Pre-Qualification Requirements (PQR) of Bidders for TSI/MMS items:

1.0 Bidder shall be Original Equipment Manufacturer or OEM's authorized distributor/channel partner having offices in India.

2.0 In case the OEM authorizes their distributors/channel partner for representing them in totality:
   a. Authorized distributor/channel partner shall submit authorization certificate from their OEM to quote for complete job, for authorized distributors/channel partner the expiry date of validity of distributorship should be clearly indicated along with documentary evidences
   b. OEM shall declare that in the event of discontinuation of their partnership, at any point of time during the warranty period, OEM will take the total responsibility for meeting all the commitments made earlier by the authorized distributor/channel partner.
   c. The responsibility of complete item to be supplied as per BHEL specification requirements including engineering and selection of its components shall be with OEM only. For this OEM shall submit a letter in original.
   d. Authorized distributors/channel partner shall have association with the OEM for the past five years and should have supplied and commissioned with the OEM supplied items in India.

3.0 Bidder to confirm that they will provide spares and services support for the offered items for at least ten years from the date of supply. In case of authorized distributor/channel partner, "After Sales Service" and availability of spares to be guaranteed by OEM for at least ten years.

4.0 Bidder shall have an established facility in India for engineering documentation, after sale service for the offered items.

5.0 OEM shall offer a proven type design supplied for in any power plant / refinery application.

Bidder shall submit a certificate of satisfactory performance of the offered items from their clients in India (client details to be provided), working satisfactorily at least 2 similar separate executed in last 10 years and out of that at least one shall be in successful operation for 1 year.

Note: If BHEL is unable to verify the PTR furnished, with end user contact details provided above, the offer will be rejected.

6.0 The Bidder shall be registered vendor of IOCL GUJARAT, DUMAD, INDIA.

Bidder must submit the documentary evidence/proof in support of vendor registration by submitting the valid vendor registration letter from the respective agency.
Note: Submitting PO copy of supply against particular project is not acceptable.

7.0 All correspondence, Documentation, catalogs and Manuals shall be in English language.

8.0 Bidder shall furnish the necessary documentary evidence/proof in support of claim for meeting the above Pre-qualification requirements, failing which their offer will be liable for rejection.

1 **SCOPE:**

This specification defines the project specific requirements for TSI System with Panel package for IOCL Dumad Syn Gas Compressor Project.

2 **TECHNICAL REQUIREMENTS:**

a **TSI SYSTEM:**

Sl.No	Technical Requirements	
i	Hazardous area classification	IEC Zone-1, Gas Group IIC, T3
ii	TSI Rack Location	Satellite Rack Room (SRR)
iii	TSI Rack Display (with connecting cable) & Location	Display Not Required.
iv	Cable Distance	i. Field Sensor to TSI Rack: 550 mts max. ii. TSI Rack to DCS / PLC: 70 mts.
v	SIL Certification for TSI System	System shall be SIL 1 or better. However it shall be capable of implementing SIL 3 functions as per IEC 61508/61511.
vi	G3 / Eqv. Conformal Coating	Required.
vii	Intrinsic Safe Barrier	Yes inbuilt.
viii	4-20 mA Output from TSI rack	Required.
ix	Serial Communication with DCS	Dual Redundant, Modbus TCP-IP.
x	Connectivity with Condition Monitoring System	Through Ethernet connection on TDI module & Raw data provision on modules.
xi	Power supply	Redundant, 110 VAC.
xii	TSI Scheme & Loop Drawing	During detail engineering.
xiii	TSI System material supply by BHEL	i. Proximitor Junction Box. ii. Triad cable from Proximitor to TSI Rack. iii. Bearing RTD. ~~iv. TSI Panel.~~
xiv	TSI Sensors, Rack, Spares Qty	Vendor to quote for all items listed in the RFQ / Price Schedule. The separation of items as Main / Spares etc. is BHEL responsibility. Other technical reference spec TC65342-R05.

<table>
<tr><th>Sl.No</th><th>Technical Requirements</th></tr>
<tr><td>xv</td><td>Panel with mounting of three racks.
BHEL Material Code: TC9765507011.
FAT to be conducted at vendor works.

Please refer attached spec TC65559-19,20 for panel and spares requirements.</td><td>
<table>
<tr><th>Sl. No.</th><th>Rack-1 Modules</th><th>Qty</th></tr>
<tr><td>a</td><td>19” Rack</td><td>01</td></tr>
<tr><td>b</td><td>Rack Power Supply, Duplex</td><td>01 set</td></tr>
<tr><td>c</td><td>Rack Transient Data Interface Module for Connectivity to CMS / Rack Programming</td><td>01</td></tr>
<tr><td>d</td><td>Keyphasor & Tachometer Module(Minimum 4 channel)</td><td>01</td></tr>
<tr><td>e</td><td>Proximity Sensor Module(Minimum 4 channel)</td><td>08</td></tr>
<tr><td>f</td><td>Programmable Relay Module 16 relays</td><td>03</td></tr>
<tr><td>g</td><td>Communication Gateway Modbus TCP/IP for DCS Dual Redundant Connectivity</td><td>01 set</td></tr>
<tr><th>Sl. No.</th><th>Rack-2 Modules</th><th>Qty</th></tr>
<tr><td>h</td><td>19” Rack</td><td>01</td></tr>
<tr><td>i</td><td>Rack Power Supply, Duplex</td><td>01 set</td></tr>
<tr><td>j</td><td>Rack Transient Data Interface Module for Connectivity to CMS / Rack Programming</td><td>01</td></tr>
<tr><td>k</td><td>Keyphasor & Tachometer Module(Minimum 4 channel)</td><td>01</td></tr>
<tr><td>l</td><td>Proximity Sensor Module(Minimum 4 channel)</td><td>04</td></tr>
<tr><td>m</td><td>Temperature Monitor Module(Minimum 6 channel)</td><td>04</td></tr>
<tr><td>n</td><td>Programmable Relay Module 16 relays</td><td>04</td></tr>
<tr><td>o</td><td>Communication Gateway Modbus TCP/IP for DCS Dual Redundant Connectivity</td><td>01 set</td></tr>
<tr><th>Sl. No.</th><th>Rack-3 Modules</th><th>Qty</th></tr>
<tr><td>a</td><td>19” Rack</td><td>01</td></tr>
<tr><td>b</td><td>Rack Power Supply, Duplex</td><td>01 set</td></tr>
<tr><td>c</td><td>Rack Transient Data Interface Module for Connectivity to CMS / Rack Programming</td><td>01</td></tr>
<tr><td>d</td><td>Temperature Monitor Module(Minimum 6 channel)</td><td>09</td></tr>
<tr><td>e</td><td>Programmable Relay Module 16 relays</td><td>03</td></tr>
<tr><td>f</td><td>Communication Gateway Modbus TCP/IP for DCS Dual Redundant Connectivity</td><td>01 set</td></tr>
</table>
</td></tr>
</table>

3 **LOGISTIC SUPPORT**

a Vendor shall ensure and provide the following information/ details along with the offer.

i. Local service facilities in India is available or not from the vendor?
ii. If not available, where the vendors approved service facility presently located nearest to India.
iii. Instruments / System shall be user serviceable.
iv. User reference list
v. When was quoted model introduced in the market?

b Certificate for logistics support (by Principal)

(To be signed by Principal's corporate level signatory on company's letterhead and submitted along with the offer)

I, on behalf of M/s …… confirm that the …… quoted by M/s …… for <by BHEL, Later> Gas Compressor of <by BHEL, Later> Project shall continue to be supported by us. The quoted item shall not be withdrawn from Indian market in next five (5) years from the date of placement of order as a matter of our corporate policy.

I further confirm that in case of placement of order by M/s BHEL on M/s …… we shall continue to support M/s BHEL / END USER in providing back-up engineering, maintenance support and spare part to M/s BHEL / END USER for a period of 10 years from the date of expiry of warranty.

SIGNATURE WITH SEAL
AUTHORIZED, SENIOR MANAGEMENT LEVEL

c Certificate for Logistics Support (by Vendor)

(To be signed by Vendor's corporate level signatory on company's letterhead and submitted along with the offer)

I, on behalf of M/s …… confirm that the …… quoted by M/s …… for <by BHEL, Later> Project shall continue to be supported by us and our principal(s). The quoted item shall not be withdrawn from Indian market in next five (5) years from the date of placement of order as a matter of our corporate policy as supported by attached certificate from our principal(s) M/s ……

I further confirm that in case of placement of order by M/s BHEL on us, we shall continue to support M/s BHEL / END USER in providing back-up engineering, maintenance support and spare part to M/s BHEL / END USER for a period of 10 years from the date of expiry of warranty.

SIGNATURE WITH SEAL
AUTHORIZED, SENIOR MANAGEMENT LEVEL SIGNATORY

4 **CHECK LIST:**

(TO BE FILLED BY BIDDER AND SUBMITTED ALONG WITH OFFER)

SL. NO.	DESCRIPTION	Vendor confirmation	Comments / Remarks
i.	Offer for complete package as per BHEL specification Vendors shall furnish the complete bill of material offered against the respective material codes.		
ii.	Clause wise confirmation / deviation to BHEL specification included in the offer.		
iii.	Certificate of logistic support included in the offer.		
iv.	Filled in Unpriced Price schedule is included in the technical offer.		
v.	UNIT prices for all items included.		

(Signature and stamp of bidder with date)

5 PRICE SCHEDULE:

Enquiry ref no. Date:

Offer ref no. Date:

A: Material Supply:

Sr No	Matl Desc	Matl Code	Qty	Unit Price	Total Price
1	AUX PANEL WITH TSI RACKS	TC9765507011	AS PER ENQUIRY		
2	AUX PANEL SPARES	TC9765507020			
3	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012			
4	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039			
5	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047			
6	CASING ACCELERATION SENSOR, M8X1	TC9765342055			
7	ACCEL SENSOR CABLE 5MTS WITH CONNECTOR	TC9765342063			
8	CONNECTOR PROTECTOR SET	TC9765342071			
9	CONNECTOR PROTECTOR KIT	TC9765342080			
10	LOW PRESSURE CABLE SEAL 3/4"NPTM	TC9765342098			
11	FLEXIBLE CONDUIT 3/4",30MTS	TC9765342101			
12	FLEXIBLE CONDUIT CONNECTOR 3/4"NPT	TC9765342110			
13	RACK CONFIGURATION LAPTOP	TC9765342209			
14	RACK CONFIGURATION SOFTWARE	TC9765342217			
15	TRANSDUCER CALIBRATION KIT	TC9765342128			
16	PORTABLE OFFLINE MEASUREMENT KIT	TC9765342284			
17	RACK POWER SUPPLY, 110VAC, DUPLEX	TC9765342136			
18	RACK TRANS DATA INTERFAC MODULE,ETHNET	TC9765342144			
19	PROXIMITY SENSOR MODULE	TC9765342160			
20	KEYPHASOR & TACHOMETER MODULE	TC9765342152			
21	PROGRAMMABLE RELAY MODULE	TC9765342187			
22	COMMUNICATION GATEWAY	TC9765342195			
23	TEMPERATURE MODULE	TC9765342179			

B: COMMISSIONING & TRAINING SERVICES:

Sl No	Service Description	Price
1	**TSI PRE COMMISSIONING:** Pre-Commissioning Assistance for 5 working days at BHEL / site and two visits. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	
2	**TSI COMMISSIONING:** Commissioning Assistance for 5 working days at site and two visits. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	
3	**TSI TRAINING:** Training for 5 days at site and one visit. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	

i. Total Price in WORDS: ……

Notes:

a Vendor shall indicate unit price of all items of Price Schedule irrespective of RFQ Qty.

b Any additional requirements which are essential for proper functioning of the control system, however not indicated in this specification shall be explicitly listed and included in the offer by vendor.

VENDOR SEAL & SIGNATURE

1 **SCOPE:**

The scope of vendor shall cover Engineering, Design, Manufacture, Inspection, packaging, supply, commissioning supervision at site, Training and Documentation of TSI (Turbo supervisory instrumentation / MMS) Transducers, TSI Monitoring Rack and accessories. Vendor shall supply all the hardware, software and accessories required for reliable and efficient measurements of various parameters.

2 **TECHNICAL REQUIREMENTS:**

a The Engineering, design, manufacture, and supply of Turbo supervisory systems for measurements of different parameters like shaft vibration, axial displacements, bearings housing vibration, Casing expansion, Eccentricity, Key-phasor & Tachometer and bearing metal temperature etc. for continuous monitoring shall be as per the technical details as given in this specification.

b The turbo-supervisory system and components shall conform to API-670 (Latest edition).

c Turbo supervisory system shall be provided for continuous monitoring and indication of machine parameters like shaft vibration, Housing vibration, axial displacement, Key-phasor & Tachometer, differential expansion, casing expansion and bearing temperature as per the requirement against respective items.

d The bill of material furnished by the vendor is for information only, it is the responsibility of the vendor to check the completeness and correct model selection of the bill of material to meet BHEL specification requirements. Any changes or additions to the bill of material offered by the vendor to meet the BHEL specification requirements identified during detailed engineering shall be accommodated by the vendor without any commercial or delivery implications.

e The selection of models and BOM along with mounting accessories suitable for the application for the entire package is the responsibility of the vendor. Any change in the offered models or requirement of additional items in view of the system requirements identified during detailed engineering shall be supplied by the vendor without any commercial or delivery implications.

f Vendor shall confirm compliance to this technical specification. Deviation, if any, shall be brought out giving technical reason for the same.

g If the vendor's standard system is different than the system envisaged, vendor shall clearly bring out the difference giving technical advantages for the offered system. Acceptance of the system offered is entirely at the discretion of BHEL

h Vendor shall furnish detailed reference list for system similar to the offered system with detail like client's name / address, model no, year of commissioning, type and rating of machines (steam turbine, generator, compressor etc.).

i Vendor shall furnish the latest EIL approved data sheets of TSI system supplied for any earlier project with the same models offered for this enquiry for reference.

j Vendor to refer project specific TSI Loop Drawing for TSI system rack arrangement as specified in project specific input data.

k The TSI rack, modules, sensors, drivers etc. shall be SIL certified.

3 **TRANSDUCER (PROBE, SENSOR) AND ACCESSORIES:**

The transducers (proximity sensors and driver) shall be mounted in the field on the machine in hazardous area classification IEC Zone-1, IIC, T3.

a **Proximity Sensor for Vibration, displacement, Zero speed, Eccentricity and Keyphasor & Tachometer: Reverse Mount Type**

The sensors shall be Non-contact type sensors with connecting leads and terminal connectors. The sensors shall be capable of operation in an atmosphere of oil fumes. The casing of the sensor shall be made of stainless steel and the measurement shall not be affected by the presence of oil in the air gap. The sensor integral cable and the extension cable shall be insulated to meet the high operating temperature requirement of the respective sensor. The length of the cable from Sensor up to nearest local junction box (JB not in the scope of vendor) shall be equal to 5 meters. The vibration transducer shall be with tip diameter 8mm, reverse mounting type and thread connection 3/8"-24 UNF with 1 meter integral cable and miniature male coaxial connector.

