAPER TEMPLATE NO.:-QMJ00001-0126/R3



NOTES :

* Liquid : 2400LPH TURBINE LUBE OIL (ISO VG46) AT 65°C SEPARATION TEMPERATURE.
* ⚠ Painting : SHADE 631 AS PER IS 5.
* WATER FOR SEALING :
  - Pressure : 1.5–6 bar
  - Total Hardness : MAX. 180ppm CaCO3 (10°dh)
  - pH-Value : > 6
  - Salinity : MAX. CHLORIDE CONTENT OF 60ppm Cl (EQUIVALENT TO 100ppm NaCl)
* WATER FOR HEATER :
  - Type : FRESH DRINKING TAP WATER(NEUTRAL)
  - Quantity : ~490Ltrs. FOR FIRST FILLING.
  - : FOR CONTINUOUS FILLING DEPENDS ON EVAPORATION LOSSES.
* INTER CONNECTING PIPES CONFORMING TO ASTM A312, TP 304, SCH40, SEAMLESS.
* INLET/OUTLET FLANGES SHALL BE AS PER ANSI B16.5, CLASS 150, RAISED FACE, SS.
* SUCTION FLOODED & DISCHARGE HEAD (+)15mwc FOR PUMPS IN THE SYSTEM.
* COUNTER FLANGES WITH NUTS, BOLTS & GASKETS SHALL BE PROVIDED.
* ALL ELECTRICAL EQUIPMENTS SHALL BE PROPERLY EARTHED AT INSTALLATION.
* MAIN OIL LINE, PRESSURE PIPE LINE SHOULD BE HYDRAULICALLY TESTED AT 6Kg/cm2 FOR HALF AN HOUR DURATION.
* A DRAIN PLUG WILL BE PROVIDED TO BASE FRAME TO DRAIN THE OIL.

CONNECTIONS :

201 : INLET FOR UNTREATED OIL – 40NB FLANGED CONN.,SS304
202 : SYSTEM FILLING CONN. – 25NB HOSE CONN.,SS304
220 : OUTLET FOR TREATED OIL – 25NB FLANGED CONN.,SS304
206 : FEED FOR LIQUID SEAL – 15NB HOSE CONN.,CS
371 : WATER INLET TO HEATER – 20NB HOSE CONN.,CS
TD : ANTIFLOOD TANK DRAIN – 20NB HOSE CONN.,CS
WD : HEATER WATER DRAIN & OVERFLOW – 20NB HOSE CONN.,CS
HD : HEATER OIL DRAIN – 20NB HOSE CONN.,CS
⚠ BD : BASE FRAME DRAIN – 15NB PLUG CONN.,CS
⚠ S1, S2 : SAMPLING CONN. – 15NB HOSE CONN.,SS304

⚠ REFER DRG NO. :-

SR.NO.	DESCRIPTION	ALFA LAVAL DRG.NO.	BHEL DRG.NO.
1	GENERAL ARRANGEMENT	SMJ6H42897–02	HY–DG–4–31101–20220
2	WIRING DIAGRAM OF CONTROL PANEL	SMJ6H42897–03	––
3	FOUNDATION DETAIL	SMJ6H42897–04	––
4	DATA SHEET	––	HY–DG–4–31101–20223
5	PART LIST	SMJD6H42897–01	––

EXPANDER / REDUCER :

R1 : REDUCER : 40NB x 25NB
R2 : REDUCER : 25NB x 20NB
E1 : EXPANDER : 20NB x 25NB
E2 : EXPANDER : 25NB x 40NB

Lube Oil P&ID System- 9962-110-PVM-F-003 (For conn 201 and 220)
Data sheet of Purification unit- 9962-110-PVM-Y-025
Equipment Foundation- 9962-110-PVC-V-012
GAD of Purification - 9962-110-PVM-B-024
Wiring and control Panel Drg- 9962-110-PVM-B-027

⚠ OIL QUALITY LOP SYSTEM :-

	SOLID PARTICAL REMOVAL AS PER ISO 4406	FREE WATER REMOVAL
INLET	21/18	15000 PPM
OUTLET	15/12	LESS THAN 500 PPM

LEGEND: –

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	BALL VALVE (OPEN POSITION)	PG	PRESSURE GAUGE		FLANGE CONN.
	BALL VALVE (CLOSE POSITION)	TH	TEMPERATURE INDICATOR		REDUCER/EXPANDER
	STRAINER	TT	TEMPERATURE SENSOR		HOSE CONN.
FG	FLOW GLASS		LEVEL SWTICH		
	CHECK VALVE	DPG+DPS	DIFFERENTIAL PRESSURE INDICATOR +SWITCH		
	SOLENOID VALVE	M	PUMP WITH MOTOR		
	NEDDLE VALVE (CLOSE POSITION)				
	GAUGE ISOLATION VALVE				
	REGULATING VALVE.				
	2 VALVE INTEGRAL MONIFOLD GAUGE ISOLATION VALVE				

