

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 1 of 12

INSTRUCTIONS TO BIDDERS:

- a) Bidders are advised to contact BHEL for essential technical queries in writing within one week of issue of RFQ. Offers with incomplete information will not be considered for evaluation, and are likely to be rejected without any further correspondence with the Bidder.
- b) 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.
- c) Any technical features over & above BHEL specification requirements proposed by Bidder will not be given preference for the purpose of evaluation.
- d) 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 In case feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder.
- e) Bidders are advised to quote models and makes with proven track record of successful operation. Offers shall include supporting catalogue and published literature [duly highlighting, as appropriate, the offered variant with complete de-codification of the offered models. In case of discrepancy between bidder's offer and published documents, details furnished in published documents will be taken for the purpose of evaluation.
- f) 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.
- g) 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".
- h) Bidder shall include all items required for implementation of system as per this specification as a complete package, exclusion of any required item, however not explicitly listed in this specification is not acceptable.
- i) 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.
- j) Bidder shall include UNIT prices for all spare items. Bidder may attach separate sheet for the same.
- k) Bidder shall include PRICE SCHEDULE format attached with this specification for its technical and commercial bids. Technical bid shall contain the PRICE SCHEDULE with 'QUOTED' against each RFQ item.
- l) 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.**
- m) In case of any technical query, bidders may contact the following BHEL engineer before submission of offer:**
 Name: Ramniwas Sangwa
 Designation: Manager
 Deptt: TC Engineering
 Phone: +91 40 2318 3548
 Email: ramsangwa@bhel.in

FORMAT	PREPARED:	APPROVED:	DATE:	REV:
TD-201 REV-00	RAVI	IS	18.06.2018	01
REF-DOC TC65342-49-50- 65-R03	COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHEL. It shall not be used directly or indirectly in any way detrimental to the interest of the company.			

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 2 of 12

1 SCOPE:

This specification defines the project specific requirements for TSI System package for HRRL DHDT / VGO / DCU 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: 700 mts max. ii. TSI Rack to DCS / PLC: 50 mts.								
v	SIL Certification for TSI System	Required SIL-2. Incase SIL-2 is not available with vendor, vendor shall supply SIL-1 sensors and TSI Rack cards. Vendor shall provide declaration on company letter head citing non-availability of SIL 2 certified TSI sensors and TSI Rack cards.								
vi	G3 / Eqv. Conformal Coating	Required.								
vii	Intrinsic Safe Barrier	Yes, in BHEL Scope. MTL5500 or Eqv series.								
viii	4-20 mA Output from TSI rack	Required.								
ix	Serial Communication with DCS	Dual Redundant, RS485 Modbus RTU / TCP-IP (will be finalized during detail engineering. Vendor to consider both options without any implication)								
x	Connectivity with Condition Monitoring System	Individual buffered output (raw data) connections for all system transducers (except temperature) from both front as well as rear of the MMS racks for connectivity to purchaser's machine conditioning monitoring and analysis system. Vendor to include special connectors (d-type / BNC etc.) for connection / termination from rack to terminals.								
xi	Power supply	Redundant, 85 to 264 VAC.								
xii	TSI Scheme & Loop Drawing	During detail engineering.								
xiii	TSI System material supply by BHEL	i. Proximitors Junction Box. ii. Triad cable from Proximitors to TSI Rack. iii. Bearing RTD. iv. TSI Panel with TSI Barriers. v. Modbus communication cables.								
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.								
xv	TSI RACK-1 as per TC65342-49-50 BHEL Material Code:	<table><tr><th>Sl. No.</th><th>Module</th><th>Qty</th></tr><tr><td>a</td><td>19" Rack</td><td>01</td></tr></table>			Sl. No.	Module	Qty	a	19" Rack	01
Sl. No.	Module	Qty								
a	19" Rack	01								

