


YERAMARUS STPS
2 X 800 MW
OF
RAICHUR POWER CORPORATION LIMITED

TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM

SPECIFICATION NO.: - PE-TS-362-555-A001



BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BUILDING, NOIDA (U.P.)
INDIA

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VOLUME – II B
SECTION – A
INTENT OF SPECIFICATION



COMPRESSED AIR SYSTEM SCOPE OF ENQUIRY

DOCUMENT NO.: PE-TS-362-555-A001

VOLUME- IIB

SECTION-A

REV. 0

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1.0 SCOPE

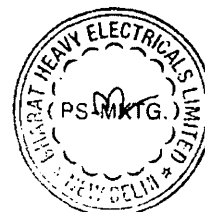
This specification covers the design, manufacturing, inspection and testing at manufacturer's work, proper packing, delivery to site, and erection and commissioning, final painting & carrying out acceptance tests at site for COMPRESSED AIR SYSTEM as mentioned in the different section of this specification for 2 X 800 MW RAICHUR POWER CORPORATION LTD., YERAMARUS STPS.

2.0 GENERAL TECHNICAL INSTRUCTIONS

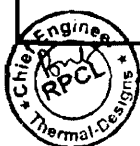
- 2.1 This volume covers requirements of design, engineering, manufacturing and delivery to site, supervision of erection and commissioning of the complete plant. It is not the intent to specify completely all details of design and construction. However, all the equipment shall conform, in all respect, to high standard of engineering, design and workmanship and be capable of performing the required duties in a manner acceptable to the owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 2.2 In case of any Technical deviation, the Bidder shall indicate the same clause by clause in the enclosed schedules. In the absence of duly filled schedules, it will be construed that the bid conforms strictly to the specification.
- 2.3 The bidder may offer optionally the standard design of equipment indicating the deviations from the specification. However, feedback reports must be furnished of equipment performance. The acceptance of optional equipment shall not be binding on Purchaser.
- 2.4 In case of conflict between the customer requirement & BHEL requirement, stringent of the two conditions shall prevail.

VOLUME – II B
SECTION – B
PROJECT INFORMATION

	RAICHUR POWER CORPORATION LIMITED YERAMARUS TPS - 2x800 MW	SECTION: B VOLUME-II
	PROJECT INFORMATION	Page 1 of 3
1.0 Owner	: Raichur Power Corporation Ltd 22/23, Sudarshan Complex, IInd floor, Sheshadri Road, Bangalore-560 009 Karnataka, India	
2.0 Consultant	: M/s Evonik Energy Services (I) Private Limited,A-29, Sector 16 Noida-201301(UP), India	
3.0 Project Title	: 2x800 MW Yeramarus Thermal Power Station	
4.0 Location	: Yermarus , Raichur Dist Karnataka State, INDIA It is situated at about 8 Kms from Raichur on the Raichur-Hyderabad State Highway- 13 and 12 kms away from Bank of river Krishna and about 5 kms from Raichur Thermal Power Station	
5.0 Nearest Railway	: Chicksugur Railway Station which is about 2 kms from site.	
6.0 Nearest Airport	: Hyderabad around 200 kms	
7.0 Nearest Port	Chennai around at about 470 kms from site.	
8.0 Latitude and Longitude	: Latitude – 16° 16' 55.9"N Longitude – 77° 20' 38.6"E	
9.0 Elevation above mean sea level	: 350-375 meters	
10.0 Climatic Conditions		
(a) Ambient Temperature		
i. maximum temperature	: 45° C	
ii. minimum temperature	: 6° C	
iii Design Temperature for all Elec/ Mech Equipment	: 50° C Ambient	
(b) Relative Humidity		
i. Maximum during monsoon	: 85%	
ii. Minimum	: 20%	



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RAICHUR POWER CORPORATION LIMITED
YERAMARUS TPS - 2x800 MW

SECTION: B
VOLUME-II

PROJECT INFORMATION

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- iii. Average : 65%
- (c) Rainfall
Annual average rain : 720 mm
Max. for one day : 115 mm
Max. intensity : 38 mm/hr
Period : June to September
- (d) Wind Speed
i. Prevailing wind direction : West, South-East, North-West, South-West
ii. Maximum mean wind speed : 15.9 Kms / hr (4.42 m/s)
iii. Average : 9.61 Km/hr (2.67 m/s)

11.0 Wind Load

Calculations for wind effect shall be in accordance with IS:875- (Part-3) latest revision taking into account the following :

- (a) Basic wind speed of 39 m/sec as given in Fig.1 of the code.
(b) Factor K1 shall be taken as 1.06
(c) Terrain category shall be 2 and corresponding values shall be taken for K2
(d) Factor K3 shall be taken as 1.0