CUSTOMER ALFA LAVAL
SUPPLY LIMITS

CUSTOMER : BHARAT HEAVY ELECTRICALS LTD, HYDERABAD.
PROJECT : 1X660MW UPRVUNL PANKI-(MPA1063)
P.O. No. : B719A00494 Dtd. 02.11.2019
Spec. No. : TC 54367 Rev.5
Material code : TC9754367450

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
Bharat Heavy Electricals Limited
Ramachandrapuram, Hyderabad

Turbine & Compressor Engineering

DESCRIPTION OF CODE : 1

→ 1. APPROVED. RELEASED FOR MANUFACTURING
2. APPROVED WITH MINOR COMMENTS. RELEASED FOR MANUFACTURING .RESUBMIT FOR FINAL APPROVAL.
3. REVISE AS PER BHEL COMMENTS AND RESUBMIT FOR APPROVAL.
4. RETAINED FOR INFORMATION.

This approval does not absolve the vendor from the responsibility to comply with BHEL's specification and all applicable codes and standards. Vendor has to ensure safe and smooth operation and meet the intended performance of the equipment.

DATE	CHECKED	APPROVED
16.06.2020		(SUNIL B JIWTODE)

Rev. No.	Revision Text	Date	Drawn	Checked	Appr
⚠2	FLOW METER ADDED AS PER CUSTOMER COMMENTS.	18.05.20	MSG	VSB	VSB
⚠1	DRAWING REVISED AS PER CUSTOMER COMMENTS.	06.04.20	MSG	ANK	VSB
⚠0	FIRST ISSUE.	18.11.19	MSG	ANK	VSB

Title : OIL PURIFICATION UNIT, MMB305 + 48kW INDIRECT HEATER + FM + PF + LSA
P & I Diagram +Part List

Proj. No. :	Proj. Type :	Proj. Name :
–	–	–

Location : Alfa Laval India Pvt. Limited
Date : 18.11.2019
Drawn : MSG
ISO Method E
Size : A3
Scale : –
Sheet : 1 OF 1
Dimensions without tolerances : –
Alfa Laval Drawing No. : SMJ6H42897–01
Rev. : 2
Bhel Drawing No. : HY–DG–4–31101–20221

REFERENCE DRAWING NO.- SMJ6H42761-01

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Document No. : SMJD6H42897-01		OIL PURIFICATION UNIT, STATIONARY MMB305 + 48KW INDIRECT HEATER + FM + PF + LSA PARTS LIST	Date	Sheet No.	Alfa Laval India Private Limited
			06.04.2020	1 of 5	
Prepared By	MSG		Rev.	Size	
Checked By	VSB	Customer :- BHARAT HEAVY ELECTRICALS LTD, HYDERABAD.	2	A4	
Approved By	VSB	Project : - 1 x 660MW UPRVUNL PANKI-(MPA1063). P.O. No. : B719A00494 Dtd. 02.11.2019 Spec. No. : TC 54367 Rev.5 Material code : TC9754367450			