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 3 of 12

Sl.No	Technical Requirements			
	TC9765342497	b	Rack Power Supply, Duplex	01
		c	Rack Transient Data Interface Module (if applicable) / RAW Data Connectivity to CMS / Rack Programming	AR
		d	Keyphasor & Tachometer Module with Zero speed relay and Reverse Rotation relay	01
		e	Proximity Sensor Module	07
		f	Programmable Relay Module for min 48 relays with at least 01 no Independent Relay Module	AR
		g	RS485 Modbus Communication Gateway for DCS Dual Redundant Connectivity	AR
xvi	TSI RACK-2 as per TC65342-49-50 BHEL Material Code: TC9765342500	Sl. No.	Module	Qty
		a	19" Rack	01
		b	Rack Power Supply, Duplex	01
		c	Rack Transient Data Interface Module (if applicable) / RAW Data Connectivity to CMS / Rack Programming	AR
		d	Temperature Monitor Module	07
		e	Programmable Relay Module for min 64 Relays with at least 01 no Independent Relay Module	AR
		f	RS485 Modbus Communication Gateway for DCS Dual Redundant Connectivity	AR
xvii	TSI RACK AS PER TC65342-65 BHEL Material Code: TC9765342659	Sl. No.	Module	Qty
		a	19" Rack	01
		b	Rack Power Supply, Duplex	01
		c	Rack Transient Data Interface Module (if applicable) / RAW Data Connectivity to CMS / Rack Programming	AR
		d	Proximity Sensor Module	04
		e	Keyphasor & Tachometer Module with Zero speed relay and Reverse Rotation relay	01
		f	Temperature Monitor Module	04
		g	Programmable Relay Module for min 32 Relays with at least 01 no Independent Relay Module	AR
		h	RS485 Modbus Communication Gateway for DCS Dual Redundant Connectivity	AR

3 STANDARD WARRANTY (DEFECT LIABILITY PERIOD):

- The vendor shall guarantee trouble free performance of the supplied systems and work during this warranty period. In case of any defect or non-performance of the system or a component during this guarantee period, the same shall be replaced/ rectified free of cost. Any such replacement / repair shall to be carried out within 72 hours of reporting the issue to the vendor. In this regard, vendor is advised to consider periodic maintenance checks, as required in order to ensure 100% availability / trouble free performance.
- During warranty period, vendor shall supply all spares and consumables for TSI package items. vendor shall provide warranty maintenance services and supply of spares for maintaining an uptime of 98% for each system. Any fault shall be attended within 72 hrs.
- All equipment/goods supplied shall be warranted for 12 months from the date of commissioning or upto 31st December 2023 whichever is earlier. Replaced / repaired equipment / material will be warranted for 12 months from the date of repair / replacement or 31st December 2024 whichever is earlier.

REF-DOC

TC65342-49-50-
65-R03

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of BHEL. It shall not be used directly or indirectly in any way detrimental to the interest of the company.

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 4 of 12

4 **EXTENDED WARRANTY:**

- a In addition to standard warranty specified above, extended warranty of 2 years for TSI package shall be considered. The extended warranty shall start after expiry of standard warranty (defect liability period) indicated above.
- b The terms and condition of extended warranty shall be same as those for standard warranty (defect liability period).

5 **POST WARRANTY COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT (PWCAMC, optional offer):**

- a Comprehensive post warranty annual maintenance contract for 3 years duration shall be provided for Package. PWCAMC shall be executed after expiry of extended warranty.
- b Vendor shall propose 3 year's post warranty maintenance contract & contract shall exclusively mention the service to be provided, methodology, scope of work, and Vendor's responsibility with year wise break-up.
- c In the event of any malfunction of the system hardware / system software, experienced service engineer shall be made available at site within 24 hours on the receipt of such Information from OWNER.
- d The contract shall include supply of maintenance spares, tools & tackles as required, Travel, boarding & lodging of service engineer. The quote shall be made year wise upto 3 Years.
- e Contract shall include on site stock & shall give cost of each item after expiry of 3 Years AMC with escalation formula.
- f The service under Post Warranty Maintenance Contract including supply of spare parts and services shall broadly encompass:
 - g Preventive maintenance
 - h Periodic maintenance
 - i Emergency service
 - j Software support
- k Preventive maintenance: Once in a year, involving complete overhaul of the system, inspection of hardware and software, fault prediction, inspection of power supply quality, environmental and operating condition checks, calibration checks, major repairs/replacements and detailed reporting.
- l Periodic maintenance: Site visits, minimum four to six times in a year, inspection of general healthiness of the system, study and advice on daily maintenance, inspection of H/W & S/W. if any problem is reported, running of test programs, on-line servicing and solving reported problems.
- m Checks shall be conducted on running system i.e. (a) On-line sub-systems (b) Power supply checks (c) Others vendor to mention.
- n Software maintenance: Maintain existing software to improve and utilize existing application and improve performance of the system. Minor modification of the software shall also be covered under this scope.
- o Emergency service: Any failure shall be on system suppliers' account. The Engineer must report at site within 24 hrs of report of failure, with necessary spares. The system must be brought back within 24 hours after reporting at site.
- p NOTE-1. Vendor to note that while carrying out the Post Warranty Maintenance Contract activities OWNER'S engineers may associate with system engineers. On job training of these associated engineers shall be covered under this scope.
- q Note-2. All financial aspects of the Post Warranty Maintenance Contract must be listed clearly by the Vendor.
- r Vendor shall stock 1 no of each type of card / module and any other additional spares recommended, at owner site, and these shall not be part of the mandatory spares. Vendor can use these spares during the