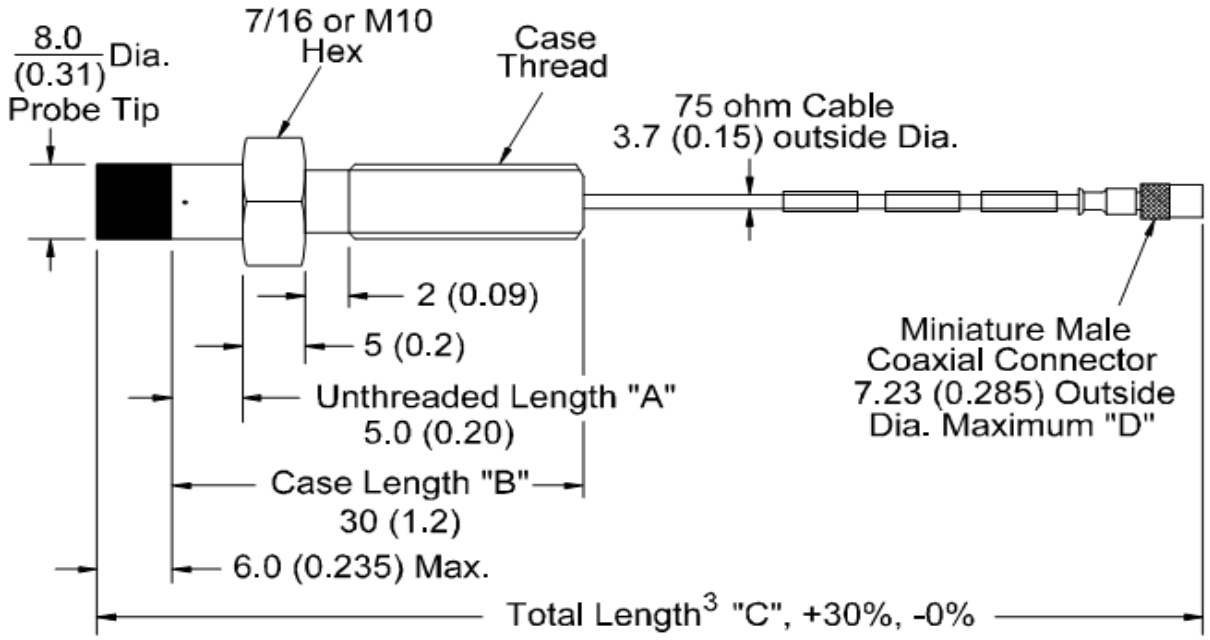


FIG: 3-a: 8 MM REVERSE MOUNT PROBE

Total length "C": 1.0 meter.
Unthreaded length "A": 0mm
Threaded Case length "B": 30mm

Sl No	Parameter	Requirement
i.	Connectors	Gold plated, corrosion resistant
ii.	Environmental Protection	Encapsulated/ Hermetically sealed
iii.	Frequency Range	10 Hz to 10 KHz
iv.	Temperature Range	0 – 177 DegC
v.	Hazardous area approval	Intrinsic safe Exia

b **Proximity Sensor for displacement: Standard Mount Type**

The transducer shall be same as 3-a above except the transducer shall be standard mounting type, thread connection M10x1. Refer variant table for dimensional details.

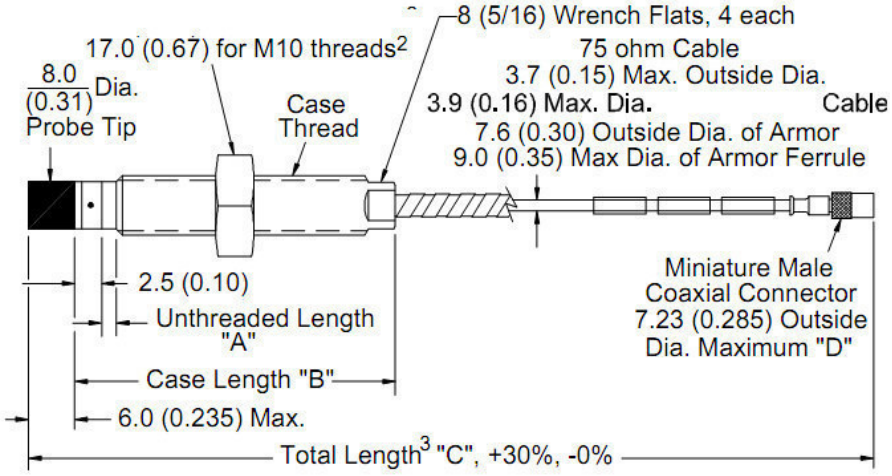


FIG: 3-b: 8 MM STANDARD MOUNT PROBE

Total length "C": 1.0 meter.
Unthreaded length: 0mm
Threaded Case length: 70mm

c **Proximity Sensor Extension cable:**

The extension cable shall be suitable for respective transducers and total length of 4 meter with suitable connector & protector for connection to the sensor cable on one side and to the driver on the other side. The electrical parameters shall match with the corresponding proximity sensor and proximitor / driver.

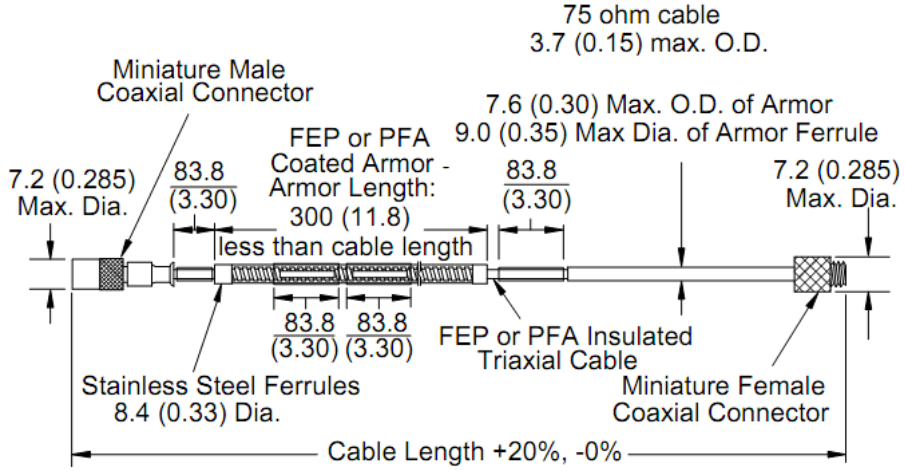


FIG: 3-c: Extension Cable

d **Proximity sensor driver / proximitor:**

It shall be suitable for total cable length of 5 meter (transducer integral cable of 1 meter plus 4 meter extension cable) and shall be compatible with respective transducers.

Sl No	Parameter	Requirement
i.	Sensor input	Accepts one non contacting 5 mm, 8 mm Proximity sensor and Extension Cable.
ii.	Power	-23 Vdc to -26 Vdc with barriers from TSI rack.
iii.	Supply Sensitivity	Less than 2 mV change in output voltage per volt change in input voltage.
iv.	Mounting	DIN rail or 4 hole (2"x2" apart)
v.	Connectors	Gold plated, corrosion resistant
vi.	Environmental Protection	Encapsulated/ Hermetically sealed
vii.	Hazardous area approval	Intrinsic safe Exia

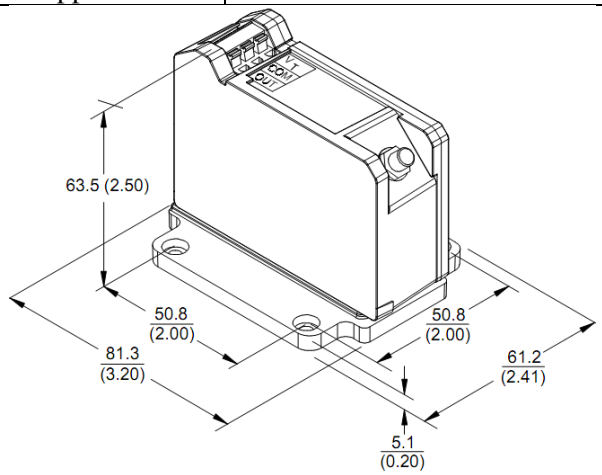


FIG: 3-d: Proximtor driver

e **Acceleration transducer (Bearing housing vibration):**

The seismic probe complete with connecting leads, terminal connectors shall be provided, and the sensors shall meet the following specifications:

The length of the cable from the sensor up to the nearest local junction shall be 5 meters. The sensor integral cable and extension cable shall be insulated and armored meeting the operating temperature requirements.

Sl No	Parameter	Requirement
i.	Connectors	Gold plated, corrosion resistant, with 5 meter connecting cable with connectors
ii.	Environmental Protection	Encapsulated/ Hermetically sealed
iii.	Acceleration range	490 m/s2 (50g) peak overall acceleration within the 1 Hz to 20 kHz frequency span
iv.	Temperature Range	0 to 85 DegC
v.	Hazardous area approval	Intrinsic safe Exia
vi.	Amplitude linearity	±1% to 490 m/ s2 (50 g) peak
vii.	Sensitivity	10.2 mV/m/s2 (100 mV/g) ±5% at 100 Hz

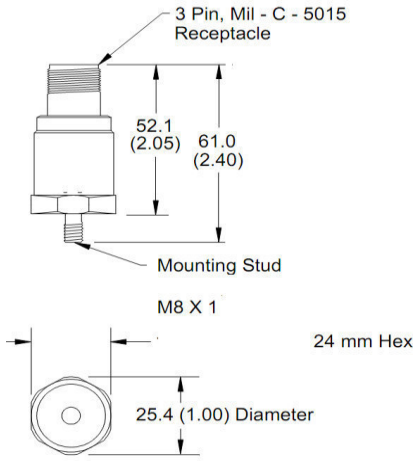


FIG: 3-e: Acceleration Probe

4 **SENSOR FITTINGS AND INSTALLATION ACCESSORIES:**

Vendor shall include all types of fittings, cable seals and accessories required for field installation and protection of sensors, extension cables, probe driver etc.

a **Connector protectors:**

It shall provide the environmental protection and electrical isolation of the connector at the junction where the proximity sensor joins with the extension cable. The connector kit shall include minimum 10 sets of connector protectors.

b **Connector protector kit:**

The kit shall preferably include minimum 10 sets of connector protector, silicon lubricant, tape, easy to use installation tools, instructions and a convenient carrying case.

c **Low pressure cable seal:**

The low pressure cable seal shall be used to exit the transducer cable through a single hole in a machine case. It shall be constructed out of SS & molded silicon rubber grommet to prevent leakage of fluids along the outer jacket of the cable. The seal is threaded on both ends & fits in to a trapped hole on the machine case. External pipe threads shall enable the seal to be mated to conduit or housings. It shall be designed to seal up to 50 psi. The high pressure side and low pressure side thread size shall be ¾" NPTM. The cable seal shall be supplied with 01 hole full drilled and remaining 03 nos half drilled.

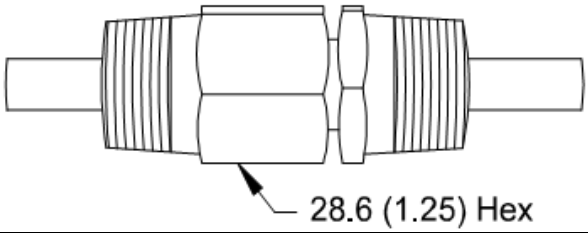


FIG: 4-c: Low Pressure Cable Seal

d **Flexible conduit:**

Flexible conduit (3/4", 30 meters) shall be provided to route the proximity sensor cables safely to the driver housing to protect transducer. It shall consist of galvanized steel core with an extruded thermoplastic cover. The conduit shall be 'Anaconda Sealtite' or equivalent.

e **Flexible conduit connector:**
The vendor shall supply conduit connectors (3/4" NPT, SS MOC) for connecting the conduit to JB and Machine Housing. The flexible conduit connector shall be T&B 5333SST or eqv.

f **Calibration Kit & Calibration Board:**
The calibration kit & Calibration board shall be suitable for performing acceptance testing of all transducers to the performance specifications and to the API 670 standard. Special calibration / Test and configuration equipment with its accessories required, if any, should be indicated & included in the offer. The calibration kit shall be Bentley Nevada TK3-2E or eqv., powered by 90 to 270 VAC.

g **Portable Offline Measurement Kit:**
The portable offline measurement kit shall be dual-channel vibration data collector and analyzer. It shall be used for data collection and analysis and shall be suitable for use in hazardous area (IEC Zone-1, IIC). The portable kit shall be supplied with the following as a minimum. The portable offline measurement kit shall be be Bentley Nevada Scout 100 or eqv.

i Carry Case.
ii DC Adaptor.
iii AC Adaptor.
iv Vibration sensor Connecting cable (02 nos).
v Accelerometer (2 nos).
vi Accelerometer magnetic base (2 nos).
vii Data Transfer cable.
viii Reference / Operation Manual.

5 **TSI MONITORS AND TSI MONITORING RACK:**
The electronic modules, to drive the various sensors shall be housed in adequate no of instrument racks / DIN rail mounted. The hardware design shall allow replacement of monitors without isolation / disconnection of the input / output cable connections. Each module shall be provided with LED status for module / channel OK / fault.
The TSI rack shall be completely assembled & pre-programmed to the specified parameters and shall be connected to purchaser supplied common machine diagnostic and health monitoring system (Analysis Package). Necessary hardware, software shall be provided for connectivity to overall machine monitoring and diagnostic system.

a **Monitor rack:**
The entire monitoring system including power supply module shall accommodated in a durable, easy to access, expandable mounting rack. The Rack bezel shall allow to individually identify machine / monitor point or loop number by using the factory engraved bezel number or clear plastics strips provided with the system to hold paper tags. The rack design shall be such that which eliminates the need for internal rack wiring and allows easy expansion to meet increased monitoring requirements. The rack size shall be selected as per project requirement. The rack shall be suitable for flush panel mounting and vendor shall also supply the necessary mounting accessories. Vendor to furnish the dimensional detail for different rack sizes along with the offer.

b **Rack power supply module:**
The power supply module shall be in redundant configuration and shall supply power (from customer supplied UPS supply of 85-264VAC) for operation for all the modules, field sensors etc. Each power supply module shall be capable for driving the total rack and proximity sensors.

c **Rack transient data interface module / RAW data provision:**
The rack interface module shall be used for interfacing the rack transient data to common machine diagnostic and health monitoring system (Analysis Package). The module shall be provided with Ethernet interface. Alternatively, incase vendor does not have a dedicated transient data interface module, each

sensor transient RAW data shall be available from the rack for connection to purchasers common machine diagnostic and health monitoring system (Analysis Package).

d **Rack keyphasor & tachometer module:**

The rack keyphasor module shall be used for interfacing the keyphasor data for proximity sensor module and shall be connected to TWO number of keyphasor sensors, mounted on different rotors. The tachometer function / module shall provide two isolated speed (4-20mA) signals. The tachometer function shall be able to detect rotor zero speed and actuate a corresponding relay in rack relay module. Incase vendor does not have a common keyphasor and tachometer module, two separate module shall be provide in the TSI rack, however the sensor signal shall be single only. Vendor shall provide all necessary hardware for connection of the sensors to two different modules. The tachometer module shall have provision of reverse rotation detection. In case it is not inbuilt function of tachometer module, an additional module shall be provided. BHEL shall provide (upto) TWO no of proximity sensors (key phasor probes) for connection to reverse rotation module.

e **Rack Proximity Sensor module:**

The rack Proximity Sensor module shall be used for measurement of the Promity Sensor signal from field. The module shall be microprocessor based monitors (Maximum 4 channel per module) with digitally adjustable alert and danger set points for on-line measurement and monitoring of vibration, axial displacement, bearing housing vibration, Casing acceleration, Eccentricity etc. with the following technical requirements. Proximity Sensor module shall meet the following specifications as a minimum:

i. Continuous two channel monitoring with each channel input from one probe. Readout scale shall read higher of the two sensors.
ii. Each channel shall have two independent alarm levels one for pre trip alarm and one for each trip, settable continuously over measurement range. Two relay potential free contacts for each pre trip alarm and trip alarm per channel shall be provided.
iii. LED lamps on monitor front for each channel to indicate pre-trip alarm, trip alarm and circuit not OK conditions.
iv. Selector switches on monitor front to read vibration/ displacement pre-trip alarm and trip set points for each channel shall be provided.
v. One number each potential free contacts to be provided for hooking up to DCS for following:
    - System failure (Rack wise or system wise as per manufacturer's standard practice).
    - Power supply OK/Failure.
vi. Broken sensor failure detection without causing shut down.
vii. Continuous 4 to 20mA DC isolated output for each channel of measurement shall be provided. The output signal of each channel shall be independent and fault in one channel shall not reflect on other output channels. Each module shall have in built indication to show at least
    - Alarm indication
    - Module healthy / Fault indication
    - Facility to set the measuring range.
viii. All alarms and related data shall be interfaced to PLC / DCS using serial interface.
ix. RAW data provision for all the input sensors.

f **Vibration measurement (Relative shaft vibration):**

The monitor shall provide radial vibration measurement for rotating machine with two probes at 90 degree apart for each location shall be provided and connected to same monitor. It shall continuously measure and monitor two independent channels of radial vibration accepting inputs from two proximity sensors. The various full scale ranges for the monitor shall be user programmable. Preferably without use of jumper

pots or dip switch display of gap measurement in voltages or in engineering units shall be possible. The minimum specifications are as follows for various monitor options in addition to clause 5-d above:

i. Frequency response is user-programmable for 4 to 4000HZ (240 to 240,000 cpm) or 1 to 600 hz (60 to 36,000 cpm);-3dB.
ii. An output for recorder etc. shall be 4-20 mA, Galvanically isolated. Individual recorder outputs shall be provided for each channel. Monitor output shall remain unaffected for short circuits on recorder outputs.
iii. One coaxial connector per channel on the front panel and one terminal connection per channel on the rear panel shall be provided for buffered transducer outputs.
iv. Transducer supply voltages shall be user programmable.
v. Vibration alert and danger setpoints shall be available for both the channels. The setpoints shall be digitally adjustable from 0 to 100% of fullscale.
vi. Alarm time delay option shall be programmable for 0 sec to 6 seconds
vii. Selectable alert reset option (latching / nonlatching).
viii. Danger relay voting option(OR voting for relay drive/AND voting for relay drive)
ix. The display meter shall be non-multiplexing vertical bar graph type. Probe gap also shall be indicated.
x. The following minimum indication shall be provided.
    - **OK:** This will indicate system status.
    - **Alarm**: status indication for alert & danger shall be provided.
xi. RAW data provision for all the input sensors.