I. No.	Tag No.	Qty	Name	Make	Model / Part No.	Technical Data
1	100	1	BASE FRAME	ALIPL	SMJ6H42897-05	STATIONARY TYPE, CARBON STEEL FABRICATION, IS:2062.
2	101	1	STRAINER	FORBES MARSHALL / TRIVENI		25NB SOCKET WELD CONN, SS, `Y' TYPE, MESH 12, SS SCREEN.
3 R1	102	1	FEED PUMP	TUSHACO	RT 40HBCI3LNJ	INLET/OUTLET: 1"BSP CONN., GEAR PUMP, HORIZANTAL MOUNTING, CAPACITY:2640LPH. BODEY: IS 210 GR.FG 260, SHAFT: EN 10084 20 MnCr5
4	103[M]	1	FEED PUMP MOTOR	CROMPTON GREAVES/ BHARAT BIJLEE/ ABB / SIEMENS		0.75kW, 4 POLE, 415V±10%, 50Hz±5%, 3PH, IP55, B3, IE3, STD TEFC, SQ CAGE, AC INDUCTION TYPE, AS PER BHEL SPEC NO. TC 54373
5	105	1	OIL HEATER	ALIPL	48KWIDH SMJ6H42761-06	INDIRECT TYPE, Rating : 48kW, 415V, 3PH, 50HZ, AC, SUPPLY WITH SS TUBES.
6 R1	107	1	SEPARATOR	ALIPL	MMB305 S-11	CENTRIFUGAL TYPE, SOLID RETAINING , SPECIFICATION : 88115201050150 FRAME: CI EN 1561,BOWL: SS Alloy, EN 10088, steel no 1.4462,DISKS: SS316, ASTM A480M,SPINDLE: Steel EN 10083-3
7	108[M]	1	SEP. MOTOR	CROMPTON GREAVES/ BHARAT BIJLEE/ ABB / SIEMENS		3.7kW, 2 POLE, 415V±10%, 50Hz±5%, V&F 10%, 3PH, IP55, V1, INSLN.CL.`F', TEMP. RISE LIMITED TO CL.`B', 50°C AMB. TEMP., IE3, STD TEFC, SQ.CAGE, AC INDUCTION TYPE, AS PER BHEL SPEC NO. TC 54373

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
Bharat Heavy Electricals Limited
Turbine & Compressor Engineering
DESCRIPTION OF CODE : :
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2. APPROVED WITH MINOR COMMENTS. RELEASED FOR MANUFACTURING. RESUBMIT FOR FINAL APPROVAL.
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8	109	1	ANTIFLOOD TANK	ALIPL	SEJB192-106	Capacity : 20 LTRS (APPROX.), CARBON STEEL FABRICATION, IS:2062.
9	115	1	CONTROL PANEL	ALIPL	SMJ6H42897-03	INPUT SUPPLY 415V, 3PH, 50HZ.
10	RV1	1	REGULATING VALVE	L&T/BDK		25NB SOCKET WELD CONN., SS304, GLOBE TYPE.
11	FG1-2	2	FLOW GLASS	TECHNOFLOW/SIGMA		25NB FLANGED CONN., CLASS 150, SS304.
12	PG1	1	PRESSURE GAUGE	GIC / WIKA	LFBSPG-V-150-S4S-S6S-S6S-S4S-T15NTM-(-1 to 5)-BAR-GLY	1/2"NPT(M) CONN., RANGE : -1 TO +5Kg/cm², SS CASE, DIAL 150mm, BOTTOM CONN., GLYCERINE FILLED, BOURDON TUBE TYPE, WEATHER PROOF.
13	PG2-4	3	PRESSURE GAUGE	GIC / WIKA	LFBSPG-V-150-S4S-S6S-S6S-S4S-T15NTM-(0 to 6)-BAR-GLY	1/2"NPT(M) CONN., RANGE : 0 TO +6Kg/cm², SS CASE, DIAL 150mm, BOTTOM CONN., GLYCERINE FILLED, BOURDON TUBE TYPE, WEATHER PROOF.
14	GV1-GV4	4	GAUGE ISOLATION VALVE	GIC		2 VALVE MANIFOLD- ½"NPT(F) CONN., SS304 BODY & INTERNALS, Model: G2VM2.
15	CV1	1	CHECK VALVE	EXPERT		25NB FLANGED CONN., CLASS 150, NON SLAM TYPE, BODY ASTM A351, Gr.CF8M, DISC AISI316.
16 R2	BV1-BV8, BV13-BV15	11	BALL VALVE	L&T/ MICROFINISH / BDK		25NB SOCKET WELD CONN., SS304