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 5 of 12

AMC. The spares used shall be replaced by vendor within 7 days with no cost to Owner. Vendor shall maintain a record of all faults during the PWCAMC.

- s Purchase order for PWCAMC shall be placed before expiry of extended warranty as per commercial terms and conditions).

6 **PRE-COMMISSIONING & COMMISSIONING ASSISTANCE:**

Pre-Commissioning & Commissioning assistance at site & BHEL works during turbine testing for the above equipment shall be provided by vendor (Lump sum). A total period of 5 working days for pre-commissioning, excluding travel time and 2 visits shall be considered. A total period of 12 working days for commissioning, excluding travel time and 3 visits shall be considered. The offer shall be inclusive of Travel, Boarding & Lodging and local conveyance during the visit. BHEL may decide to place order for additional number of days & visits (refer actual no of days / number of visits in Price Schedule / RFQ).

7 **TRAINING (If specified in RFQ):**

- a The training shall include configuration, operation and maintenance of the ITCCS and ODS package. 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 Training of 5 engineers for 5 days excluding travel time at site and one visit inclusive of Travel, Boarding, Lodging and local conveyance shall be considered.

8 **LOGISTIC SUPPORT**

- a Vendor shall ensure and provide the following information/ details along with the offer.
- Local service facilities in India is available or not from the vendor?
 - If not available, where the vendors approved service facility presently located nearest to India.
 - Instruments / System shall be user serviceable.
 - User reference list
 - 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)

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 6 of 12

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

9 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 as per clause no 10 is included in the technical offer.		
v.	Offer for extended warranty included.		
vi.	Offer for PWAMC included.		
vii.	UNIT prices for all items included.		

(Signature and stamp of bidder with date)

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 7 of 12

10 PRICE SCHEDULE-DHDT:

Enquiry ref no.

Date:

Offer ref no.

Date:

A: Material Supply:

Sl No	Matl Desc	Matl Code	PR No	PR Qty	Unit Price	Total Price
1	PROX SENSOR 5MM,STD MNT,110MM LEN,M8X1	TC9765185162	7000088520	2		
2	PROX SENSOR 5MM,STD MNT,110MM LEN,M8X1	TC9765185162	7000088526	1		
3	PROX SENSOR 5MM,STD MNT,110MM LEN,M8X1	TC9765185162	8000093747	2		
4	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	7000088521	2		
5	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	7000088527	2		
6	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000093730	6		
7	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000093740	6		
8	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000093748	6		
9	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	7000088528	2		
10	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000093731	6		
11	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000093741	6		
12	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000093749	8		
13	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	7000088529	2		
14	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000093732	6		
15	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000093742	6		
16	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000093750	8		
17	FLEXIBLE CONDUIT 3/4",30MTS	TC9765342101	8000093734	3		
18	TRANSDUCER CALIBRATION KIT	TC9765342128	7000088525	1		
19	RACK POWER SUPPLY, 110VAC, DUPLEX	TC9765342136	7000088530	1		
20	RACK TRANS DATA INTERFAC MODULE,ETHNET	TC9765342144	7000088531	1		
21	KEYPHASOR & TACHOMETER MODULE	TC9765342152	7000088532	1		
22	PROXIMITY SENSOR MODULE	TC9765342160	7000088533	1		
23	TEMPERATURE MODULE	TC9765342179	7000088534	1		
24	PROGRAMMABLE RELAY MODULE	TC9765342187	7000088535	1		
25	COMMUNICATION GATEWAY	TC9765342195	7000088536	1		
26	RACK CONFIGURATION LAPTOP	TC9765342209	7000088523	1		
27	RACK CONFIGURATION SOFTWARE	TC9765342217	7000088524	1		
28	TSI RACK-1 as per TC65342-49-50	TC9765342497	8000093738	1		
29	TSI RACK-2 as per TC65342-49-50	TC9765342500	8000093739	1		