g **Axial displacement measurement**

The Axial displacement / thrust position monitor shall provide early warning of thrust bearing failure. It shall continuously measure and monitor one or two independent channels of axial shaft position relative to the axial clearances within the machine accepting inputs from two-eddy current probes. The various full-scale ranges for the monitor shall be user programmable. The minimum applicable technical specification shall be same indicated in clause 5-d & e above.

h **Bearing temperature module:**

Temperature Sensors shall be 3-wire / 4-wire RTD PT-100 / TC-k / TC-j as per IEC60752 standard, the monitors shall have broken sensor failure detection without causing shutdown.

i. In general, bearing temperature shall be measured at the points which are under maximum loading.
ii. Bearing temperature shall be monitored by means of a (six channel maximum) temperature monitor.
iii. Continuous six channel maximum monitoring with each channel input from one RTD. Read out scale shall read higher of the six temperatures.
iv. Each channel shall have two independent alarm levels one for pre-trip alarm and one for trip alarm, settable continuously over measurement range.
v. Broken sensor failure detection without causing shut down.
vi. Selector switches on monitor front, to read temperature, pre-trip alarm and trip set points for each channel shall be provided.
vii. All alarms and related data shall be interfaced to DCS using serial interface.

i **Programmable Relay module:**

The Relay Module shall provide (min) 16 relay outputs. Each output of the Relay Module shall be independently programmed to perform needed voting logic. Each relay utilized on the Relay Module shall include "Alarm Drive Logic". Programming for the Alarm Drive Logic uses AND and OR logic, and shall use alarming inputs (Alert and Danger statuses), Not OK, or individual PPLs from any monitor channel or any combination of monitor channels in the rack. Users shall program this Alarm Drive using the Rack

Configuration Software to meet the specific needs of the application. The module shall be provided with status LED for each relay as well as module status. The relay shall be single pole dual throw type.

j **Communication gateway:**

Communication gateway module with redundant RS 485 MODBUS RTU / TCP protocol shall be provided with necessary hardware including the cable for redundant serial data communication from TSI rack to DCS. The module shall have facility for daisychaing another rack. Vendor shall furnish all details like pin configuration details and tag number wise MODBUS address mapping list etc. for interfacing with DCS. The data via this interface shall include the following on a per channel basis:

i. Proportional value for each monitored variable as current values and a Fast Trend file
ii. Proportional value for probe gap voltage (for proximity probe channel)
iii. Ok status
iv. Alert and Danger alarm status
v. Bypass status

The above requirement, if provided in different fashion, shall be elaborated in detail by the vendor

k **Rack Configuration laptop:**

One laptop with required configuration software and hardware for configuration of TSI system including the communication cable between the configuration laptop and TSI rack shall be supplied. Vendor shall provide the hardware latest configuration with operating system compatible with the rack configuration software. Vendor shall supply a copy of back up disk of the laptop OS with all the software installed along with antivirus.

l **Rack Configuration software:**

The rack configuration software shall be used for programming and configuration of TSI rack. The software shall not be license limited for a specific rack (project specific) or number of racks to be programmed / configured. The rack configuration software and final rack configuration shall be supplied as separate software copies.

m **TSI rack System display:**

The System Display shall be suitable for panel mount and shall be designed to meet the requirements of American Petroleum Institute (API) Standard 670. It shall provide local or remote visual indication of all TSI Machinery Protection System information residing in the rack including:

i. System Event List.
ii. Alarm Event List.
iii. All Channel, Monitor, Relay Module, Keyphasor Module or Tachometer Module data.

The display shall be backlit type and shall include Display interface module & power supply if required along with the cable and connectors for connection between the rack and the display.

6 INSPECTION AND TEST REQUIREMENTS:

a Calibration test certificate shall be furnished.
b Certificate for Explosion proof/ intrinsic safe execution shall be furnished.
c Materials compliance certificate shall be furnished.
d Statutory certificates shall be furnished as follows:

i. For all intrinsically safe / explosion proof / flameproof equipments / instruments / systems or equipments with any other type of protection allowable as per this package which are manufactured abroad and certified by any statutory authority like BASEEFA, FM, UL, PTB, LCIE etc. should also have the approval of Petroleum And Explosives Safety Organisation (PESO)/ Chief Controller of Explosives (CCE), Nagpur.
ii. For all flame proof equipments manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like CMRI/ERTL etc. The equipment shall in addition bear

the valid approval from Petroleum and Explosives Safety Organisation (PESO) / Chief Controller of Explosives, Nagpur and a valid BIS license.

iii. For all intrinsically safe equipment manufactured locally (indigenously), the testing shall be carried out by any of the approved test house like CMRI/ERTL etc. The equipment shall in addition bear the valid approval from Petroleum and Explosives Safety Organisation (PESO)/ Chief Controller of Explosives, Nagpur

7 **DOCUMENTATION:**

Documentation shall be in three steps, during offer submission as response to BHEL Enquiry stage, drawing approval stage, and during delivery of items stage (as-built). Incomplete data, without title blocks, name of the item, document number, revision number, page number etc. will not be acceptable. Bidder shall be responsible for creating, making and arranging complete documentation as per BHEL requirements at all stages.

a During Technical offer submission:
   i. Filled up check list as per clause 17.
   ii. Catalogues of TSI system and other hardware.
   iii. Communication interface diagram.
   iv. GA & Bill of material.
   v. Deviation list as per "deviation format clause 12 if any.
   vi. Compliance certificate (duly signed & stamped copy of complete specification).
   vii. Un-priced price schedule.
   viii. Reference list (mandatory) as per clause 14 for all the items.
   ix. Filled in Certificate of logistics support as per clause 15.
   x. Cable specification for TSI Sensors.

b Vendor shall visit BHEL office within one week of PO / LOI to collect the project specific information (Tag no's, services, range, etc.) for engineering their drawings/documents.

c During drawing approval after PO placement: Two copies of the following within 2 week of order placement
   i. General arrangement
   ii. Bill of material
   iii. MODBUS address list for serial communication
   iv. Wiring diagram.
   v. Quality plans of individual items.
   vi. Detailed GA drawing for each item as per PO.
   vii. Type Test certificates.

d It is the responsibility of the vendor to review the documents for total compliance with all the BHEL specifications furnished with the inquiry before submitting to BHEL.

e The data sheets will be forwarded by BHEL to Customer/Consultant for approval, comments if any from Customer/Consultant shall be clarified and revise the data sheets if required by the vendor in line with BHEL specifications furnished with the inquiry.

f Vendor has to attend technical meeting with Customer/Consultant along with BHEL if required for technical discussions and obtaining approval of documents for the package items.

g Along with material, final documentation in 6 Copies shall be sent to project site and two numbers of soft copies in USB with the following listed documents. However, one advance copy shall be handed over to BHEL- Engineering for approval before dispatching multiple sets to the project site.

i. Packing list.
ii. All the documents submitted during drawing approval.
iii. Inspection reports & Test certificates.
iv. Copy of BHEL Approved documents.
v. Warrantee certificates.
vi. Operation & Maintenance manual.
vii. Erection & commissioning procedure.

h It is Vendors responsibility for obtaining approvals on drawings/documents from BHEL/Customer within time frame and dispatch material in time to project site office as per purchase order delivery schedule. Further vendor requests for any clarifications or approvals for delivery extensions etc. are not entertained at any stage.

i Within 15 days after commissioning:
i. Final reports giving details of commissioning data, its analysis and recommendations, if any.
ii. Vendor shall supply the portion of system engineering document, which requires updating as per commissioning data, and 06 copies of it shall be furnished.

8 **GUARANTEE:**

Vendor shall be responsible for all the items supplied in this package. i.e. vendor shall provide a guarantee certificate for trouble free performance of all the items for 18 months from date of supply. Vendor shall have tie-ups with sub-vendors for providing guarantee & only OEM authorized agency shall handle the warranty period services. If any defect in the material is reported from site the same shall be replaced by vendor at site immediately without any commercial or delivery implications.

9 **PACKING, MARKING & SHIPPING:**

a PACKING:
i. All the items shall be packed in very good quality packing; the packing shall be such that the items should not be damaged during loading, unloading and transportation, the packing shall be suitable for 6 months of outdoor storage from the date of shipment.
ii. The operation and maintenance manuals of all the items 2 copies shall be included in the packing.
iii. One copy of the packing list shall be fixed on the packing with suitable protection to with stand loading, unloading, transportation and rain.
iv. Adequate amount of silica gel or equivalent shall be provided in each box before dispatch for the removal of moisture till installation.
v. All safety instructions for storage and handling shall be indicated on external surface of each box.

b PACKING LIST:
i. Detailed packing list with description, quantity, tag nos, make and model no. etc. including the list of O&M manuals shall be prepared by vendor and submitted to BHEL before dispatch.
ii. All the items shall be shipped in a single shipment.
iii. It is the responsibility of the vendor to check that all the items are dispatched along all the accessories i.e. Cable glands, Mounting brackets, adapters etc. queries if any received from site regarding the ASC system package items shall be clarified by vendor immediately, malfunction or defects of any items reported from site within the guarantee period shall be replaced at site immediately without any commercial or delivery implications.

iv. Bidder to consider and include charges for one visit to site as part of the main package as and when informed by BHEL to resolve issues if any reported from site regarding material discrepancy of the ASC system package items.

v. Each device shall be identified with the following information as a minimum. The information shall be in a permanent form on a stainless steel nameplate and permanently attached to the device/equipment.

- OEM name or identity
- Manufacturer's model and /or serial number
- instrument range
- Tag no.

10 ERECTION AND COMMISSIONING:

a The erection of the TSI system shall be by BHEL / Customer. However expert E&C services are required to commission the offered items and Bidder to consider the supervision of E&C services in the offer.

b Commissioning Assistance for 3 days at site and one visit inclusive of Travel, boarding, lodging, and local conveyance shall be considered.

11 TRAINING:

a The training shall include configuration, operation and maintenance of the TSI system. The training shall be conducted at site. All requisite training material for the said training shall be provided by the vendor during the training.

b Optional offer for Training of 5 engineers for 2 days at site and one visit inclusive of Travel, boarding, lodging, and local conveyance shall be indicated in Price Schedule.

12 DEVIATION FORMAT:

Bidder shall submit duly filled deviation format (as given below) along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be considered for rejection. If, there are no deviations, bidder shall submit signed copy of this format, mentioning "No Deviations".

Sl.No	Clause No. of Spec	Deviation	Reason for deviation	Deviation category	
				Product / design limitation	Optimization
1					

13 PROVEN TRACK RECORD:

The system being offered as per specification shall have well proven performance record of operating satisfactorily in TWO similar units in a hydrocarbon processing industry for a minimum of 8000 running Hours. The above criteria shall be applicable to main equipment, sub- components as well as brought out items if any. Prototype equipment / instruments or instrument under phase out cycle shall not be offered or supplied. Bidder shall submit necessary supporting documents / past users confirmation supporting to above PTR requirements along with technical offer. Bidder to furnish the PTR details as per clause 14.

14 PROVEN TRACK RECORD FORMAT

a Name of the Bidder

b Whether manufacturer & supplier:

c Whether System Integrator & Supplier:

d Name of Packager:

Sl.No	PTR Requirement	Ref-1	Ref-2	Ref-3	Ref-4
1	Description of the items offered: Please add list of MMS items as follows: (Make / Model) 1) Sensor 2) Sensor Cable & Driver 3) MMS Rack with Dual Redundant Power Supply 4) MMS Rack-Proximity card 5) MMS Rack-Temperature card 6) MMS Rack-Key Phasor card, Zero Speed and Speed Measurement / Reverse Rotation. 7) MMS Rack-Communication card 8) MMS Rack Module-Relay Card.				
2	Description of item as manufactured & Supplied/ engineered (identify bidder's scope of work)				
3	Purchaser's name, address, Tel no, Fax no, email and contact person				
4	Date of order placed				
5	Contractual completion date				
6	Actual completion date/ month & year of commissioning				
7	Reasons of delay if any				
8	Details of major break down till date.				

15 **CERTIFICATE FOR LOGISTICS SUPPORT:**(To be signed by Manufacturer's corporate level signatory on company's letterhead and submitted along with offer)

I, on behalf of M/s _____confirm that the (Name of the Instrument/Equipment) Model No_____ for (name of application: TSI System & TSI Field Instruments) quoted by M/s _____for M/s (BHEL Customer) against M/s BHEL inquiry no _____shall continue to be supported by us. The quoted Items shall not be withdrawn from Indian market in next three (3) years from the date of placement of order as a matter of our corporate policy.

I further confirm that in case of placement of order by M/s BHEL on us, we shall continue to support M/s in providing back-up engineering, maintenance support and spare part support to M/s (BHEL Customer) for a period of ten (10) years from the date of expiry of warranty.

SIGNATURE WITH SEAL
AUTHORISED, SENIOR MANAGEMENT LEVEL SIGNATORY

16 **TENDER EVALUATION CRITERIA**

a The total price for the complete package i.e. Main System, Spares, Supervision of erection & commissioning charges shall be considered for L1 evaluation.

b Duly signed & stamped un-priced price schedule and unit prices shall be submitted along with technical offer by bidder as a token of concurrence that all items are quoted without which the offer will not be evaluated. For un-priced bid bidder to fill 'Quoted' for each item and submit (refer clause 19 for PRICE SCHEDULE).

17 **CHECK LIST:**

(TO BE FILLED BY BIDDER AND SUBMITTED ALONG WITH OFFER)

SL. NO.	DESCRIPTION	Vendor confirmation	Comments / Remarks
1	Offer for complete package as per BHEL specification Vendors shall furnish the complete bill of material offered against the respective material codes.		
2	Offer for Spares as per BHEL specification. Vendor shall furnish the bill of material of mandatory spares offered.		
3	Clause wise confirmation / deviation to BHEL specification (as per the deviation format clause 15) included in the offer.		
4	Reference list for TSI System satisfying the Proven track record requirement as per clause no 14 of BHEL specification included in the offer.		
5	Certificate of logistic support as per clause no 15 of BHEL specification included in the offer for TSI System.		
6	Cable specification / datasheet for TSI Sensors (for cable distance indicated in project specific requirement).		
7	Filled in Un-priced Price schedule is included in the technical offer.		