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17	SV1	1	SOLENOID VALVE	ASCO	WPTE210 B154 220V/50Hz	1"BSP CONN., 2/2 WAY DIRECT ACTING TYPE, NC, BRASS, 220VAC,50Hz, IP55
18	TH1,TH3	2	THERMOMETER	GIC / WIKA	BDT-V-150-S4S-S06-200MM-S4S-T15NTM-(0 TO 120)-DGC-TW TW-BT01-S4S-28-16-07-T15NTF-T15NTM-100-50-4-0	RIGID STEM TYPE WITH SS THERMOWELL, DIAL ø150, 1/2" NPT(M) CONN., RANGE : 0°-120°C, WEATHERPROOF, DIRECT BOTTOM ENTRY.
19	BV9-BV11	3	BALL VALVE	L&T/MICROFINISH/ BDK		3/4"BSP CONN., SS304
20	BV12	1	BALL VALVE	L&T/ MICROFINISH / BDK		3/4" BSP CONN., SS304. -PART OF INDIRECT HEATER.
21	LS1-2	2	LEVEL SWITCH	PUNE TECHTROL /SBEM	MODEL : FPS-JN2B2SRWW /137 EA 27F SF-S000-	MAGNET FLOAT SWITCH, HORIZONTAL MOUNTED STD FLOAT ASSY, SS FLOAT, 2 SPDT
22	NV1-NV2	2	SAMPLING NEEDLE VALVE	GIC / FLUCON		NEEDLE TYPE, 1/2"NPT(MxF) CONN., SS304
23	TT1, TT2	2	TEMPERATURE SENSOR	RADIX/GIC		1/2"NPT(M) CONN., SIMPLEX, 3 WIRE, HEAD TYPE, ACF HEAD, L=150mm, ø6.25mm, WITH THERMOWELL.
24	110A-B	2	OIL HOSE	A L I P L	Art. No. : 1762012-80	FLEXIBLE TYPE, 3/4" BSP x 1" BSP CONN., SS BRAIDED, L=600mm FOR OIL IN/OUT.
25	114	1	WATER HOSE	A L I P L	Art. No. : 1763910-	FLEXIBLE TYPE, 1/2" BSP x 3/4" BSP CONN.,

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I. No.	Tag No.	Qty	Name	Make	Model / Part No.	Technical Data
					01	SS BRAIDED, L=1500mm FOR SEAL WATER.
26	116	1	VALVE ASSY FOR WATER SEAL	A L I P L	Art. No. : 1763875-80	3/4" BSP CONN., , PART OF CENTRIFUGE.
27	117	1	HOSE FOR HEAVY PHASE(WATER)	A L I P L		ø76, FLEXIBLE TYPE RUBBER PIPE.
28	TH2	1	THERMOMETER	GIC / WIKA	BDT-C-150-S4S-S06-200MM-S4S-T15NTM-(0 TO 120)-DGC-TW TW-BT01-S4S-28-16-07-T15NTF-T15NTM-100-50-4-0	RIGID STEM TYPE WITH SS THERMOWELL, DIAL ø150, 1/2" NPT(M) CONN., RANGE : 0°-120°C, WEATHERPROOF, DIRECT BACK ENTRY.
29	*	4	FOUNDATION BOLTS WITH NUTS & WASHERS	A L I P L		LOOSE SUPPLY - M12 x 300Lg.
30	GV6-GV7	2	GAUGE ISOLATION VALVE	GIC / FLUCON		NIDDLE TYPE, 1/4""NPT(MxM) CONN., SS304
31 R1	113	1	POLISHING FILTER	EPE	40-LE-0030-H3XL-A-00-07-0-R0-P-00	Simplex Inline Filter with Bypass valve . Filtration Grade: 3 Microns (Absolute) , Connection: 1.1/2" BSPF, Filer Bowl: Carbon Steel, Filter Head: Aluminium , Filter

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I. No.	Tag No.	Qty	Name	Make	Model / Part No.	Technical Data
						Element: Micro Glass Fibre (Disposable), Seals: Nitrile
32	DPG + DPS	1	DIFFER.PRESSURE INDICATOR + SWITCH	SWITZER	120-B07-S-4-0B-2-W-C-A-Z-0	1/4" NPT(F) CONN., DIAL-150mm, 2 SPDT, RANGE: 0-2.5 bar
33	*	1	SEP. MOUNTING STAND	A L I P L	SEN006561-3	CARBON STEEL FABRICATION, IS:2062.
34	*	1	FEED PUMP MOUNTING STAND	A L I P L	SEN006097-2	CARBON STEEL FABRICATION, IS:2062.
35 R2	FM	1	FLOW METER	EUREKA	SSVF-PG-14(M)	25NB FLANGED CONN., CLASS 150, GLASS TUBE ROTAMETER TYPE, RANGE : 300-3000 LPH,

REVISION TABLE:

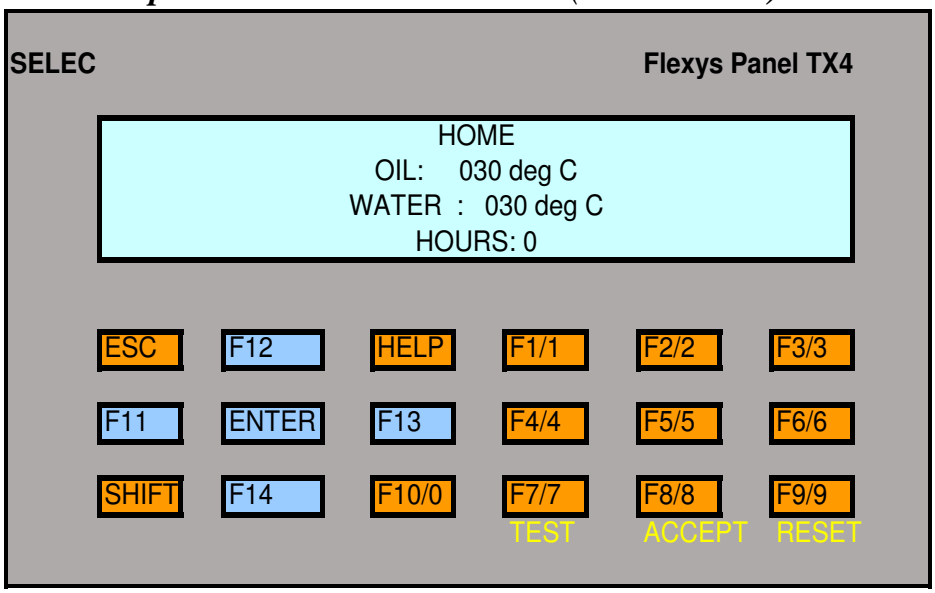
Rev.No.	Revision Comments	Date	Created By	Checked By	Approved By
0	AS PER CUSTOMER COMMENTS SEPARATE PART LIST DOCUMENT PREPARED.	06.04.2020	MSG	ANK	VSB
1	AS PER CUSTOMER COMMENTS /AS MARKED - R1	22.04.2020	MSG	ANK	VSB
2	AS PER CUSTOMER COMMENTS FLOW METER & BALL VALVE ADDED.	18.05.2020	MSG	ANK	VSB

Reference Drawing No. : **SMJ6H42897-01** For Schematic Flow Diagram.

Operational Write up of Separator Controller

OIL PURIFICATION SYSTEM :

MMB Separator + In Direct Heater (H1+H2+H3) + LSA +PF



1. **Specifications**:

   a) Compact PLC with Built in HMI
   b) Display : LCD backlight , 4 line x 16 character
   c) Digital inputs (DC PNP- 6-30VDC) : 18 nos
   d) Digital outputs (relay, 5A@230VAC) : 8 nos
   e) Analog inputs : 4 nos
   f) Number of keys: 18
   g) Pre-programmed & Pre-configured , user friendly editing for temp set points.
   h) Input supply: 90-270 VAC
   i) Size : 99x99x100 , Cutout :92x92

2. **Digital Inputs**:

Digital Input	Description
I0	Separator Motor Overload
I1	Liquid Seal Broken
I2	Separator Motor F/B
I3	*Not applicable*
1.I0	Low water Level in Heaters
1.I1	Heater-I F/B
1.I2	Heater-II F/B

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Turbine & Compressor Engineering

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Digital Input	Description
1.I3	Heater-III F/B
1.I4	*Not applicable*
1.I5	Feed Pump Motor Overload
1.I6	Feed Pump Motor F/B
1.I7	Emergency Stop
1.I8	*Not applicable*
1.I9	Filter Choke
1.I10	*Not applicable*
1.I11	*Not applicable*
1.I12	*Not applicable*
1.I13	*Not applicable*

Normal condition = Input closed

Abnormal condition = input open

3. **RTD Inputs**:

RTD Input	Description
I0+ / I0- / R30	Oil Temp TT1
I1+ / I1- / R31	Water Temp TT2
I2+ / I2- / R32	not connected
I3+ / I3- / R33	not connected

4. **Digital Outputs**:

Digital Output	Description
R0	Separator Motor
R1	Heater-I
R2	Heater-II
R3	Heater-III
R4	*Not applicable*
R5	Feed Pump Motor
R6	Buzzer
R7	Fault

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5. Keys :

Function / number **: F1/1** to **F9/9** & **F10/0**

F11: Move left, **F13:** Move right,

F12: Move Up, **F14**: Move down

6. Below Faults are monitored & displayed :

a) **Separator Motor Overload**
b) **Feed Pump Motor overload**
c) **Separator Motor F/B Failure**
d) **Feed Pump Motor F/B Failure**
e) **Liquid Seal Broken**
f) **Polishing Filter Choke**
g) **Low water Level in Heaters**
h) **Heater – I F/B Failure**
i) **Heater – II F/B Failure**
j) **Heater –III F/B Failure**
k) **Low oil temp - LOT**
l) **High oil temp – HOT**
m) **High Water temp – HWT**
n) **Emergency Stop**
o) **Sensor break**