B: COMMISSIONING & TRAINING SERVICES:

Sl No	Service Description	PR No	Price
30	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	1600020940	
31	TSI COMMISSIONING: Commissioning Assistance for 5 working days at site and two visits. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	1600020941	
32	TSI TRAINING: Training for 5 days at site and one visit. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	1600020942	
33	Per-diem Rates for pre-commissioning and Commissioning Assistance at site. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	Optional price required	
34	Per-diem Rates for Training. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	Optional price required	

C: EXTENDED WARRANTY: **OPTIONAL**

Sl No	Service Description	PR No	Price
1	TSI EXTENDED WARRANTY: Extended warranty for 2 years after expiry of standard warranty (defect liability period)	1600020943	

REF-DOC
TC65342-49-50-
65-R03

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of BHEL. It shall not be used directly or indirectly in any way detrimental to the interest of the company.

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 8 of 12

D: Post Warranty Comprehensive Annual Maintenance Contract (TSI PWCAMC): **OPTIONAL**

SI No	Service Description	PR No	Price
1	First year after expiry of extended warranty	1600020944	
2	Second year after expiry of extended warranty		
3	Third year after expiry of extended warranty		
	Total Price for 3-year PWCAMC		

i. Total Price in WORDS:

Notes:

- Vendor shall indicate unit price of all items of Price Schedule irrespective of RFQ Qty.
- 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.
- Extended Warranty (item-C) & PWCAMC (item-D) is yet to be ordered by Customer. In case these are ordered by Customer, the same shall be required and considered for L1 evaluation. BHEL will inform this before commercial bid opening.

VENDOR SEAL & SIGNATURE

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 9 of 12

11 PRICE SCHEDULE-VGO:

Enquiry ref no.

Date:

Offer ref no.

Date:

A: **Material Supply:**

Sr No	Matl Desc	Matl Code	PR No	PR Qty	Unit Price	Total Price
1	PROX SENSOR 5MM,STD MNT,110MM LEN,M8X1	TC9765185162	8000094159	3		
2	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000094126	6		
3	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000094201	2		
4	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000094069	6		
5	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	7000088920	2		
6	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	7000088868	1		
7	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000094125	8		
8	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000094068	6		
9	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	7000088869	1		
10	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000094124	8		
11	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000094067	6		
12	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	7000088930	1		
13	FLEXIBLE CONDUIT 3/4",30MTS	TC9765342101	8000094065	3		
14	TRANSDUCER CALIBRATION KIT	TC9765342128	7000088917	1		
15	RACK POWER SUPPLY, 110VAC, DUPLEX	TC9765342136	7000088931	1		
16	RACK TRANS DATA INTERFAC MODULE,ETHNET	TC9765342144	7000088932	1		
17	KEYPHASOR & TACHOMETER MODULE	TC9765342152	7000088933	1		
18	PROXIMITY SENSOR MODULE	TC9765342160	7000088934	1		
19	TEMPERATURE MODULE	TC9765342179	7000088935	1		
20	PROGRAMMABLE RELAY MODULE	TC9765342187	7000088936	1		
21	COMMUNICATION GATEWAY	TC9765342195	7000088937	1		
22	RACK CONFIGURATION LAPTOP	TC9765342209	7000088918	1		
23	RACK CONFIGURATION SOFTWARE	TC9765342217	7000088919	1		
24	PROX SENSOR,STD MNT,1.6" LEN,3/8-24UNF	TC9765342292	8000094123	2		
25	PROX SENSOR,STD MNT,1.6" LEN,3/8-24UNF	TC9765342292	8000094158	2		
26	PROX SENSOR,STD MNT,1.6" LEN,3/8-24UNF	TC9765342292	7000088921	2		
27	PROX SENSOR,STD MNT,1.6" LEN,3/8-24UNF	TC9765342292	7000088938	1		
28	TSI RACK AS PER TC65342-65	TC9765342659	8000094094	1		
29	PROX SENSOR,STD MNT,150MM LEN,M8X1	TC9765342985	8000094200	2		