(Signature and stamp of bidder with date)

18 **VARIANT TABLE:**

a **Variant Table-1:**

Var No	Material Description	Ref. Drawing	Material Code
1	Proximity sensor (Vibration / axial measurement, keyphasor, speed), reverse mount, 8mm tip, 1.2" length, 3/8-24 UNF thread	3-a	TC9765342012
2	Proximity sensor (Vibration / axial measurement), Standard mount, 8mm tip, 70mm length, M10x1 thread, , Unarmoured	3-b	TC9765342020
3	Proximity Probe Extension Cable, 4mts, Unarmoured	3-c	TC9765342039
4	Proximity Probe Driver for 5mts system	3-d	TC9765342047
5	Acceleration Sensor, M8x1, with 5mts Cable & Connector	3-e	TC9765342055
6	Acceleration Sensor Cable 5mts with Connector, Armoured	3-e	TC9765342063
7	Connector protectors (10nos per set)		TC9765342071
8	Connector protector Kit (assembly kit with 1 connector protector set)		TC9765342080
9	Low Pressure Cable Seal 3/4"NPTM	4-c	TC9765342098
10	Flexible Conduit 3/4", 30 mts		TC9765342101
11	Flexible Conduit Connector 3/4"		TC9765342110
12	Transducer Calibration Kit		TC9765342128
13	Rack Power Supply, 85-264VAC, Duplex		TC9765342136
14	Rack Transient Data Interface Module, Ethernet TCP/IP		TC9765342144
15	Keyphasor & Tachometer Module (with reverse rotation function)		TC9765342152
16	Proximity Sensor module		TC9765342160
17	Temperature module		TC9765342179
18	Programmable Relay module		TC9765342187
19	Communication gateway		TC9765342195
20	Rack Configuration laptop		TC9765342209
21	Rack Configuration software		TC9765342217
22	Rack System display		TC9765342225
23	Ethernet to SM Fiber optic Convertor with patch cords & LIU		TC9765342233
24	RS485 Serial to SM Fiber optic Convertor with patch cords & LIU		TC9765342241
25	RS485 Serial Cable, armoured with Connectors		TC9765342250
26	Rack Power Supply, 220VAC, Duplex		TC9765342268
27	Proximity sensor (Keyphasor & tachometer), reverse mount, 8mm tip, 1.2" length, 3/8-24 UNF thread	3-a	TC9765342276
28	Portable Offline Measurement Kit		TC9765342284
29	Proximity sensor (Vibration / axial measurement), Standard mount, 8mm tip, 40mm / 1.6" length, 3/8-24 UNF thread	3-b	TC9765342292
30	Fibre optic cable, 6 fibre, armoured, Orange colour		TC9765342306
31	Fibre optic cable HDPE conduit as per IS-4984 or eqv. IEC standard. Colour shall be orange with black fittings (1" or ¾ ")		TC9765342314
32	PROX SENSOR,STD MNT	3-b	TC9765342322

b **Variant Table-2:**

Var No	Material Description	Ref. Drawing	Material Code
-	TSI Rack & Spares as per TC65342-<Variant No.>	Project specific	TC9765342xxx

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	03.11.15	ISSUE	--------	PSVS
01	30.01.16	Variant 26, 53 & 54 added for 220VAC	RAM	PSVS
02	16.09.16	Revised and new variants added.	RAM	PSVS
03	09.08.17	Updated for IOCL Haldia BS-VI	RAM	PSVS
04	07.05.18	Updated for APL	PG	RAM
05	31.12.19	New variant & UPS power supply updated.	IS	RAM

INSTRUCTIONS TO BIDDERS:

1) Bidders are advised to contact BHEL for essential technical queries in writing within one week of issue of Enquiry. Offers with incomplete information will not be considered for evaluation, and are likely to be rejected without any further correspondence with the Bidder.
2) Unsolicited requests from bidders for alterations to their already submitted offer will not be permitted. These would not be taken cognizance, and offers will be evaluated without taking into account such requests/correspondence.
3) Any technical features over & above BHEL enquiry specification requirements proposed by Bidder will not be given preference for the purpose of evaluation.
4) Bidders shall comply BHEL specifications in total. Incomplete offers will be rejected. In case feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder.
5) The make and model no of Bidder bought out items along with relevant catalogues are attached. In case Bidder proposes alternate make / model of bought out item due to non-availability of statutory certification etc., the same shall not be binding on BHEL. Such changes shall be explicitly listed in deviation list with applicable price (for removal of the said deviation) explicitly indicated (with specific item no) in the PRICED price schedule.
6) In the event of any conflict between these specifications, data sheets, related standards, codes etc. the bidder shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture / procurement of the items in question.
7) Bidder shall submit duly filled deviation format enclosed with this specification along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be rejected. If, there are no deviations, bidder shall submit signed copy of deviation format, mentioning "No Deviations".
8) Changes if any made by BHEL during technical evaluation on the specification requirements or Bill of material, bidder is requested by the purchase to submit impact price (amount to be reduced or increased to the original offered price) for those changed items only, other items for which there are no technical changes, unit rates shall be maintained as it is.
9) **Bidder shall conduct IP-55 certification for the panel from NABL approved third party testing agency.**
10) **Exception to IP-55 testing is acceptable only if the vendor furnishes valid IP-55 certificate for same size panel.**
11) **Bidder shall necessarily quote for all the optional items listed in the price schedule. This optional unit prices shall be exercised if there is any increase in Panel BOM due to Customer comments.**
12) The panels shall be assembled and tested at vendor works. Thereafter, the panel shall be dispatched to BHEL or site. Vendor technical services are required at BHEL or site for mounting of TSI (MMS Racks). The MMS Racks are BN3500 series or Shinkawa VM7B series / Equivalent.
13) **Sourcing of any raw material or finish good products, any testing and processing on product (e.g. assembly) from China is not allowed except for the following: Electronic cards, modules, power supplies, barriers, isolators, network components etc. may have some internal components / parts manufactured in China, however the supplier shall not be from China.**

Rev. No.	Revision	Prepared	Approved	Date
00	ISSUE	LVAB	PDM	12.02.2022
01	ISSUE	LVAB	PDM	30.03.2022

PROJECT SPECIFICATION FOR COMPRESSOR MMS PANEL

1. **Technical specifications:**

Sl.No.	Requirement	Description
1	**Environment**	a. Ambient Temp: 12-42℃ b. Humidity: 80-100% c. Area classification: NA. MMS Sensors / Field Instruments are located in IEC Zone-1, IIC, T3 d. Mounting location: Indoor, Air Conditioned. e. Ingress protection: IP55 for Panel. f. Panel Purging: Not Applicable.
2	**Panel Construction**	a. Make: Rittal TS8 series. **Equivalent panel is not acceptable.** b. Door: front (with glass window) & rear c. MOC: CRCA d. Sheet thickness: i. Door: : 2.0 mm ii. Sides: 3.0 mm iii. Gland plate: 3.00mm iv. Mounting plate: 3.0 mm e. Structure: As per make / model listed above. f. Base frame: Yes, 100 mm. g. Anti-vibration pads: Yes h. Lifting eyebolts: Yes, removable type i. Screws, door handles, hinges and other non-painted metallic parts: Stainless Steel j. Dimensions: 1600mm(W) x 2100mm(H) x 800mm(D) k. Cable entry: bottom **l.** Document pocket: Yes
3	**Painting**	a. Pre-treatment: 7-tank dip, de-rusting, degreasing, phosphatation, passivation, sand blasting, grinding, chemical cleaning & surface finish. b. Primer: Two coats c. External colour: RAL7035. d. Internal colour: RAL7035. e. Base channel: Black
4	**Component layout from bottom**	~1300 mm
5	**Main Name plate**	a. Material: Acrylic (engraved) b. Letter: White c. Background: Black d. Fastening: Screwed
6	**External Equipment Tag plate**	a. Material: Acrylic (engraved) b. Letter: White c. Background: Black d. Fastening: Screwed
7	**Instrument Tag Plate / Label**	a. Material: Acrylic (engraved) b. Letter: White c. Background: Black d. Fastening: Screwed
8	**Electrical**	a) Panel wiring: PVC insulated 660/1100V grade, single core multistrand, copper conductor. b) Conductor Size: 1.5 sq. mm for signal & 2.5 sq. mm for power. c) Wiring colour code: during detail engineering. d) Ferrules: Cross ferruling with White / Yellow silicon type, printed. e) Terminals: screw less, clamp-on type (Wago, Phoenix,

		Weidmuller) f) Grounding: Yes, signal and power earth with ground strip (6mm) and lugs. g) Incoming power: i. UPS: 110VAC-Redundant Feeder ii. Non-UPS: 240VAC-Single Feeder
9	Cable entry	Through MCT (Roxtec CF 32) in the panel.
10	**Exhaust fans and louvers**	The panel shall be provided with exhaust fans (back door mounted) and louvers.
11	**Inspection & test plan**	Attached.
12	**Panel Design Specification**	a. BHEL Specification TC55916-R00
13	**BHEL issue items for mounting inside Auxiliary Panel**	
a.	**TSI (MMS) Rack**	TSI Racks as per TSI loop. Detailed make / Model provided later.

2. **Bill of Material: MAIN & SPARES:** The BOM do not contain qty of electrical items like MCB, terminals etc. These shall be as per requirement along with 20% installed spares of each type / rating.

Sl.No	Item	Main Qty (mounted on Panel) BHEL Matl Code: TC9765507011	Spare Qty (Loose Supply) BHEL Matl Code: TC9765507020
1	Instrument Tag Plate / Label	As Required	
2	Electrical (MCB etc.)	As Required with 20% Installed spare of each type	10% or min 01 nos each type
3	Componenets required for making one TCP/IP redundant connection from all three racks	As Required	10% or min 01 nos each type
4	24VDC Power Supply (Phoenix QUINT PS or Eqv. with failure contact)	As Required	01 no Power Supply
5	24VDC Power Supply Diode Module (Phoenix)	As Required	01 no Diode Module.
6	Fan Failure Module	1 set	1 set
7	Panel Temperature alarm	1 set	1 set
8	Utility module	1 set	NA
9	Terminals	As Required with 20% Installed spare	50 nos for signal, 10 nos for power / each size / type.
10	Lugs	As Required	100 nos for signal, 10 nos for power / each size / type.
11	Wires / cables	As Required	NA
12	Cable Gland	2 nos Roxtec CF 32 or eqv	10% subject to min 1 nos each type
13	Fuse	As required	100% each type, rating
14	REDUNDANT MODBUS TCP/IP TO FO COVERTER SET	5 SETS	
15	REDUNDANT MODBUS TCP/IP	5 SETS	

Sl.No	Item	Main Qty (mounted on Panel) BHEL Matl Code: TC9765507011	Spare Qty (Loose Supply) BHEL Matl Code: TC9765507020
	CABLE-75M		
16	RS485 CABLE:800M	1 SET	
17	6 CORE FO CABLE:800M	1 SET	
18	RS485 TO MODBUS TCP/IP COVERTER SET	2 SETS	
19	SINGLE LOCAL DISPLAY UNIT WITH ACCESSORIES	1 SET	
20			All other items used in panel: 10% or min 01 nos each type

3. **DOCUMENTATION:**

3.1 Vendor shall supply native files of the panel GA, BOM and Wiring Diagrams as part of final Documentation. Vendor shall indicate the file type and software version used for generating the native files. All documentation shall be furnished in pdf format during engineering stage.

4. **VENDOR TECHNICAL SERVICES REQUIREMENT:**

4.1 The Panel shall be used for installation of MMS racks (Vendor Scope).

4.2 Vendor shall complete the panel assembly and wiring at vendors works.

5. **CHECKLIST:**

(TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITHOUT WHICH OFFER WILL NOT BE CONSIDERED)

Sl. No.	Requirement	Vendor Confirmation YES / NO
a.	Compliance to BHEL specification and its annexures.	
b.	Deviation (if any) included in offer with reason.	
c.	Price implication for deviation removal is indicated in Priced offer in case of any deviation.	
d.	Panel GA & BOM (with make/model) attached with technical offer.	
e.	Signed and stamped copy attached with technical offer.	
f.	Spares BOM (with make/model) attached with technical offer.	
g.	Price schedule attached with technical offer with 'QUOTED' marked against each item.	
h.	PTR attached with technical offer.	
i.	IP-55 certification / testing considered.	
j.	Unit Prices for all Panel mounted items included	

6. **Attachments:**

6.1 BHEL Standard Specification for Auxiliary Control Panel: TC55916-R00.

6.2 TSI Loop for MMS Rack Configuration.

6.3 ITP for Panel.

STANDARD SPECIFICATION FOR AUXILIARY CABINET FOR CENTRIFUGAL COMPRESSORS

1. SCOPE:

1.1 This specification covers design, manufacturing, assembling & testing of Compressor Auxiliary Cabinet. The scope of supply envisaged is supply of Compressor Auxiliary Cabinet in general with items loose supplied by BHEL and mounted in the cabinet by the vendor.

1.2 The compressor Auxiliary Cabinet shall be located in safe area.

1.3 All the equipment shall work satisfactorily even if the air conditioning fails for two hours.

2. DESIGN & FABRICATION:

2.1 GENERAL.

2.1.1. The cabinet and accessories shall be designed & fabricated in accordance with latest revision drawings given below, applicable clauses as indicated in project specific requirement & instrumentation code of practices.

2.1.2. The control cabinet with all the hardware shall meet the requirements stipulated in this specification & shall fully confirm to the following drawings (latest revision). Vendor to note that these drawings may under go various revisions till the approval of vendor documents.

a) Loop diagram.
b) Logic diagram.

2.2 MECHANICAL CONSTRUCTION:

2.2.1. The cabinet shall be free standing, floor mounting type with back doors and shall be totally enclosed cubicle. It shall comprise of rigid structural frame enclosed completely with cold rolled steel sheets with suitable stiffness at the rear of the cabinet.

2.2.2. The overall dimensions of the cabinet shall be in general 800mm (w) X ~~2200mm~~ (h) (including base channel of 100 mm height) X 800mm (d). However, the dimensions shall be finalised during detailed engineering.

2.2.3. Fabrication shall be made out of:

~~a) Structure : ISA 50X50X6 THK mm~~
~~b) Cabinet front sheet & Gland Plate : 3.2 mm CRCA (Cold Rolled Steel Sheet)~~
~~c) Base frame : ISMC 100X50~~
~~d) Kick Plate, Doors : 2.0 mm CRCA Sheet~~
~~e) Side covers Top & Bottom : 3.2 mm CRCA sheet~~

2.2.4. Inside the cubicle, steel frame work shall be provided to support instruments, raceways, other instrument accessories, power distribution boxes etc. The arrangement shall ensure proper installation and ease of maintenance.

2.2.5. All doors shall be gasketted all-round with Neoprene gaskets. Doors shall be double leaved type with handle and shall be provided with lock and key.

2.2.6. Anti vibration pads of Dunlop make (cushy foot mounting) shall be provided between cabinet & base frame.

2.2.7. Cabinet shall have bottom entry with removable gland plates for all the power/control/signal cables. Cable glands are in cabinet supplier's scope. (~~Size 1½" ET-20 Nos., 1" ET-20Nos.~~) Cable OD sizes shall be furnished during detailed engineering. ~~Cable glands shall be explosion proof type, suitable for the area classification as per point 2.1.1 above. The cable gland material shall be in general, Nickel-plated Brass.~~ The Cable gland shall be provided with checknut & PVC hood.

2.2.8. Lifting eye bolts of removable type shall be provided for each cabinet.

2.2.9. (Screws and other non-painted metallic parts for items shall be of stainless steel material/nickel plated). Door handles shall be of SS. Screws for hinges and door handles shall be of SS.

2.3 CABINET LAYOUT:

Generally the equipment layout shall be carried out keeping in view the following:

2.3.1. Functional requirements.

2.3.2. Aesthetics.

2.3.3. Utilization of space.

2.3.4. Accessibility & ease of maintenance

2.4 PAINTING:

The entire surface of cabinet & accessories shall be pre-treated & painted as follows:

2.4.1. All surfaces including structure shall be pre – treated in 7 Tank dip system. The process is de-rusting, degreasing, phosphatation & passivation.

2.4.2. Then two coats of high quality primer is applied and stoved after each coat and suitable filler putty applied between the coats to fill the pits etc.,

2.4.3. Finally the cabinet will be finished with two coats of high quality epoxy paint. Cabinet colour shall be as indicated in project specific requirement; the base frame colour shall be black.

2.4.4. The finish shall include sand blasting; grinding, chemical cleaning & surface finish by surface putty/ filter.

3. ELECTRICAL SYSTEM:

3.1 GENERAL:

3.1.1. All wiring shall be carried out with PVC insulated ~~660V~~ grade single core multi strand copper conductor. The conductor cross section shall be 1 Sq. mm minimum.

3.1.2. All wiring shall be routed in suitable perforated PVC troughs. No trough shall be more than 70% full.

3.1.3. Open terminals shall generally be avoided. Terminal strips shall be of anti vibrant type Wago or equivalent type.

3.1.4. Cabinet shall be provided with ample lighting inside the cabinet with door limit switch

3.1.5. At least 10% spare space 20% panel front/inside mounted instrument, 20% spare terminals in TB, 20% additional power feeders -- each provided with switch fuse unit, 20 % spare cable entry points shall be provided with plugs.

3.1.6. Wires carrying measurement signals associated with thermocouples, resistance thermometers and other low-level signals shall be routed in separate troughs/wire ways and not along with power cables. Power wiring and control wiring shall be separated by not less than 150mm. The crossing, if unavoidable, shall be as close to right angles as possible.

3.1.7. Wiring Colour code shall be as below:

1)	Power supply hot	- Black
2)	Power supply neutral	- White
3)	Ground	- Green
4)	Control & Shutdown	- Red
5)	Signal(IS)	- Blue
6)	Alarm system	-Yellow

3.1.8. Cabinet layout shall be designed considering ease of operation. Instrument Mounting heights, in general, shall be as follows:

a)	Miniature and sub miniature instruments(3 rows)	Bottom row	1100mm
		Middle row	1350mm
		Top row	1600mm

3.1.9. The internal Cabinet layout shall be designed considering proper approach for instruments, terminals and other accessories for maintenance, easy removal and on-line calibration. No instrument, terminals, power distribution box etc shall be mounted on the cabinet side plates inside the Cabinet.