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7. Interlocks :

SR NO	CONDITION / ALARM	ACTION
1	Separator Motor Overload	Separator Motor OFF
2	Liquid Seal Broken	Separator Motor OFF
3	Feed Pump Motor Overload	Feed Pump Motor OFF
4	Separator Motor OFF	Feed Pump Motor OFF
5	High Oil Temp	Heaters OFF
6	High Water Temp	Heaters OFF
7	Oil temp > set temp Of Heater-I	Heater-I OFF
8	Oil temp > set temp Of Heater-II	Heater-II OFF
9	Oil temp > set temp Of Heater-III	Heater-III OFF
10	Motor / Heater Feedback Fail	Corresponding Equipment OFF
11	Emergency Stop	All Motors/ Heaters OFF
12	Running Hours > Cleaning timer	Separator Motor OFF
13	Separator Motor OFF /Feed Pump Motor OFF	Solenoid valve OFF
14	Polishing Filter Choke	Separator Motor OFF

8. Alarms :

a. Press **F7** to Test the Buzzer / Alarm lamp.
b. In the event of any Alarm , Alarm will be displayed on display, for example such as

Separator Motor overload
ACK: Y/N Y

c. Press " **Enter** " key to accept the Alarm message.
d. Press " **F8** " key to silence the Buzzer, rectify the fault .
e. Press " **F9** " key to reset the Alarms . if alarm still present – the Buzzer will sound again. Press " **F8**" key to silence the Buzzer. After fault removal- Press **F9** to reset the fault.
f. If more than one alarm is present or you need to see accepted alarm , Press **F11** to see alarm history . Press **F11** repeatedly to come out from alarm history.

F11: ALARM PRESENT
F7: TEST
F8: ACCEPT HOOTER
F9: RESET OFF

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g. Press " **F12/F14** " key to go to desired pages.

9. Following pages will be displayed on controller display :

Press " **F12/F14** " key to go to desired pages.

a) Home >
Oil temperature -TT1,TT2 & Running hours:

HOME
OIL: ---- deg C
WATER : ---- deg C
HOURS: ----

b) Temp set points- Alarms:

HOT	LOT
75.0	40.0
EHWT	
80.0	

c) Temp set points- Heater stages :

H1	H2
62.0	59.0
H3	H4
56.0	0.0

d) Separator Motor :

SEPARATOR MOTOR
F1: START
F4: STOP
STATUS : OFF

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e) Feed Pump Motor :

FEED PUMP MOTOR
F2: START
F5: STOP
STATUS : OFF

f) Heater:

HEATER
F3: START
F6: STOP
Command : OFF

g) Heater – ON/OFF Status:

HEATER STATUS	
H1 : OFF	H2 : OFF
H3 : OFF	H4 : OFF

h) Alarm :

F11: ALARM PRESENT
F7: TEST
F8: ACCEPT HOOTER
F9: RESET OFF

i) Cleaning timer :

CLEANING TIMER
SETTING: 100 Hr
REMAINING TIME:
100 Hr

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j) Input / Output Status :
Input/output status can be seen by pressing F13 for more than 3 sec on Home page

10. Settings :

Check all set points . If any set point is required to be change - then proceed as below:

a) Go to Home page . Press **"Shift + F14**" keys.
b) All set points will be displayed one by one.
c) To change the value press " **Shift + F10**" keys . Existing set value will flash. Press the required number key to input the new value.
d) Press "**Enter** "key to store the new value.
e) Press " **F14"** to go next set point.
f) Ensure that all new set values are correctly displayed on set point pages.
g) As a general guide line ,

- High water temp can be set at temp + 90 deg C
- High oil temp can be set at Separation temp + 10 deg C
- Low oil temp = (Separation temp - 15 deg C)
- Heater –I set point (Separation temp – 3 deg C)
- Heater –II set point (Separation temp – 6 deg C)
- Heater –III set point (Separation temp – 9 deg C)

h) Cleaning timer is provided in the controller. Set the same as per requirement. At the end of the set time Separator will be shut down with alarm.
To reset cleaning timer : switch Off the Separator Motor . Go to cleaning timer setting page , Press "**shift +F4"**
" 0" will be shown - which indicates that timer has reset to 0 , whatever time has elapsed same will be reset to 0