B: **COMMISSIONING & TRAINING SERVICES:**

Sl No	Service Description	PR No	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	1600021166	
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	1600021167	
3	TSI TRAINING: Training for 5 days at site and one visit. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	1600021168	
4	Per-diem Rates for pre-commissioning and Commissioning Assistance at site. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	Optional price required	
5	Per-diem Rates for Training. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	Optional price required	

C: **EXTENDED WARRANTY: OPTIONAL**

Sl No	Service Description	PR No	Price
1	TSI EXTENDED WARRANTY: Extended warranty for 2 years after expiry of standard	1600021169	

REF-DOC
TC65342-49-50-
65-R03

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of BHEL. It shall not be used directly or indirectly in any way detrimental to the interest of the company.

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 10 of 12

	warranty (defect liability period)		
--	------------------------------------	--	--

D: Post Warranty Comprehensive Annual Maintenance Contract (TSI PWCAMC): OPTIONAL

Sl No	Service Description	PR No	Price
1	First year after expiry of extended warranty	1600021190	
2	Second year after expiry of extended warranty		
3	Third year after expiry of extended warranty		
	Total Price for 3-year PWCAMC		

ii. Total Price in WORDS:

Notes:

- d Vendor shall indicate unit price of all items of Price Schedule irrespective of RFQ Qty.
- e 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.
- f Extended Warranty (item-C) & PWCAMC (item-D) is yet to be ordered by Customer. In case these are ordered by Customer, the same shall be required and considered for L1 evaluation. BHEL will inform this before commercial bid opening.

VENDOR SEAL & SIGNATURE

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 11 of 12

12 PRICE SCHEDULE-DCU:

Enquiry ref no.

Date:

Offer ref no.

Date:

A: **Material Supply:**

Sl No	Matl Desc	Matl Code	PR No	PR Qty	Unit Price	Total Price
1	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	7000088923	2		
2	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	7000088941	1		
3	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000094100	12		
4	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000094109	6		
5	PROX SENSOR,REV MNT,1.2" LEN,3/8-24UNF	TC9765342012	8000094112	4		
6	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	7000088942	1		
7	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000094099	12		
8	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000094108	4		
9	PROXIMITY PROBE EXTENSION CABLE, 4MTS	TC9765342039	8000094110	6		
10	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	7000088943	1		
11	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000094098	12		
12	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000094107	4		
13	PROXIMITY PROBE DRIVER FOR 5MTS SYSTEM	TC9765342047	8000094111	6		
14	CASING ACCELERATION SENSOR, M8X1	TC9765342055	7000088944	1		
15	CASING ACCELERATION SENSOR, M8X1	TC9765342055	8000094097	2		
16	ACCEL SENSOR CABLE 5MTS WITH CONNECTOR	TC9765342063	7000088945	1		
17	ACCEL SENSOR CABLE 5MTS WITH CONNECTOR	TC9765342063	8000094096	2		
18	FLEXIBLE CONDUIT 3/4",30MTS	TC9765342101	8000094105	4		
19	RACK POWER SUPPLY, 110VAC, DUPLEX	TC9765342136	7000088946	1		
20	RACK TRANS DATA INTERFAC MODULE,ETHNET	TC9765342144	7000088947	1		
21	KEYPHASOR & TACHOMETER MODULE	TC9765342152	7000088948	1		
22	PROXIMITY SENSOR MODULE	TC9765342160	7000088949	1		
23	TEMPERATURE MODULE	TC9765342179	7000088950	1		
24	PROGRAMMABLE RELAY MODULE	TC9765342187	7000088951	1		
25	COMMUNICATION GATEWAY	TC9765342195	7000088952	1		
26	RACK CONFIGURATION LAPTOP	TC9765342209	7000088925	1		
27	RACK CONFIGURATION SOFTWARE	TC9765342217	7000088926	1		
28	TSI RACK-1 as per TC65342-49-50	TC9765342497	8000094114	1		
29	TSI RACK-2 as per TC65342-49-50	TC9765342500	8000094113	1		

B: **COMMISSIONING & TRAINING SERVICES:**

Sl No	Service Description	PR No	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	1600021193	
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	1600021194	
3	TSI TRAINING: Training for 5 days at site and one visit. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	1600021195	
4	Per-diem Rates for pre-commissioning and Commissioning Assistance at site. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	Optional price required	
5	Per-diem Rates for Training. Price shall be inclusive of Travel, boarding, lodging, and local conveyance	Optional price required	

C: **EXTENDED WARRANTY: OPTIONAL**

Sl No	Service Description	PR No	Price
1	TSI EXTENDED WARRANTY: Extended warranty for 2 years after expiry of standard warranty (defect liability period)	1600021196	

REF-DOC

TC65342-49-50-65-R03

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of BHEL. It shall not be used directly or indirectly in any way detrimental to the interest of the company.