3.1.10. It shall be possible to switch off incoming power to Cabinet from Cabinet inside.

3.1.11. Fluorescent lamp to be provided for inside Cabinet lighting.

3.1.12. Provision shall be made for terminating the shielding of each cable terminated in Cabinet.

3.2 POWER SUPPLY:

3.2.1. One feeder each of power supplies (as indicated in project specific requirement) shall be provided at Compressor Auxiliary Cabinet and further distribution of power supplies to all equipments in Compressor Auxiliary Cabinet shall be in vendor's scope. Isolation switches/circuit breakers for all power supplies shall be provided on the Cabinet (inside).

3.3 GROUNDING:

3.3.1. Cabinet shall be provided with an earthling lug and shall be grounded to an Earth bus bar.

3.3.2. Cabinet vendor to provide a separate insulated instrument circuit ground bus. This shall be electrically isolated from cabinets, structure, equipment, incoming cable trays, amour of cable etc. All circuit grounds of electronic instruments, shields and ground wires of signals cables; barrier earth etc. shall be connected to this ground. This ground shall be typically 6mm thick and 50mm wide and of copper. Both ends of this bus bar shall have suitable terminals for further connection to ground electrode provided by purchaser. Creation of multiple grounds in a loop shall be avoided.

4. IDENTIFICATION & MARKING:

4.1 Each wire will be identified at both ends with its identification ferrules.

4.2 All terminals & terminal strips shall be identified by their individual identity.

5. NAME PLATES:

5.1 All cabinet mounted instruments, pushbuttons, lamps etc. shall be provided with name plates.

5.2 The name plates shall be made out of black-white-black (1.6mm thick) phenolic laminate.

5.3 All equipment in the cabinet shall be provided with identification.

6. DOCUMENTATION:

The following documents shall be furnished:

6.1 Cabinet General Arrangement and Bill of Material along with the offer for approval.

6.2 The electrical schematic & wiring diagram shall be submitted within 3 weeks of order placement.

6.3 Terminal schedules.

6.4 Cable interconnection details for the project.

6.5 Test & Calibration certificates including cabinet IP 41 certification (Vendor's internal Q.C certificate).

6.6 12 sets of hard copy and 2 sets of soft copy for 6.1 through 6.4, and 2 sets of hard copy for 6.5 shall be supplied along with the cabinet. After the cabinet is commissioned, one set of as commissioned (commented) copy for 6.1 through 6.3 shall be given to the vendor. Vendor shall incorporate the changes & submit the as–commissioned documents for 6.1 through 6.4 in 4 sets of hard copy and in 2 sets of soft copy.

7. INSPECTION & TESTING:

7.1 Vendor shall furnish quality plan for the cabinet for BHEL approval.

7.2 Final inspection shall be done by BHEL/Customer/Consultant.

7.3 The Inspection of cabinet shall include the following as a minimum.

7.3.1. Dimensional check of the whole cabinet.

7.3.2. Cabinet layout, accessibility, mounting connected materials etc.

7.3.3. Checking of wiring (continuity tests).

7.3.4. Completeness in the supply of all the items.

7.3.5. Functional tests.

7.3.6. High voltage/IR test.

8. PACKING:

8.1 Prior to packing, the cabinet shall be thoroughly cleaned & suitably packed and protected from damage due to weather, transportation's, loading & unloading etc.

8.2 The cabinet shall be provided with proper identification tags.

9. Vendor shall submit General Arrangement drawing & Bill of material along with the offer for approval. The electrical schematic diagram shall be submitted within 3 weeks of order placement.

10. Vendor shall confirm clause wise compliance to this specification and project specific requirement in the offer. Deviations if any shall be brought out giving technical reasons.

RECORD OF REVISION

Rev. No.	Date	Revision Details	Revised	Approved
00	28.04.2008	New Standard	--	AK

LIST OF SUBVENDORS

5.56	JUNCTION BOXES (FLAME PROOF)		
A	Indian Bidders		
5.56.1	Baliga Lighting Equipments (P) Limited	INDIA	
5.56.2	Cooper Crouse-Hinds	INDIA	
5.56.3	FCG Flamproof Control Gears P. Ltd	INDIA	
5.56.4	FCG Power Industries Pvt Ltd	INDIA	
5.56.5	Flameproof Equipments Pvt.Ltd	INDIA	
5.56.6	Flexpro Electricals Pvt Ltd	INDIA	
5.56.7	Kaysons Techno Equipment P Ltd.	INDIA	
5.56.8	PEPPERL & FUCHS MANUFACTURING (INDIA) PRIVATE LIMITED / OEM Authorised bidder: M/s. Pepperl & Fuchs (India) Pvt Ltd. – INDIA	INDIA	Rev.1: Name Change
5.56.9	Prompt Engineering Works	INDIA	
5.56.10	R Stahl Pvt Ltd.	INDIA	
5.56.11	Sudhir Switchgears Pvt Ltd	INDIA	

5.25	CONTROL SWITCHES / SELECTOR SWITCHES (Independent supply / Retrofitting / Alteration / Modification work)	INDIA	
A	Indian Bidders		
5.25.1	GE T&D India Limited	INDIA	
5.25.2	Hotline Switchgear & Controls	INDIA	
5.25.3	Kaycee Industries Ltd.	INDIA	
5.25.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.25.5	Reliable Electronic Components Pvt Ltd	INDIA	
5.25.6	Siemens Limited	INDIA	
5.25.7	Switron Devices	INDIA	

5.27	FUSES (Independent supply / Retrofitting / Alteration / Modification work)		
A	Indian Bidders		
5.27.1	Cooper Bussman India Pvt Ltd	INDIA	
5.27.2	GE T&D India Limited	INDIA	
5.27.3	Havells India Ltd	INDIA	
5.27.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
5.27.5	Novateur Electrical & Digital Systems P	INDIA	
5.27.6	Siemens Ltd	INDIA	

6.171	PUSH BUTTON AND INDICATING LAMPS		
A	INDIAN BIDDERS		
6.171.1	C & S ELECTRIC LTD	INDIA	
6.171.2	ESSEN DEINKI	INDIA	
6.171.3	HOTLINE SWITCHGEAR & CONTROLS	INDIA	
6.171.4	LARSEN & TOUBRO LIMITED	INDIA	Rev.2: Name Change
6.171.5	PRECIFINE PRODUCTS PVT LTD	INDIA	
6.171.6	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	
6.171.7	SHRI TULSI SWITCHGEARS PVT LTD	INDIA	
6.171.8	SIEMENS LIMITED	INDIA	
6.171.9	STANDARD ELECTRICALS LTD	INDIA	
6.171.10	IDEC-IZUMI	INDIA	
6.171.11	R. STAHL (P) LTD	INDIA	
6.171.12	TEKNIK	INDIA	

6.134	LOOP POWERED INDICATORS		
A	INDIAN BIDDERS		
6.134.1	EMERSON PROCESS MANAGEMENT (INDIA) PRIVATE LIMITED.	INDIA	
6.134.2	ENDRESS+HAUSER (INDIA) PRIVATE LIMITED	INDIA	Rev.2: Name Change
6.134.3	HONEYWELL AUTOMATION INDIA LTD	INDIA	
6.134.4	INVENSYS INDIA PVT LTD (SCHNEIDER ELECTRIC INDIA PVT. LTD.)	INDIA	
6.134.5	MTL INSTRUMENTS PVT LTD	INDIA	
6.134.6	YOKOGAWA INDIA LIMITED	INDIA	
6.134.7	ABB INDIA LIMITED	INDIA	Rev.2: Name Change

LIST OF SUBVENDORS

6.8	SIGNAL CABLE - FIRE RESISTANT		
A	INDIAN BIDDERS		
6.8.1	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	
6.8.2	CORDS CABLE INDUSTRIES LTD	INDIA	
6.8.3	ELKAY TELELINKS LTD.	INDIA	
6.8.4	KEI INDUSTRIES LIMITED	INDIA	
6.8.5	POLYCAB WIRES PVT LTD	INDIA	
6.8.6	SUYOG ELECTRICALS LTD	INDIA	
6.8.7	THERMO CABLES LTD	INDIA	
6.8.8	ASSOCIATED CABLES LIMITED	INDIA	
6.8.9	UDEY PYROCABLES PVT LTD	INDIA	
6.8.10	TC COMMUNICATION PVT LTD	INDIA	
6.8.11	Lapp India Pvt Ltd	INDIA	
6.8.12	Leoni Cable Solutions (India) Pvt. Ltd.	INDIA	

6.128	MCT BLOCKS		
A	INDIAN BIDDERS		
6.128.1	MCT BRATTBERG	INDIA	
6.128.2	ROXTEC	INDIA	
6.128.3	HILTI INDIA	INDIA	
6.128.4	DELSEAL INDIA PVT. LTD.	INDIA	

6.129	BARRIERS (IS) / BARRIERS (FF)		
A	INDIAN BIDDERS		
6.129.1	MTL	INDIA	
6.129.2	P &F	INDIA	

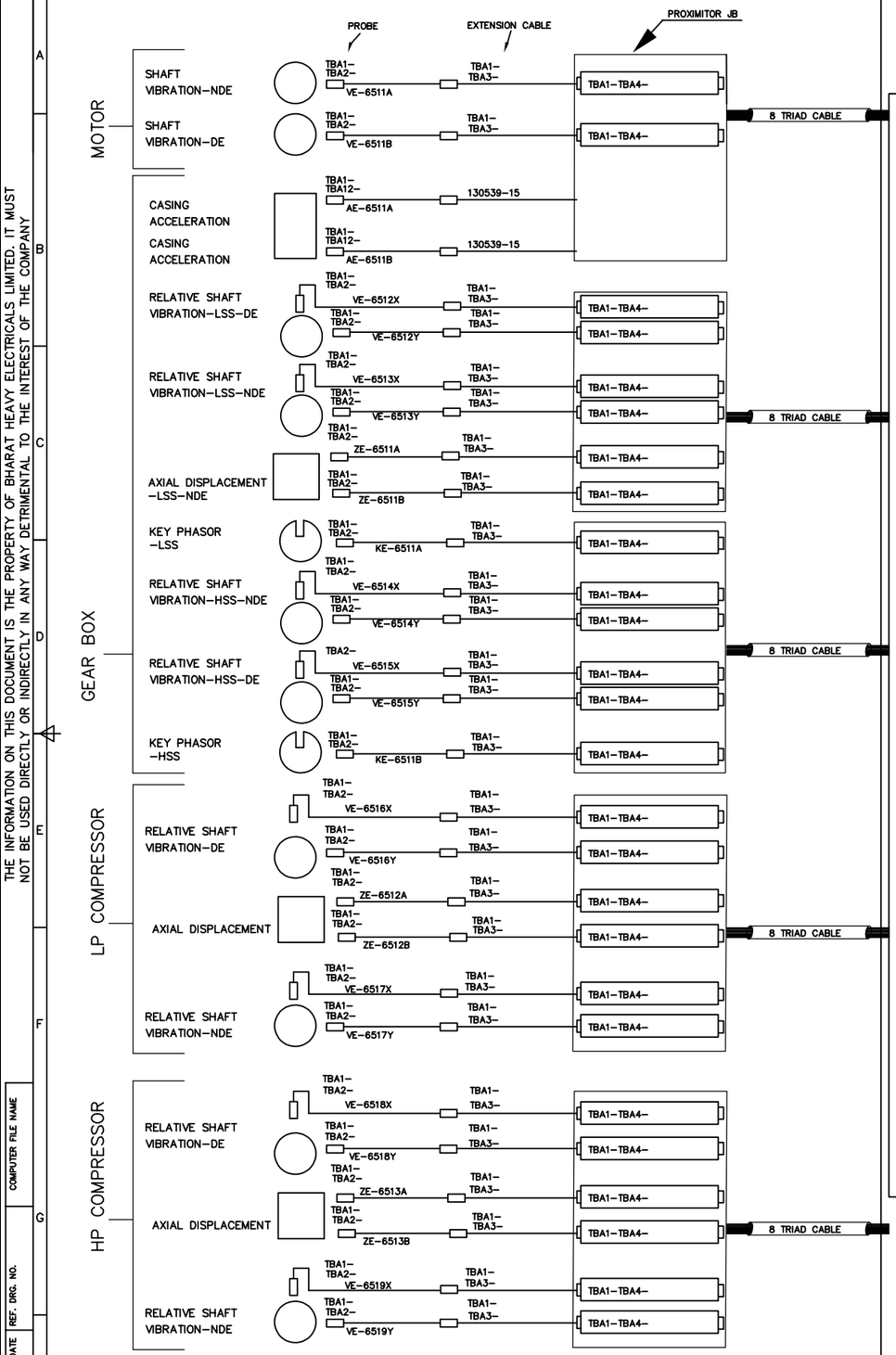
6.130	BEACONS / HOOTERS/ MCP		
A	INDIAN BIDDERS		
6.130.1	BALIGA LIGHTING EQUIPMENT PVT LTD	INDIA	
6.130.2	CAEG FCG	INDIA	
6.130.3	EX PROTECTA	INDIA	
6.130.4	FLAMEPROOF EQUIPMENT PVT. LTD.	INDIA	
6.130.5	FLEXPRO ELECTRICALS	INDIA	

6.100	CONTROL PANEL & ACCESSORIES		
A	INDIAN BIDDERS		
6.100.1	ACCUSONIC CONTROLS PVT LTD	INDIA	
6.100.2	CONTROL SYSTEMS ENGINEERS	INDIA	
6.100.3	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	
6.100.4	ELECTRONIC INSTRMNTATION & CONTROL P LTD	INDIA	
6.100.5	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	INDIA	
6.100.6	INSTRUMENTATION LIMITED	INDIA	
6.100.7	IRIS AUTOMATION PVT LTD	INDIA	
6.100.8	POSITRONICS PVT LTD	INDIA	
6.100.9	PRIMA AUTOMATION INDIA PVT LTD	INDIA	
6.100.10	PYROTECH ELECTRONICS PVT LTD	INDIA	
6.100.11	RADHA KRISHNA CONTROLS	INDIA	

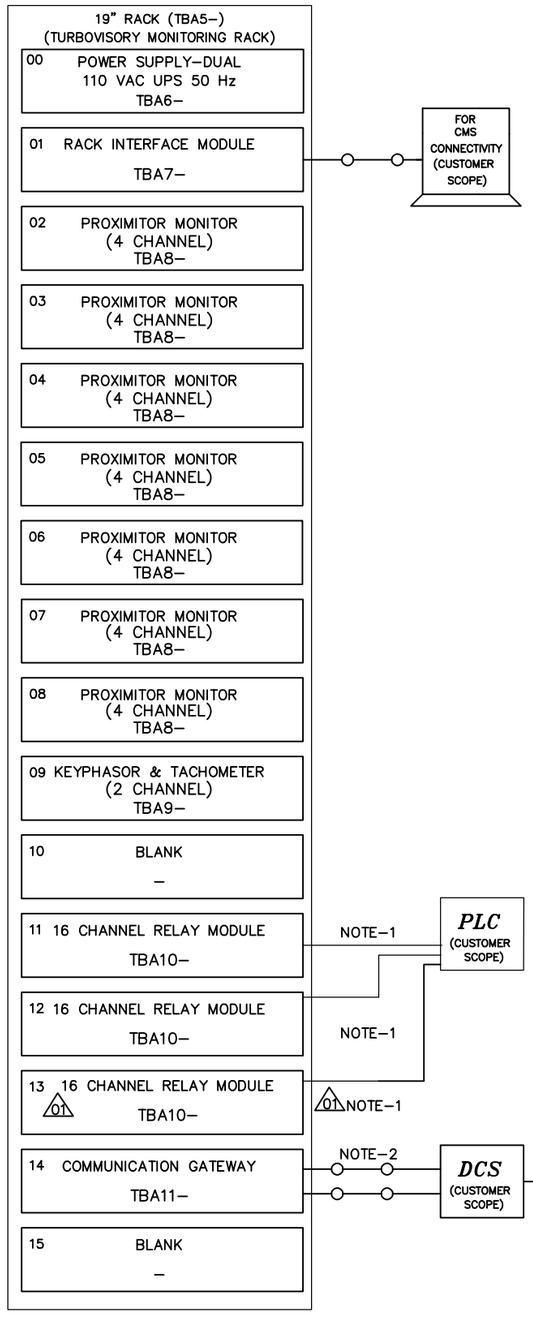
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. HY-DS-3-33700-43003



BARRIERS (MTL 5031 or P & F Eqv.)