11. Operations :

A) Starting:

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16.06.2020		(SUNIL B JIWTODE)

1) Switch On the Main Switch .
Home page will be displayed .

```
HOME
OIL:  ---- deg C
WATER : ---- deg C
HOURS: ----
```

Press " **F14** /**F12**" key to scroll the pages

2) Press " **F14** " key to go to temp set point page. All alarm temp set points will be displayed.

```
HOT          LOT
75.0         40.0
      HWT
      90.0
```

3) Press " **F14** " key to go to temp set point page. Individual heater stages ON/OFF temp set points will be displayed.

```
H1           H2
62.0         59.0


56.0         0.0
```

Check all set points . If any set point is required to be change - then proceed as mentioned in above point no:10 Settings

4) Press **F14** key to go to " Heater" page

```
HEATER
F3: START
F6: STOP
Command : OFF
```

- Press "**F3"** to switch on the heaters. Command Status on display will changed to ON.
- Heater stages will be made on/off automatically depending on set point & actual oil temp.
- To see the individual heater stage status – Press **F14** to go to Heater status page.

5) Press **F14** key to go to " Separator Motor" page

SEPARATOR MOTOR
F1: START
F4: STOP
STATUS : OFF

- Press "**F1"** to start the separator motor. Separator Motor Status on display will changed to ON
- Wait for full speed of the bowl , normally it takes 2-3 minutes to attains the full bowl speed. Provide water to establish liquid seal .
- Close water after liquid seal is established.

6) Press **F14** key to go to " Feed Pump Motor" page

FEED PUMP MOTOR
F2: START
F5: STOP
STATUS : OFF

- Press F2 to start the feed pump motor. Feed Pump Motor Status on display will changed to ON
- Open oil inlet to separator

B) Stopping:

a) Press **" F14/F12** " key to scroll the pages
b) Go to " Heater " page . Press "**F6** " to switch off the heater.
c) Press " **F12** " key to go to " Feed Pump Motor" page
d) Press "**F5 "** to switch off the "Feed Pump Motor"
e) Press " **F12** " key to go to " Separator Motor" page
f) Press "**F4 "** to switch off the Separator Motor.
g) Close oil inlet valve.
h) Switch OFF the Main Switch .

---------- ---------- End ---------- -------

BHEL RAMACHANDRAPURAM HYDERABAD	**STANDARD MANUFACTURING QUALITY PLAN**	QP. NO.:HYQA/STD QP/TC/1213/07	
	PRODUCT: OIL PURIFICATION UNIT	BHEL SPEC: TC54216, TC54217, TC54367, TC54014, TC54017	REV NO: 02 / DATE: 31.12.2015
			PAGE 1 OF 4

SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**												
1.01	Base Plate	Chemical Mechanical	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.02	Centrifuge Bowl	Chemical Mechanical	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC/COC	√	2		1	
	Bowl Balancing	Balancing Test	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC/COC	√	2		1	
	Bowl Spindle	UT	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC/COC	√	2		1	
1.03	Control Wiring & Power Cables	Material Functional	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.04	Filters	Material Functional	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.05	Pressure Piping	Mechanical Chemical properties	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.06	Indirect type oil heater	Functional	Major	Review	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.07	Instruments	Calibration Performance	Major	Measurement	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.08	Strainer	Visual inspection	Major	Visual	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.09	Valves	Performance & accuracy	Major	Visual	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.10	Flexible hose	Visual inspection	Major	Visual	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
1.11	Pumps with AC Motor	Routine test	Major	Mechanical	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
		Type test	Minor	Elect. test	Sample			TC	√	2		1	
		Flame proof-ness	Major	Elect. test	Type test			TC	√	2		1	

LEGEND:
WPS – WELDING PROCESS SPECIFICATION
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2: - MANUFACTURER / VENDOR/SUB CONTRACTOR
* D: RECORDS IDENTIFIED WITH TICK (✓) SHALL BE ESSENTIALLY INCLUDED IN QA DOCUMENTATION.