PROJECT SPECIFIC REQUIREMENTS TSI SYSTEM

TC 65342-49-50-65

Rev. No: 03

Page 12 of 12

D: Post Warranty Comprehensive Annual Maintenance Contract (TSI PWCAMC): **OPTIONAL**

SI No	Service Description	PR No	Price
1	First year after expiry of extended warranty	1600021197	
2	Second year after expiry of extended warranty		
3	Third year after expiry of extended warranty		
	Total Price for 3-year PWCAMC		

iii. Total Price in WORDS:

Notes:

- g Vendor shall indicate unit price of all items of Price Schedule irrespective of RFQ Qty.
- h 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.
- i Extended Warranty (item-C) & PWCAMC (item-D) is yet to be ordered by Customer. In case these are ordered by Customer, the same shall be required and considered for L1 evaluation. BHEL will inform this before commercial bid opening.

VENDOR SEAL & SIGNATURE

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 1 of 16

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.

FORMAT	PREPARED:	APPROVED:	DATE:	REV:
TD-201 REV-00	RAM	PSVS	03.11.2015	00
REF-DOC	COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.			

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.

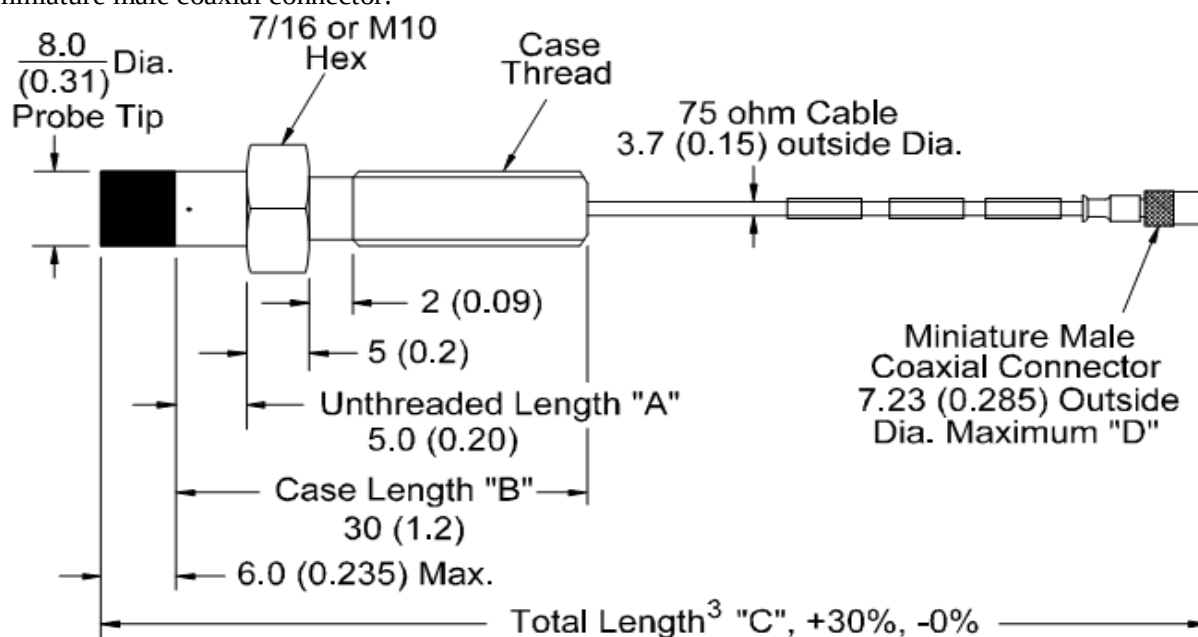


FIG: 3-a: 8 MM REVERSE MOUNT PROBE

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.