BILL OF MATERIAL

01	TURBOVISORY MONITORING RACK–1 (WIRED & ASSEMBLED)	01 nos	TBA
02	BEARING RTD–COMP	18 nos	TBA
03	VIB / KEYPHASOR / AXIAL PROBES– (TBA2–)	24 nos	TBA
04	ACCELEROMETER–GEARBOX (TBA12–)	02 nos	TBA
05	ACCELEROMETER INTERCONNECTING CABLE	02 nos	TBA
06	EXTENSION CABLE (TBA3–)	24 nos	TBA
07	PROXIMITOR (TBA4–)	24 nos	TBA
08	LOW PRESSURE CABLE SEAL (TBA13–)	03 nos	TBA
09	CONNECTOR PROTECTOR KIT (TBA14–)	01 nos	TBA
10	CONNECTOR PROTECTORS (TBA15–)	04 set	TBA
11	SEAL TIGHT FLEXIBLE CONDUIT (TBA16–)	04 nos	TBA
12	SEAL TIGHT FLEXIBLE CONNECTOR (TBA17–)	40 nos	TBA
13	JUNCTION BOX–PROXIMITOR	04 nos	TBA
14	VIBRATION PROBE CONNECTION HEAD–COMP	04 nos	TBA
15	JUNCTION BOX–RTDs	02 nos	TBA
16	FLUID SEAL FITTINGS (COMPRESSOR RTDs)	14 nos	TBA
17	RACK CONFIGURATION SOFTWARE (TBA18–)	01 nos	TBA
18	RACK CONFIGURATION LAPTOP	01 nos	TBA
19	RS–485 SERIAL CABLE (70 METERS)	04 nos	TBA
20	–	–	–

NOTES:

1. MULTIPAIR CABLE BETWEEN TSI RACK & PLC/DCS IS IN SCOPE OF CUSTOMER.
2. MODBUS TCP/IP SERIAL CABLE BETWEEN TSI SYSTEM & DCS IS IN BHEL SCOPE.
3. THE 8–TRIAD CABLES FROM FIELD TO TSI SYSTEM ARE IN BHEL SCOPE.
4. THE RTDs ON MOTOR WINDING SHALL BE CONNECTED TO MMS. (01)
5) MMS to CMS(at both ends) FO Converters is by BHEL. (01)

TWO RACKS SHOWN IN THIS DOCUMENT, HOWEVER IT WILL BE OF 3 NOS OF RACKS, THESE SIGNALS WILL BE DISTRIBUTED IN 3 RACKS.
PLS CONSIDER 3 NOS OF MMS RACKS.
ACTUAL DRGS WILL BE SHARED AFTER AWARD OF PO

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE	01	21.09.21	L.V.A.B P.D.M

REVISED AS PER COMMENTS

PROJECT NAME : EPCM/PMC SERVICES FOR ACRYLICS/ OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD

CLIENT : INDIAN OIL CORPORATION LTD. GUJARAT REFINERY AND DUMAD

ENGINEERING CONSULTANT : Worley — NEW ENERY HOUSE, RAMKRISHNA MANDIR ROAD, KONDIVITA, ANDHERI (EAST) MUMBAI – 400 059. INDIA. TEL : +91 22 26812000 FAX : +91 22 26208295

A GROUP COMPANY OF WORLEY LTD.

PROJ NO. 44AC9100-BHEL-1011-J.01-0004-A3

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	L.V.A.B	–sd–	05.07.21	–N.A.–
CHD.	P.D.M	–sd–	05.07.21	
APPD.	P.D.M	–sd–	05.07.21	

DEPT. TCD DEPT. 415 | UNLESS OTHERWISE SPECIFIED | SCALE N.T.S | WEIGHT (KG) –N.A.– | REF. TO ASSY. DRG. –N.A.– | ITEM NO. –N.A.– | NO.OF ITEMS –N.A.–

TITLE: TSI LOOP DIAGRAM

CARD CODE N.A. | DRAWING NO. HY–DS–3–33700–43003 | REV. 01 | SHT. No 2 | NO. OF SHT. 2

Located in 010–AUX–01
NEW SRR

FIELD

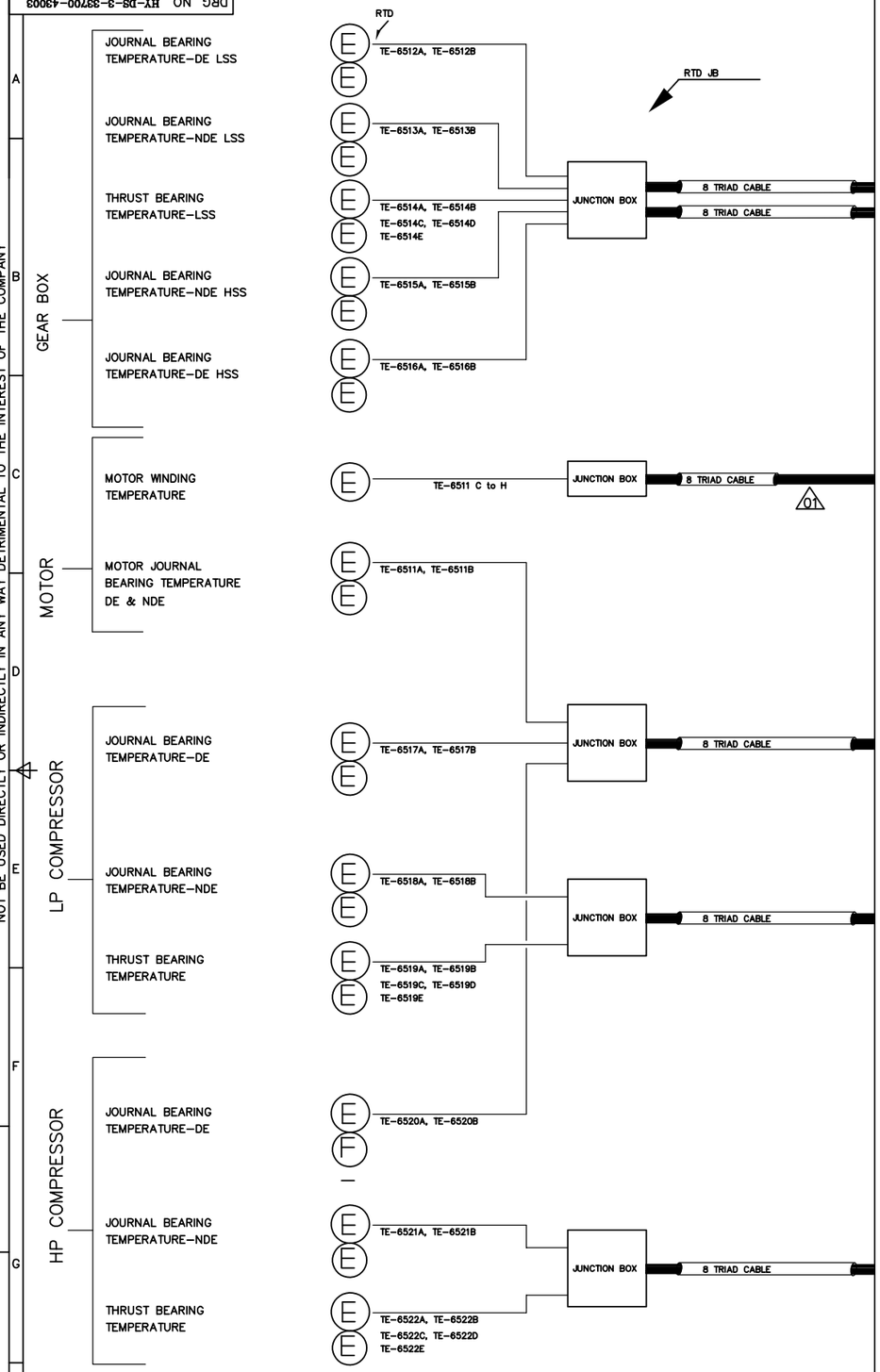
XXX–LCP–001

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

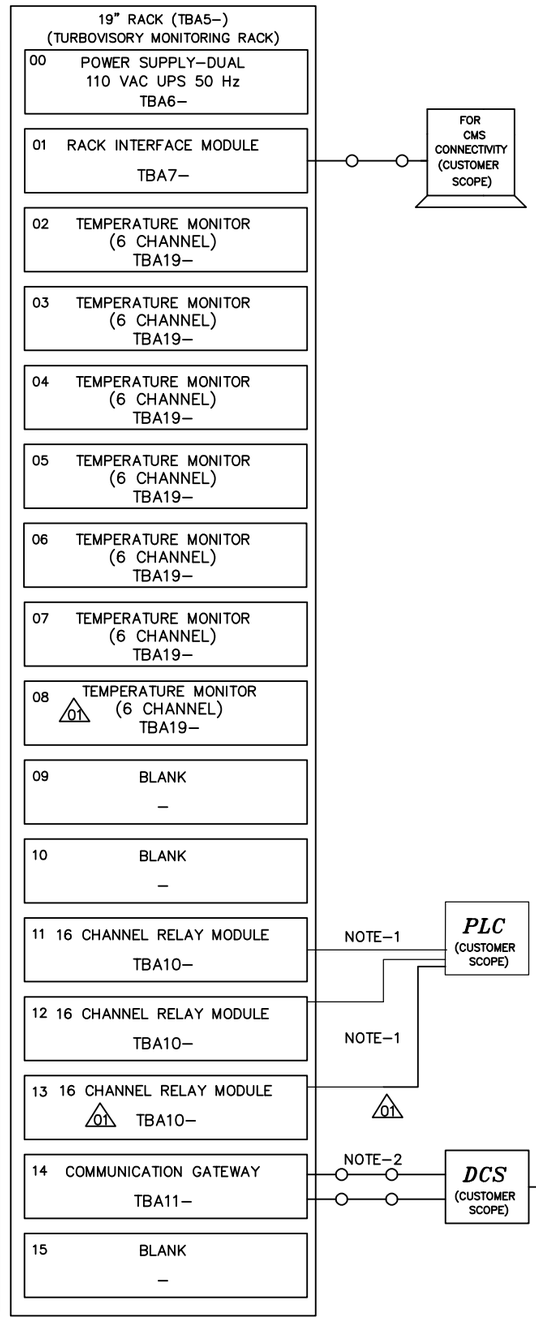
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. HY-DS-3-33700-43003



BARRIERS (MTL 5082 or P & F Eqv.)



Located in 010–AUX–01

01 *NEW SRR*

BILL OF MATERIAL

21	TURBOVISORY MONITORING RACK–2 (WIRED & ASSEMBLED)	01 nos	TBA
22	RTD FOR MOTOR WINDING (mounted & wired to Junction box)	06 nos	WITH MOTOR
23	RTD FOR MOTOR BRG (mounted & wired to Junction box)	02 nos	WITH MOTOR
24	RTD FOR GEAR BOX (mounted & wired to Junction box)	13 nos	WITH GEARBOX
25	–	–	–

NOTES:

1. MULTIPAIR CABLE BETWEEN TSI RACK & PLC/DCS IS IN SCOPE OF CUSTOMER.
2. MODBUS TCP/IP SERIAL CABLE BETWEEN TSI SYSTEM & DCS IS IN BHEL SCOPE.
3. THE 8–TRIAD CABLES FROM FIELD TO TSI SYSTEM ARE IN BHEL SCOPE.
01 4. THE RTDs ON MOTOR WINDING SHALL BE CONNECTED TO MMS.
01 5) MMS to CMS(at both ends) FO Converters is by BHEL.

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

REV.	DATE	ALTERED	CHD/APPD	ZONE
01	21.09.21	ALTERED L.V.A.B	CHD/APPD P.D.M	01 REVISED AS PER COMMENTS

PROJECT NAME: EPCM/PMC SERVICES FOR ACRYLICS/ OXO ALCOHOL PROJECT AT GUJARAT REFINERY AND DUMAD

CLIENT: INDIAN OIL CORPORATION LTD. GUJARAT REFINERY AND DUMAD

ENGINEERING CONSULTANT: Worley — NEW ENERY HOUSE, RAMKRISHNA MANDIR ROAD, KONDIVITA, ANDHERI (EAST) MUMBAI - 400 059, INDIA TEL. : +91 22 26812000 FAX : +91 22 28208295

A GROUP COMPANY OF WORLEY LTD.

PROJ NO. 44AC9100-BHEL-1011-J,01-0004-A3

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	L.V.A.B	–sd–	05.07.21	–N.A.–
CHD.	P.D.M	–sd–	05.07.21	
APPD.	P.D.M	–sd–	05.07.21	

DEPT. TDS 415 | UNTOL. DIMS. AS PER DWG. | SCALE N.T.S | WEIGHT (KG) –N.A.– | REF. TO ASSY. DRG. –N.A.– | ITEM NO. –N.A.– | NO.OF ITEMS –N.A.–

TITLE: TSI LOOP DIAGRAM

CARD CODE: N.A.