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1.12	Drive Motor	Routine test	Major	Elect. test	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
		Type test	Minor	Elect. test	Sample			TC	√	2		1	
		Energy Efficiency	Major	Type Tests	Sample			TC	√	2		1	
		Flame proof-ness	Major	Elect. test	Type test			TC	√	2		1	
2.0	**IN PROCESS CONTROL / INSPECTION**												
2.1	Fabrication / Welding	WPS, PQR review	Major	Verification	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
		DP Test	Major	NDT	100%			TC	√	2		1	
2.2	Assembly	Dimensions	Major	Measurement	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
		Completeness	Major	Visual	100%			TC	√	2		1	
2.3	Piping	Butt weld / Fillet weld	Major	RT / DT	100%	BHEL Spec/ Approved Drawing / Data Sheet		TC	√	2		1	
		Hydro Test	Major	Mechanical	100%			TC	√	2		1	
2.4	Controls & Panel	Dimension	Minor	Measurement	100%	BHEL Spec/ Approved Drawing / Data Sheet		IR	√	2		1	
		Interlock & sequential operation	Major	Simualtion	100%			IR	√	2		1	
		Insulation resistance before & after HV	Major	Megger test	100%			IR	√	2		1	
		HV test	Major	HV test	100%			IR	√	2		1	
		Bill of Material	Minor	Visual	100%			IR		2		1	
		Flame proof-ness	Major	Electrical test	Type test			TC	√	2		1	
3.0	**FINAL ASSEMBLY, INSPECTION & TESTING**												
3.1	Dimension and general layout of system	Dimension & layout Completeness Lifting Arrangement	Minor	Measurement & visual check	100%	BHEL Spec/ Approved Drawing / Data Sheet		I.R	√	2	1		
3.2	Assembly	Hydro test (without centrifuge)	Criti-cal	Pressure Test	100%	Approved Test Procedure / Appd Drg & BHEL Spec		IR	√	2	1		

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3.3	System interlocks and alarms & DOL Starter Function.	Functioning of instruments	Major	Simulation	100%	BHEL Spec/ Approved Drawing / Data Sheet		I.R	√	2	1		
3.4	Mechanical run test	Cleanliness , Vibration , leakages, Noise level ,	Major	Measurement	100%	BHEL Spec/ Approved Drawing / Data Sheet		I.R	√	2	1		
3.5	Performance & Acceptance	Moisture content in oil before & after separation (sample to be collected in the presence of TPI)	Criti-cal	Lab report on samples collected	100%	BHEL Spec/ Approved Drawing / Data Sheet / ISO:4406		I.R	√	2	1		
3.6	Oil Purity	Particle Size of Oil Inlet & Outlet	Criti-cal	Visual	Sample	BHEL Spec/ Approved Drawing / Data Sheet / ISO:4406		I.R	√	2	1		Type Test Report to be verified by BHEL TPI.
3.7	Completeness Check	Bill of material	Major	Visual	100%	BHEL Spec/ Approved Drawing / Data Sheet		I.R	√	2	1		
4.0	**SURFACE PREPARATION & PAINTING**												
4.1	Painting	Paint shade & finish	Major	Visual	100%	BHEL Spec/ Approved Drawing / Data Sheet		IR	√	2		1	
4.2	Marking	Name Plate & Rating	Minor	Visual	100%	BHEL Spec/ Approved Drawing / Data Sheet		Conformance Certificate	√	2		1	
4.3	Packing		Minor	Visual	100%	BHEL Spec/ Approved Drawing / Data Sheet			√	2		1	

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NOTE:

1. This QP should be read along with BHEL Spec, approved drawings, data sheet, BOM and PO.
2. Latest revisions of specification / drawings as per P.O., approved drawings & bill of materials are applicable.
3. Any other tests/ checks indicated in specification, P.O., or drawing & any additional checks envisaged by BHEL/TPI to ensure workmanship, finish, aesthetics, etc. shall also be conducted and witnessed/verified by BHEL /TPI / customer as required.
4. All test certificates/ reports reviewed and certified by BHEL/TPI shall be submitted to BHEL as documentation package.
5. Drawing / Data Sheet shall prevail over Quality Plan in case of any contradiction between Quality Plan and Drawing / Data Sheet.
6. **Any project / customer specific requirement, like QP approval & Customer/Consultant Inspection, which shall be notified have to be fulfilled by the vendor at the time of execution of order.**
7. **This QP shall not be applicable to the orders for which QP approval & Inspection by customer/consultant is required.**
8. **This SQP is not applicable for vendors supplying this item for the first time to BHEL.**
9. Requirement of carrying out the type tests and other tests shall be as per BHEL spec/ approved drawing.
10. All type test reports submitted shall not be older than 3 years from date of purchase order.

LEGEND:	PREPARED BY	APPROVED BY
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