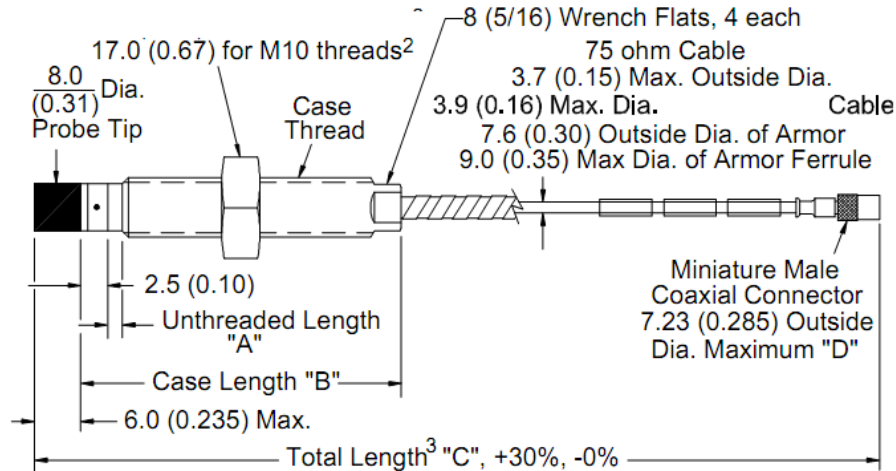


FIG: 3-b: 8 MM STANDARD MOUNT PROBE

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 proximator / driver.

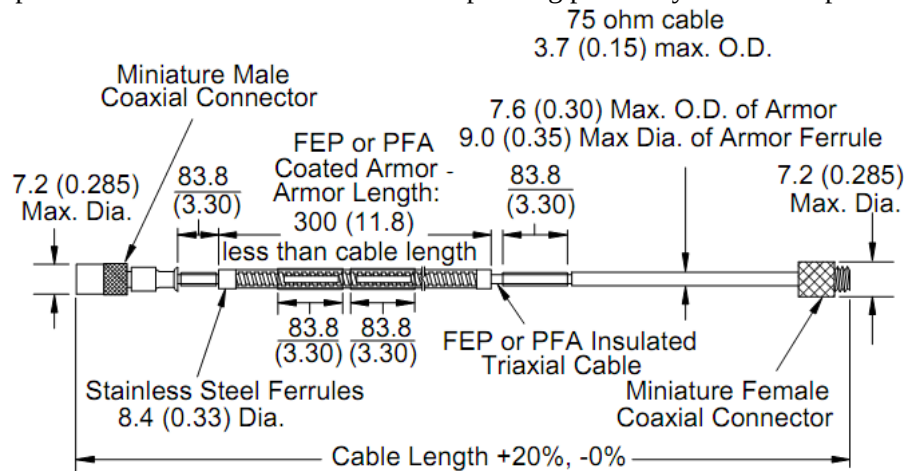


FIG: 3-c: Extension Cable

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 4 of 16

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

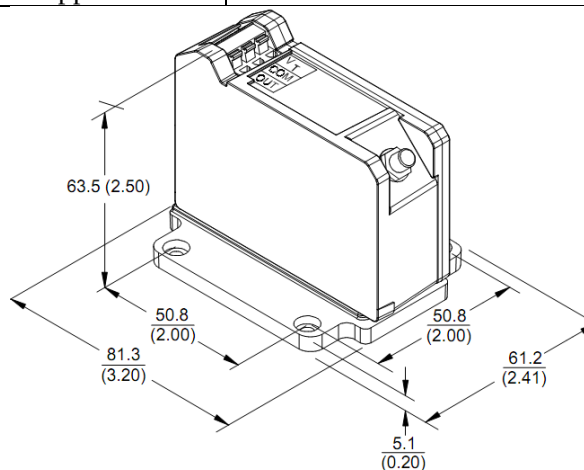


FIG: 3-d: Proximitor driver

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/s ² (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/ s ² (50 g) peak
vii.	Sensitivity	10.2 mV/m/s ² (100 mV/g) ±5% at 100 Hz

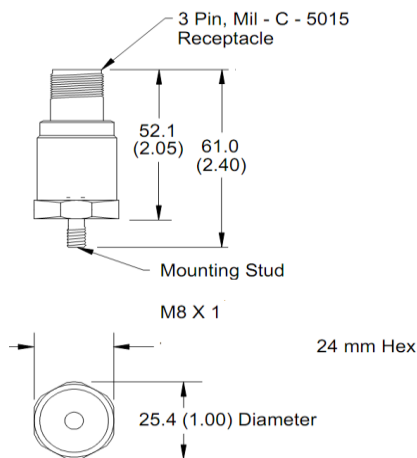


FIG: 3-e: Acceleration Probe

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 $\frac{3}{4}$ " NPTM. The cable seal shall be supplied with 01 hole full drilled and remaining 03 nos half drilled.