DRAWING NO. HY–DS–3–33700–43003 REV. 01

SHT. No 2 NO. OF SHT. 2

Rack 1_TSI-001_Channel Distribution												
Sl. No.	Probe Sensor Tag Name	Proximity Sensor Tag Name	Monitor IN		Monitor OUT		Relay OUT	Relay IN	Channel Type	Description	TO ESD PLC /DCS	Aux Panel Terminal No
			Monitor	Slot-Channel	Tag	Channel	Tag Name	Tag Name				
1	NA	NA	TBA6-	S00	-	-	-	-	-	POWER SUPPLY		
2	NA	NA	TBA7-	S01-10/100TX	-	-	-	-	COMMUNICATION	COMMUNICATION WITH LAPTOP		
3	NA	NA	TBA7-	S01-RST	-	-	-	XS-6511M	RACK RESET	TSI RACK RESET		
4	VE-6511A	VT-6511A	TBA8-	S02C01	VI-6511A	REC1	-	-	RADIAL VIBRATION	MOTOR SHAFT VIBRATION-NDE	DCS(SOFT)	TB1-1 / 2 / 3
5	VE-6511B	VT-6511B	TBA8-	S02C02	VI-6511B	REC2	-	-	RADIAL VIBRATION	MOTOR SHAFT VIBRATION-DE	DCS(SOFT)	TB1-4 / 5 / 6
6	AE-6511A	NA	TBA8-	S02C03	AI-6511A	REC3	-	-	CASING ACCELERATION	GEARBOX LSS CASING ACCELERATION	DCS(SOFT)	TB1-7 / 8 / 9
7	AE-6511B	NA	TBA8-	S02C04	AI-6511B	REC4	-	-	CASING ACCELERATION	GEARBOX HSS CASING ACCELERATION	DCS(SOFT)	TB1-10 / 11 / 12
8	VE-6512X	VT-6512X	TBA8-	S03C01	VI-6512X	REC1	-	-	RADIAL VIBRATION	GEARBOX LSS VIBRATION-DE	DCS(SOFT)	TB1-13 / 14 / 15
9	VE-6512Y	VT-6512Y	TBA8-	S03C02	VI-6512Y	REC2	-	-	RADIAL VIBRATION	GEARBOX LSS VIBRATION-DE	DCS(SOFT)	TB1-16 / 17 / 18
10	VE-6513X	VT-6513X	TBA8-	S03C03	VI-6513X	REC3	-	-	RADIAL VIBRATION	GEARBOX LSS VIBRATION-NDE	DCS(SOFT)	TB1-19 / 20 / 21
11	VE-6513Y	VT-6513Y	TBA8-	S03C04	VI-6513Y	REC4	-	-	RADIAL VIBRATION	GEARBOX LSS VIBRATION-NDE	DCS(SOFT)	TB1-22 / 23 / 24
12	ZE-6511A	ZT-6511A	TBA8-	S04C01	ZI-6511A	REC1	-	-	AXIAL DISPLACEMENT	GEARBOX AXIAL DISPLACEMENT	DCS(SOFT)	TB1-25 / 26 / 27
13	ZE-6511B	ZT-6511B	TBA8-	S04C02	ZI-6511B	REC2	-	-	AXIAL DISPLACEMENT	GEARBOX AXIAL DISPLACEMENT	DCS(SOFT)	TB1-28 / 29 / 30
14	VE-6514X	VT-6514X	TBA8-	S04C03	VI-6514X	REC3	-	-	RADIAL VIBRATION	GEARBOX HSS VIBRATION-NDE	DCS(SOFT)	TB1-31 / 32 / 33
15	VE-6514Y	VT-6514Y	TBA8-	S04C04	VI-6514Y	REC4	-	-	RADIAL VIBRATION	GEARBOX HSS VIBRATION-NDE	DCS(SOFT)	TB1-34 / 35 / 36
16	VE-6515X	VT-6515X	TBA8-	S05C01	VI-6515X	REC1	-	-	RADIAL VIBRATION	GEARBOX HSS VIBRATION-DE	DCS(SOFT)	TB1-37 / 38 / 39
17	VE-6515Y	VT-6515Y	TBA8-	S05C02	VI-6515Y	REC2	-	-	RADIAL VIBRATION	GEARBOX HSS VIBRATION-DE	DCS(SOFT)	TB1-40 / 41 / 42
18	VE-6516X	VT-6516X	TBA8-	S05C03	VI-6516X	REC3	-	-	RADIAL VIBRATION	LP COMPRESSOR SHAFT VIBRATION-DE	DCS(SOFT)	TB1-43 / 44 / 45
19	VE-6516Y	VT-6516Y	TBA8-	S05C04	VI-6516Y	REC4	-	-	RADIAL VIBRATION	LP COMPRESSOR SHAFT VIBRATION-DE	DCS(SOFT)	TB1-46 / 47 / 48
20	VE-6517X	VT-6517X	TBA8-	S06C01	VI-6517X	REC1	-	-	RADIAL VIBRATION	LP COMPRESSOR SHAFT VIBRATION-NDE	DCS(SOFT)	TB1-49 / 50 / 51
21	VE-6517Y	VT-6517Y	TBA8-	S06C02	VI-6517Y	REC2	-	-	RADIAL VIBRATION	LP COMPRESSOR SHAFT VIBRATION-NDE	DCS(SOFT)	TB1-52 / 53 / 54
22	ZE-6512A	ZT-6512A	TBA8-	S06C03	ZI-6512A	REC3	-	-	AXIAL DISPLACEMENT	LP COMPRESSOR AXIAL DISPLACEMENT	DCS(SOFT)	TB1-55 / 56 / 57
23	ZE-6512B	ZT-6512B	TBA8-	S06C04	ZI-6512B	REC4	-	-	AXIAL DISPLACEMENT	LP COMPRESSOR AXIAL DISPLACEMENT	DCS(SOFT)	TB1-58 / 59 / 60
24	VE-6518X	VT-6518X	TBA8-	S07C01	VI-6518X	REC1	-	-	RADIAL VIBRATION	HP COMPRESSOR SHAFT VIBRATION-DE	DCS(SOFT)	TB1-61 / 62 / 63
25	VE-6518Y	VT-6518Y	TBA8-	S07C02	VI-6518Y	REC2	-	-	RADIAL VIBRATION	HP COMPRESSOR SHAFT VIBRATION-DE	DCS(SOFT)	TB1-64 / 65 / 66
26	VE-6519X	VT-6519X	TBA8-	S07C03	VI-6519X	REC3	-	-	RADIAL VIBRATION	HP COMPRESSOR SHAFT VIBRATION-NDE	DCS(SOFT)	TB1-67 / 68 / 69
27	VE-6519Y	VT-6519Y	TBA8-	S07C04	VI-6519Y	REC4	-	-	RADIAL VIBRATION	HP COMPRESSOR SHAFT VIBRATION-NDE	DCS(SOFT)	TB1-70 / 71 / 72
28	ZE-6513A	ZT-6513A	TBA8-	S08C01	ZI-6513A	REC1	-	-	AXIAL DISPLACEMENT	HP COMPRESSOR AXIAL DISPLACEMENT	DCS(SOFT)	TB2-1 / 2 / 3
29	ZE-6513B	ZT-6513B	TBA8-	S08C02	ZI-6513B	REC2	-	-	AXIAL DISPLACEMENT	HP COMPRESSOR AXIAL DISPLACEMENT	DCS(SOFT)	TB2-4 / 5 / 6
30	NA	NA	TBA8-	S08C03	NA	REC3	-	-	-	-		TB2-7 / 8 / 9
31	NA	NA	TBA8-	S08C04	NA	REC4	-	-	-	-		TB2-10 / 11 / 12
32	KE-6511A	KT-6511A	TBA9-	S09C01	SI-6511A	REC1	-	-	TACHOMETER	MOTOR & GEARBOX LSS SPEED	DCS(SOFT)	TB2-13 / 14 / 15
33	KE-6511B	KT-6511B	TBA9-	S09C02	SI-6511B	REC2	SSL-6511	-	TACHOMETER	GEARBOX HSS & COMPRESSOR SPEED	DCS(SOFT)	TB2-16 / 17 / 18
34	NA	NA	BLANK	S10	-	-	-	-	-	-		
35	NA	NA	TBA10-	S11CH1	-	-	ZSHH-6511A	-	RELAY	GEARBOX AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB5-1 / 2 / 3
36	NA	NA	TBA10-	S11CH2	-	-	ZSHH-6512A	-	RELAY	LP COMPRESSOR AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB5-4 / 5 / 6
37	NA	NA	TBA10-	S11CH3	-	-	ZSHH-6513A	-	RELAY	HP COMPRESSOR AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB5-7 / 8 / 9
38	NA	NA	TBA10-	S11CH4	-	-	VSHH-6511A	-	RELAY	MOTOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB5-10 / 11 / 12
39	NA	NA	TBA10-	S11CH5	-	-	VSHH-6512A	-	RELAY	GEARBOX LSS VIBRATION VERY HIGH	ESD PLC(HW)	TB5-13 / 14 / 15
40	NA	NA	TBA10-	S11CH6	-	-	VSHH-6514A	-	RELAY	GEARBOX HSS VIBRATION VERY HIGH	ESD PLC(HW)	TB5-16 / 17 / 18
41	NA	NA	TBA10-	S11CH7	-	-	VSHH-6516	-	RELAY	LP COMPRESSOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB5-19 / 20 / 21
42	NA	NA	TBA10-	S11CH8	-	-	VSHH-6518A	-	RELAY	HP COMPRESSOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB5-22 / 23 / 24
43	NA	NA	TBA10-	S11CH9	-	-	-	-	RELAY	-		TB5-25 / 26 / 27
44	NA	NA	TBA10-	S11CH10	-	-	-	-	RELAY	-		TB5-28 / 29 / 30

Rack 1_TSI-001_Channel Distribution												
Sl. No.	Probe Sensor Tag Name	Proximity Sensor Tag Name	Monitor IN		Monitor OUT		Relay OUT	Relay IN	Channel Type	Description	TO ESD PLC /DCS	Aux Panel Terminal No
			Monitor	Slot-Channel	Tag	Channel	Tag Name	Tag Name				
45	NA	NA	TBA10-	S11CH11	-	-	-	-	RELAY	-		TB5-31 / 32 / 33
46	NA	NA	TBA10-	S11CH12	-	-	-	-	RELAY	-		TB5-34 / 35 / 36
47	NA	NA	TBA10-	S11CH13	-	-		-	RELAY	-		
48	NA	NA	TBA10-	S11CH14	-	-		-	RELAY	-		
49	NA	NA	TBA10-	S11CH15	-	-		-	RELAY	-		
50	NA	NA	TBA10-	S11CH16	-	-		-	RELAY	-		
51	NA	NA	TBA10-	S12CH1	-	-	ZSHH-6511B	-	RELAY	GEARBOX AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB6-1 / 2 / 3
52	NA	NA	TBA10-	S12CH2	-	-	ZSHH-6512B	-	RELAY	LP COMPRESSOR AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB6-4 / 5 / 6
53	NA	NA	TBA10-	S12CH3	-	-	ZSHH-6513B	-	RELAY	HP COMPRESSOR AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB6-7 / 8 / 9
54	NA	NA	TBA10-	S12CH4	-	-	VSHH-6511B	-	RELAY	MOTOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB6-10 / 11 / 12
55	NA	NA	TBA10-	S12CH5	-	-	VSHH-6512B	-	RELAY	GEARBOX LSS VIBRATION VERY HIGH	ESD PLC(HW)	TB6-13 / 14 / 15
56	NA	NA	TBA10-	S12CH6	-	-	VSHH-6514B	-	RELAY	GEARBOX HSS VIBRATION VERY HIGH	ESD PLC(HW)	TB6-16 / 17 / 18
57	NA	NA	TBA10-	S12CH7	-	-	VSHH-6516B	-	RELAY	LP COMPRESSOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB6-19 / 20 / 21
58	NA	NA	TBA10-	S12CH8	-	-	VSHH-6518B	-	RELAY	HP COMPRESSOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB6-22 / 23 / 24
59	NA	NA	TBA10-	S12CH9	-	-	-	-	RELAY	-		TB6-25 / 26 / 27
60	NA	NA	TBA10-	S12CH10	-	-	-	-	RELAY	-		TB6-28 / 29 / 30
61	NA	NA	TBA10-	S12CH11	-	-	-	-	RELAY	-		TB6-31 / 32 / 33
62	NA	NA	TBA10-	S12CH12	-	-	-	-	RELAY	-		TB6-34 / 35 / 36
63	NA	NA	TBA10-	S12CH13	-	-		-	RELAY	-		
64	NA	NA	TBA10-	S12CH14	-	-		-	RELAY	-		
65	NA	NA	TBA10-	S12CH15	-	-		-	RELAY	-		
66	NA	NA	TBA10-	S12CH16	-	-		-	RELAY	-		
67	NA	NA	TBA10-	S13CH1	-	-	ZSHH-6511C	-	RELAY	GEARBOX AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB7-1 / 2 / 3
68	NA	NA	TBA10-	S13CH2	-	-	ZSHH-6512C	-	RELAY	LP COMPRESSOR AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB7-4 / 5 / 6
69	NA	NA	TBA10-	S13CH3	-	-	ZSHH-6513C	-	RELAY	HP COMPRESSOR AXIAL DISPLACEMENT VERY HIGH	ESD PLC(HW)	TB7-7 / 8 / 9
70	NA	NA	TBA10-	S13CH4	-	-	VSHH-6511C	-	RELAY	MOTOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB7-10 / 11 / 12
71	NA	NA	TBA10-	S13CH5	-	-	VSHH-6512C	-	RELAY	GEARBOX LSS VIBRATION VERY HIGH	ESD PLC(HW)	TB7-13 / 14 / 15
72	NA	NA	TBA10-	S13CH6	-	-	VSHH-6514C	-	RELAY	GEARBOX HSS VIBRATION VERY HIGH	ESD PLC(HW)	TB7-16 / 17 / 18
73	NA	NA	TBA10-	S13CH7	-	-	VSHH-6516C	-	RELAY	LP COMPRESSOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB7-19 / 20 / 21
74	NA	NA	TBA10-	S13CH8	-	-	VSHH-6518C	-	RELAY	HP COMPRESSOR SHAFT VIBRATION VERY HIGH	ESD PLC(HW)	TB7-22 / 23 / 24
75	NA	NA	TBA10-	S13CH9	-	-	-	-	RELAY	-		TB7-25 / 26 / 27
76	NA	NA	TBA10-	S13CH10	-	-	-	-	RELAY	-		TB7-28 / 29 / 30
77	NA	NA	TBA10-	S13CH11	-	-	-	-	RELAY	-		TB7-31 / 32 / 33
78	NA	NA	TBA10-	S13CH12	-	-	-	-	RELAY	-		TB7-34 / 35 / 36
79	NA	NA	TBA10-	S13CH13	-	-		-	RELAY	-		
80	NA	NA	TBA10-	S13CH14	-	-		-	RELAY	-		
81	NA	NA	TBA10-	S13CH15	-	-		-	RELAY	-		
82	NA	NA	TBA10-	S13CH16	-	-		-	RELAY	-		
83	NA	NA	TBA11-	S14TCP/IP1	-	-	-	-	COMMUNICATION	MODBUS TCP/IP LINK-1		
84	NA	NA	TBA11-	S14TCP/IP2	-	-	-	-	COMMUNICATION	MODBUS TCP/IP LINK-2		
85	NA	NA	BLANK	S15	-	-	-	-	-	-		

Rack 2_TSI-002_Channel Distribution												
Sl. No.	Probe Sensor Tag Name	Proximity Sensor Tag Name	Monitor IN		Monitor OUT		Relay OUT	Relay IN	Channel Type	Description	TO ESD PLC /DCS	Aux Panel Terminal No
			Monitor	Slot-Channel	Tag	Channel	Tag Name	Tag Name				
1	NA	NA	TBA6-	S00	-	-	-	-	-	POWER SUPPLY		
2	NA	NA	TBA7-	S01-10/100TX	-	-	-	-	COMMUNICATION	COMMUNICATION WITH 3500 HOST PC		
3	NA	NA	TBA7-	S01-RST	-	-	-		RACK RESET	TSI RACK RESET		
4	TE-6511A	NA	TBA19-	S02C01	TI-6511A	REC1	-	-	TEMPERATURE	MOTOR JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB2-19 / 20 / 21
5	TE-6511B	NA	TBA19-	S02C02	TI-6511B	REC2	-	-	TEMPERATURE	MOTOR JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB2-22 / 23 / 24
6	TE-6512A	NA	TBA19-	S02C03	TI-6512A	REC3	-	-	TEMPERATURE	GEARBOX LSS JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB2-25 / 26 / 27
7	TE-6512B	NA	TBA19-	S02C04	TI-6512B	REC4	-	-	TEMPERATURE	GEARBOX LSS JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB2-28 / 29 / 30
8	TE-6513A	NA	TBA19-	S02C05	TI-6513A	REC5	-	-	TEMPERATURE	GEARBOX LSS JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB2-31 / 32 / 33
9	TE-6513B	NA	TBA19-	S02C06	TI-6513B	REC6	-	-	TEMPERATURE	GEARBOX LSS JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB2-34 / 35 / 36
10	TE-6514A	NA	TBA19-	S03C01	TI-6514A	REC1	-	-	TEMPERATURE	GEARBOX THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB2-37 / 38 / 39
11	TE-6514B	NA	TBA19-	S03C02	TI-6514B	REC2	-	-	TEMPERATURE	GEARBOX THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB2-40 / 41 / 42
12	TE-6514C	NA	TBA19-	S03C03	TI-6514C	REC3	-	-	TEMPERATURE	GEARBOX THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB2-43 / 44 / 45
13	TE-6514D	NA	TBA19-	S03C04	TI-6514D	REC4	-	-	TEMPERATURE	GEARBOX THRST BRG TEMPERATURE-NON ACT	DCS(SOFT)	TB2-46 / 47 / 48
14	TE-6514E	NA	TBA19-	S03C05	TI-6514E	REC5	-	-	TEMPERATURE	GEARBOX THRST BRG TEMPERATURE-NON ACT	DCS(SOFT)	TB2-49 / 50 / 51
15	TE-6515A	NA	TBA19-	S03C06	TI-6515A	REC6	-	-	TEMPERATURE	GEARBOX HSS JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB2-52 / 53 / 54
16	TE-6515B	NA	TBA19-	S04C01	TI-6515B	REC1	-	-	TEMPERATURE	GEARBOX HSS JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB2-55 / 56 / 57
17	TE-6516A	NA	TBA19-	S04C02	TI-6516A	REC2	-	-	TEMPERATURE	GEARBOX HSS JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB2-58 / 59 / 60
18	TE-6516B	NA	TBA19-	S04C03	TI-6516B	REC3	-	-	TEMPERATURE	GEARBOX HSS JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB2-61 / 62 / 63
19	TE-6517A	NA	TBA19-	S04C04	TI-6517A	REC4	-	-	TEMPERATURE	LP COMPRESSOR JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB2-64 / 65 / 66
20	TE-6517B	NA	TBA19-	S04C05	TI-6517B	REC5	-	-	TEMPERATURE	LP COMPRESSOR JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB2-67 / 68 / 69
21	TE-6518A	NA	TBA19-	S04C06	TI-6518A	REC6	-	-	TEMPERATURE	LP COMPRESSOR JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB2-70 / 71 / 72
22	TE-6518B	NA	TBA19-	S05C01	TI-6518B	REC1	-	-	TEMPERATURE	LP COMPRESSOR JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB3-1 / 2 / 3
23	TE-6519A	NA	TBA19-	S05C02	TI-6519A	REC2	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-NON ACT	DCS(SOFT)	TB3-4 / 5 / 6
24	TE-6519B	NA	TBA19-	S05C03	TI-6519B	REC3	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-NON ACT	DCS(SOFT)	TB3-7 / 8 / 9
25	TE-6519C	NA	TBA19-	S05C04	TI-6519C	REC4	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB3-10 / 11 / 12
26	TE-6519D	NA	TBA19-	S05C05	TI-6519D	REC5	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB3-13 / 14 / 15
27	TE-6519E	NA	TBA19-	S05C06	TI-6519E	REC6	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB3-16 / 17 / 18
28	TE-6520A	NA	TBA19-	S06C01	TI-6520A	REC1	-	-	TEMPERATURE	HP COMPRESSOR JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB3-19 / 20 / 21
29	TE-6520B	NA	TBA19-	S06C02	TI-6520B	REC2	-	-	TEMPERATURE	HP COMPRESSOR JRNL BRG TEMPERATURE-DE	DCS(SOFT)	TB3-22 / 23 / 24
30	TE-6521A	NA	TBA19-	S06C03	TI-6521A	REC3	-	-	TEMPERATURE	HP COMPRESSOR JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB3-25 / 26 / 27
31	TE-6521B	NA	TBA19-	S06C04	TI-6521B	REC4	-	-	TEMPERATURE	HP COMPRESSOR JRNL BRG TEMPERATURE-NDE	DCS(SOFT)	TB3-28 / 29 / 30
32	TE-6522A	NA	TBA19-	S06C05	TI-6522A	REC5	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-NON ACT	DCS(SOFT)	TB3-31 / 32 / 33
33	TE-6522B	NA	TBA19-	S06C06	TI-6522B	REC6	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-NON ACT	DCS(SOFT)	TB3-34 / 35 / 36
34	TE-6522C	NA	TBA19-	S07C01	TI-6522C	REC1	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB3-37 / 38 / 39
35	TE-6522D	NA	TBA19-	S07C02	TI-6522D	REC2	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB3-40 / 41 / 42
36	TE-6522E	NA	TBA19-	S07C03	TI-6522E	REC3	-	-	TEMPERATURE	HP COMPRESSOR THRST BRG TEMPERATURE-ACT	DCS(SOFT)	TB3-43 / 44 / 45
37	TE-6511C	NA	TBA19-	S07C04	TI-6511C	REC4	-	-	TEMPERATURE	MOTOR WINDINGTEMPERATURE-NDE	DCS(SOFT)	TB3-46 / 47 / 48
38	TE-6511D	NA	TBA19-	S07C05	TI-6511D	REC5	-	-	TEMPERATURE	MOTOR WINDINGTEMPERATURE-NDE	DCS(SOFT)	TB3-49 / 50 / 51
39	TE-6511E	NA	TBA19-	S07C06	TI-6511E	REC6	-	-	TEMPERATURE	MOTOR WINDINGTEMPERATURE-NDE	DCS(SOFT)	TB3-52 / 53 / 54
40	TE-6522F	NA	TBA19-	S08C01	TI-6522C	REC1	-	-	TEMPERATURE	MOTOR WINDINGTEMPERATURE-NDE	DCS(SOFT)	TB3-55 / 56 / 57
41	TE-6522G	NA	TBA19-	S08C02	TI-6522D	REC2	-	-	TEMPERATURE	MOTOR WINDINGTEMPERATURE-NDE	DCS(SOFT)	TB3-58 / 59 / 60
42	TE-6522G	NA	TBA19-	S08C03	TI-6522E	REC3	-	-	TEMPERATURE	MOTOR WINDINGTEMPERATURE-NDE	DCS(SOFT)	TB3-61 / 62 / 63
43	TE-6511C	NA	TBA19-	S08C04	TI-6511C	REC4	-	-	TEMPERATURE	-	DCS(SOFT)	TB3-64 / 65 / 66