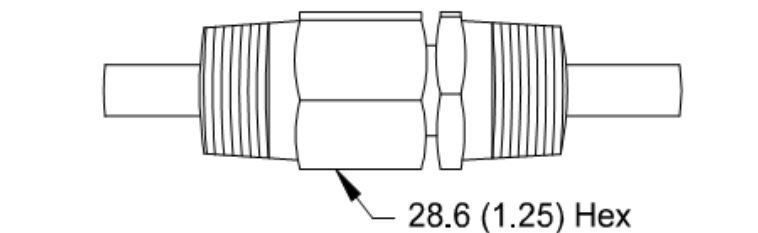


FIG: 4-c: Low Pressure Cable Seal

d **Flexible conduit:**

Flexible conduit ($\frac{3}{4}$ ", 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.

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 6 of 16

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 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 110VAC) 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

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 7 of 16

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. [Incuse 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

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 8 of 16

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

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 9 of 16

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 daisy chaining 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

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 10 of 16

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: Two copies of following
 - 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.

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 11 of 16

- 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: Refer additional Project specific requirements.

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.

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 12 of 16

- 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:

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 13 of 16

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~~

REF-DOC
TC65342-R04

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 14 of 16

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)

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 15 of 16

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, 110VAC, 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 3/4 ")		TC9765342314

b Variant Table-2:

Var No	Material Description	Ref. Drawing	Material Code
51 to 99	TSI Rack & Spares as per TC65342-<Variant No.>	Project specific	TC9765342xxx

REF-DOC
TC65342-R04

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65342

Rev. No: 04

Page 16 of 16

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

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC 65185

Rev. No: 00

Page 1 of 2

1 SCOPE:

This specification is extension of TC65342. Refer TC65342 latest revision for all technical information.

2 VARIANT TABLE:

a Variant Table-1:

Var No	Material Description	Ref. Drawing	Material Code
1	RACK POW SUPPLY-VAC,DUPLX.G3(SHIN)		TC9765185014
2	RACK DATA INTERFAC MOD,ETHNET.G3(SHIN)		TC9765185022
3	KEYPHASOR & TACHOMETER MODULE.G3(SHIN)		TC9765185030
4	PROXIMITY SENSOR MODULE.G3(SHIN)		TC9765185049
5	TEMPERATURE MODULE.G3(SHIN)		TC9765185057
6	PROGRAMMABLE RELAY MODULE.G3(SHIN)		TC9765185065
7	COMMUNICATION GATEWAY.G3(SHIN)		TC9765185073
8	TRANSDUCR CALIB KIT(SHIN)		TC9765185081
9	RACK POWER SUPPLY-VAC DUPLX(SHIN)		TC9765185090
10	RACK DATA INTERFAC MOD,ETHNET(SHIN)		TC9765185103
11	KEYPHASOR & TACHOMETER MODULE(SHIN)		TC9765185111
12	PROXIMITY SENSOR MODULE(SHIN)		TC9765185120
13	TEMPERATURE MODULE(SHIN)		TC9765185138
14	PROGRAMMABLE RELAY MODULE(SHIN)		TC9765185146
15	COMMUNICATION GATEWAY(SHIN)		TC9765185154
16	PROX SENSOR 5MM,STD MNT,110MM LEN,M8X1	TC65342, 3.b	TC9765185162
17	PROX SENSOR 5MM,STD MNT,80MM LEN,M8X1	TC65342, 3.b	TC9765185170
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			
35			

.

FORMAT	PREPARED:	APPROVED:	DATE:	REV:
TD-201 REV-00	RAM	PSVS	17.11.2018	00
REF-DOC TC65185-R00	COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.			

SPECIFICATION OF TURBO SUPERVISORY INSTRUMENTATION (TSI) SYSTEM

TC

Rev. No:

Page 2 of 2

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
00	17.11.18	ISSUE	-----	PSVS