Rack 2_TSI-002_Channel Distribution												
Sl. No.	Probe Sensor Tag Name	Proximity Sensor Tag Name	Monitor IN		Monitor OUT		Relay OUT	Relay IN	Channel Type	Description	TO ESD PLC /DCS	Aux Panel Terminal No
			Monitor	Slot-Channel	Tag	Channel	Tag Name	Tag Name				
44	TE-6511D	NA	TBA19-	S08C05	TI-6511D	REC5	-	-	TEMPERATURE	-	DCS(SOFT)	TB3-67 / 68 / 69
45	TE-6511E	NA	TBA19-	S08C06	TI-6511E	REC6	-	-	TEMPERATURE	-	DCS(SOFT)	TB3-70 / 71/ 72
46	NA	NA	BLANK	S09	-	-	-	-	-	-		
47	NA	NA	BLANK	S10	-	-	-	-	-	-		
48	NA	NA	TBA10-	S11CH1	-	-	TSHH-6511A	-	RELAY	MOTOR JRNL BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB5-37 / 38 / 39
49	NA	NA	TBA10-	S11CH2	-	-	TSHH-6512A	-	RELAY	GEARBOX LSS JRNL BRG TEMPERATURE-DE VERY HIGH	ESD PLC(HW)	TB5-40 / 41 / 42
50	NA	NA	TBA10-	S11CH3	-	-	TSHH-6513A	-	RELAY	GEARBOX LSS JRNL BRG TEMPERATURE-NDE VERY HIGH	ESD PLC(HW)	TB5-43 / 44 / 45
51	NA	NA	TBA10-	S11CH4	-	-	TSHH-6514A	-	RELAY	GEARBOX THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB5-46 / 47 / 48
52	NA	NA	TBA10-	S11CH5	-	-	TSHH-6515A	-	RELAY	GEARBOX HSS JRNL BRG TEMPERATURE-NDE VERY HIGH	ESD PLC(HW)	TB5-49 / 50 / 51
53	NA	NA	TBA10-	S11CH6	-	-	TSHH-6516A	-	RELAY	GEARBOX HSS JRNL BRG TEMPERATURE-DE VERY HIGH	ESD PLC(HW)	TB5-52 / 53 / 54
54	NA	NA	TBA10-	S11CH7	-	-	TSHH-6519A	-	RELAY	LP COMPRESSOR THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB5-55 / 56 / 57
55	NA	NA	TBA10-	S11CH8	-	-	TSHH-6522A	-	RELAY	HP COMPRESSOR THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB5-58 / 59 / 60
56	NA	NA	TBA10-	S11CH9	-	-	-	-	RELAY	-		TB5-61 / 62 / 63
57	NA	NA	TBA10-	S11CH10	-	-	-	-	RELAY	-		TB5-64 / 65 / 66
58	NA	NA	TBA10-	S11CH11	-	-	-	-	RELAY	-		TB5-67 / 68 / 69
59	NA	NA	TBA10-	S11CH12	-	-	-	-	RELAY	-		TB5-70 / 71 / 72
60	NA	NA	TBA10-	S11CH13	-	-		-	RELAY	-		
61	NA	NA	TBA10-	S11CH14	-	-		-	RELAY	-		
62	NA	NA	TBA10-	S11CH15	-	-		-	RELAY	-		
63	NA	NA	TBA10-	S11CH16	-	-		-	RELAY	-		
64	NA	NA	TBA10-	S12CH1	-	-	TSHH-6511B	-	RELAY	MOTOR JRNL BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB6-37 / 38 / 39
65	NA	NA	TBA10-	S12CH2	-	-	TSHH-6512B	-	RELAY	GEARBOX LSS JRNL BRG TEMPERATURE-DE VERY HIGH	ESD PLC(HW)	TB6-40 / 41 / 42
66	NA	NA	TBA10-	S12CH3	-	-	TSHH-6513B	-	RELAY	GEARBOX LSS JRNL BRG TEMPERATURE-NDE VERY HIGH	ESD PLC(HW)	TB6-43 / 44 / 45
67	NA	NA	TBA10-	S12CH4	-	-	TSHH-6514B	-	RELAY	GEARBOX THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB6-46 / 47 / 48
68	NA	NA	TBA10-	S12CH5	-	-	TSHH-6515B	-	RELAY	GEARBOX HSS JRNL BRG TEMPERATURE-NDE VERY HIGH	ESD PLC(HW)	TB6-49 / 50 / 51
69	NA	NA	TBA10-	S12CH6	-	-	TSHH-6516B	-	RELAY	GEARBOX HSS JRNL BRG TEMPERATURE-DE VERY HIGH	ESD PLC(HW)	TB6-52 / 53 / 54
70	NA	NA	TBA10-	S12CH7	-	-	TSHH-6519	-	RELAY	LP COMPRESSOR THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB6-55 / 56 / 57
71	NA	NA	TBA10-	S12CH8	-	-	TSHH-6522B	-	RELAY	HP COMPRESSOR THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB6-58 / 59 / 60
72	NA	NA	TBA10-	S12CH9	-	-	-	-	RELAY	-		TB6-61 / 62 / 63
73	NA	NA	TBA10-	S12CH10	-	-	-	-	RELAY	-		TB6-64 / 65 / 66
74	NA	NA	TBA10-	S12CH11	-	-	-	-	RELAY	-		TB6-67 / 68 / 69
75	NA	NA	TBA10-	S12CH12	-	-	-	-	RELAY	-		TB6-70 / 71 / 72
76	NA	NA	TBA10-	S12CH13	-	-		-	RELAY	-		
77	NA	NA	TBA10-	S12CH14	-	-		-	RELAY	-		
78	NA	NA	TBA10-	S12CH15	-	-		-	RELAY	-		
79	NA	NA	TBA10-	S12CH16	-	-		-	RELAY	-		
80	NA	NA	TBA10-	S13CH1	-	-	TSHH-6511C	-	RELAY	MOTOR JRNL BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB7-37 / 38 / 39
81	NA	NA	TBA10-	S13CH2	-	-	TSHH-6512C	-	RELAY	GEARBOX LSS JRNL BRG TEMPERATURE-DE VERY HIGH	ESD PLC(HW)	TB7-40 / 41 / 42
82	NA	NA	TBA10-	S13CH3	-	-	TSHH-6513C	-	RELAY	GEARBOX LSS JRNL BRG TEMPERATURE-NDE VERY HIGH	ESD PLC(HW)	TB7-43 / 44 / 45
83	NA	NA	TBA10-	S13CH4	-	-	TSHH-6514C	-	RELAY	GEARBOX THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB7-46 / 47 / 48
84	NA	NA	TBA10-	S13CH5	-	-	TSHH-6515C	-	RELAY	GEARBOX HSS JRNL BRG TEMPERATURE-NDE VERY HIGH	ESD PLC(HW)	TB7-49 / 50 / 51
85	NA	NA	TBA10-	S13CH6	-	-	TSHH-6516C	-	RELAY	GEARBOX HSS JRNL BRG TEMPERATURE-DE VERY HIGH	ESD PLC(HW)	TB7-52 / 53 / 54
86	NA	NA	TBA10-	S13CH7	-	-	TSHH-6519C	-	RELAY	LP COMPRESSOR THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB7-55 / 56 / 57

Rack 2_TSI-002_Channel Distribution												
Sl. No.	Probe Sensor Tag Name	Proximity Sensor Tag Name	Monitor IN		Monitor OUT		Relay OUT	Relay IN	Channel Type	Description	TO ESD PLC /DCS	Aux Panel Terminal No
			Monitor	Slot-Channel	Tag	Channel	Tag Name	Tag Name				
87	NA	NA	TBA10-	S13CH8	-	-	TSHH-6522C	-	RELAY	HP COMPRESSOR THRST BRG TEMPERATURE VERY HIGH	ESD PLC(HW)	TB7-58 / 59 / 60
88	NA	NA	TBA10-	S13CH9	-	-	-	-	RELAY	-		TB7-61 / 62 / 63
89	NA	NA	TBA10-	S13CH10	-	-	-	-	RELAY	-		TB7-64 / 65 / 66
90	NA	NA	TBA10-	S13CH11	-	-	-	-	RELAY	-		TB7-67 / 68 / 69
91	NA	NA	TBA10-	S13CH12	-	-	-	-	RELAY	-		TB7-70 / 71 / 72
92	NA	NA	TBA10-	S13CH13	-	-		-	RELAY	-		
93	NA	NA	TBA10-	S13CH14	-	-		-	RELAY	-		
94	NA	NA	TBA10-	S13CH15	-	-		-	RELAY	-		
95	NA	NA	TBA10-	S13CH16	-	-		-	RELAY	-		
96	NA	NA	TBA11-	S14TCP/IP1	-	-	-	-	COMMUNICATION	MODBUS TCP/IP LINK-1		
97	NA	NA	TBA11-	S14TCP/IP2	-	-	-	-	COMMUNICATION	MODBUS TCP/IP LINK-2		
98	NA	NA	BLANK	S15	-	-	-	-	-	-		

JACOBS

IndianOil

INDICATIVE INSPECTION & TEST PLAN** **Project: 44AC9100 – Acrylic / Oxo Alcohol Project at Gujarat Refinery, Dumad**	SHEET 1 OF 1
EQUIPMENT / ITEM DESCRIPTION : **CONTROL PANEL** EQUIPMENT / ITEM TAG NO. : TEST & INSPECTION AS PER : (CODES & SPECIFICATIONS) :	VENDOR : P.O. NO. : PR/PS NO. DRG. NO.

ACTIVITY	1	2	3	4	
	1 WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY OWNER / PMC.				
		2 WITNESS INSPECTION AND / OR DOCUMENT REVIEW BY THIRD PARTY INSPECTION AGENCY (TPIA) NOMINATED BY LSTK / STATUTORY AUTHORITY.			
			3 WITNESS INSPECTION BY SUB VENDOR, VENDOR & LSTK CONTRACTOR.		
				4 CERTIFICATES / DATA TO BE SUBMITTED BY LSTK CONTRACTOR / VENDOR FOR APPROVAL / REVIEW BY TPIA / OWNER / PMC.	
1	A	A	R	X	Detailed inspection & test plan after issue of PO/PR/PS.
2	R	A	R	X	Inspection & test procedures.
3	-	R	R	X	Summary of all supplementary requirements as specified in the PO/PR/PS.
4	-	R	A	X	Packing procedure / shipping drawing of completed equipment.
5	-	H	W	X	Routine test consist of : - Straightness, alignment, paint quality, thickness & shade. - Visual & dimensional check including accessories - Name plate, labels, bill of material - Bus bar size & clearance, bus sleeving & shrouding - Degree of protection - Compartmentalization, shrouding, termination facility, glanding, earthing arrangement, operating height. - Functional check of switches, contactors, meters, lamps including current injection test - Electrical operation check (wiring and scheme check, relay operation check) - HV test, IR test before and after HV test - Continuity test, earth continuity test - any other test as per PR/PS
6	H	H	W	X	Closeout of Concession Request (CR) / Non-Conformance Notice (NCN).
7	-	H	W	X	Spares & packing list check. packing & loading of equipment as per shipping drawing.
8	R	R	R	X	Review of documents: – Test certificate for bought out components – Calibration report of instruments – Short circuit & temperature rise test of bus bars – Test certificate for enclosure protection and weather proof/flame proof requirement as applicable.
9	R	H	H	-	Inspection Release Certificate (IRC) by TPIA.

LEGENDS: H - HOLD, W – WITNESS, R – REVIEW, A - APPROVAL, I – INFORMATION, X – SUBMIT
PO – PURCHASE ORDER, PR – PURCHASE REQUISITION, PS – PURCHASE SPECIFICATION

**** NOTE :** THIS IS AN INDICATIVE INSPECTION AND TEST PLAN IDENTIFYING SCOPE OF INSPECTION /REVIEW OF DOCUMENTS AS A MINIMUM REQUIREMENT, DETAILED INSPECTION AND TEST PLAN INDICATING ALL SPECIFIED REQUIREMENTS AFTER ISSUE OF PO / PR TO BE GENERATED BY LSTK / VENDOR / SUB-VENDOR AND SAME DULY VETTED BY TPIA TO BE SUBMITTED TO OWNER/PMC FOR REVIEW AND APPROVAL.

***** TPIA TO CARRY OUT INSPECTION AT SUB-VENDORS' WORKS.

OWNER / PMC RESERVES RIGHT TO WITNESS INSPECTION OF ANY ITEM AT ANY STAGE WHICH SHALL BE INDICATED ON INSPECTION & TEST PLAN / QAP AT THE TIME OF APPROVAL AND SAME TO BE COVERED AS PART OF PURCHASE ORDER CONDITION ISSUED BY LSTK CONTRACTOR.