12.0 Wind Loading for Stack

- (a) For wind pressure as per clause 11.0 above
(b) For RC stacks as per IS: 4998

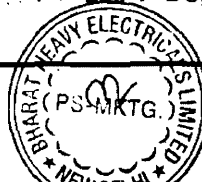
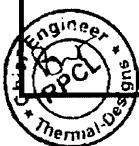
13.0 Seismic data (as per IS:1893 latest issue)


- (a) Zone : Zone III (as per IS:1893- latest)
(b) Importance factor (I) : 1.75

14.0 Auxiliary power supply


Auxiliary electrical equipment to be supplied against this specification shall be suitable for operation on the following supply system.

- (a) For motors rated above 1500 kW : 11000V, 3 phase, 3 wire, 50Hz medium earthed AC
(b) For motors rated 175KW and above and below 1499KW. : 3300V, 3 phase, 3 wire, 50Hz medium earthed AC
(c) For motor rated 174 kW and below : 415, 3 phase, 3 wire solidly earthed AC
(d) For motor control centre : 415V, 3 phase, 3 wire solidly earthed AC
(e) DC. motor starters, DC solenoids, DC alarm, control and protections : 220 V DC, 2 wire, unearthed DC




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(f)	AC control & protective devices	:	110 V 1 phase, 50Hz, 2 wire AC supply. The single-phase 110V AC supply shall be derived by Contractor by providing 415V/110V control transformers of adequate rating with MCCB /MCB on both the primary and secondary sides.
(g)	Uninterrupted power supply	:	240 V, 1 phase, 50Hz, 2 wire AC supply from UPS system for I&C (including indicator recorders) and UCMS only
(h)	AC solenoids, indicators/recorders, space heaters (for motors rated 30KW and above)	:	240V 1 phase, 2 wire, 50Hz AC system with effectively earthed neutral. The power supply shall be derived by CONTRACTOR by providing 415V/240V transformer of adequate rating with MCCB/MCB on primary/secondary sides.
(i)	Winding heating of motors below 30kW	:	24 V 1 phase, 50Hz, AC with one point earthed. This shall be derived by CONTRACTOR by providing 415V 3 phase, 3 wire, AC supply through an adequately rated step-down transformer of adequate rating with MCCB / MCB on primary/secondary sides.
(j)	Solid state controls (including solenoid valves)	:	24 V DC, 2 wire, supply from Battery chargers for instrumentation system only.
(k)	Lighting fixtures	:	240 V, 1 phase, 2 wire, 50Hz system.
(l)	Lighting fixtures and space heaters in panels	:	240 V, 1 phase, 2 wire, 50Hz system.
(m)	Construction supply	:	415 V, 3 phase, 4 wire, 50 Hz AC supply with neutral lead solidly earthed.
(n)	The above voltages may vary as follows : All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without any change in their performance.		
i.	AC supply	:	Voltage variation $\pm 10\%$ Frequency variation $\pm 5\%$ Combined voltage & frequency variation $\pm 10\%$
ii.	DC supply	:	Voltage variation +10% - 20%



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VOLUME – II B
SECTION - C

VOLUME – II B
SECTION – C.1
SPECIFIC TECHNICAL REQUIREMENTS
MECHANICAL

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1.	GENERAL DESCRIPTION
	The compressed air system is comprised of the instrument air system and the plant air system. Instrument air is required for the various pneumatically operated valves and instruments in the power plant, while plant air is required for general plant services.
2.	GENERAL DESCRIPTION
	The compressed air system is comprised of the instrument air system and the service air system. Instrument air is required for the various pneumatically operated valves and instruments in the power plant, while service air is required for general plant services.
3.	DESIGN CRITERIA
3.1	SYSTEM DESIGN CRITERIA
	Compressed air system includes the following:
3.1.1	Six (6) nos. (4 working + 2 standby) Instrument air compressors i.e. 3x50% capacity for each unit and three (3) nos. (2 working + 1 standby) Service air compressor, including drives, intercoolers, after coolers, step up gearbox, silencer and other accessories.
3.1.2	Six (6) nos. (4 working + 2 standby) air-drying plants (ADP) each suitable for connecting to individual instrument air compressor.
3.1.3	Intake air filters.
3.1.4	Twelve (12) nos. air receivers as follows:
3.1.4.1	Nine (09) nos. air receive of 10 M3 capacity, i.e., one no. for each compressor near compressor house.
3.1.4.2	Two (02) nos. unit air receiver of 10 M3 capacity (instrument air) at 'BC' bay.
3.1.4.3	One (01) no air receiver of capacity 2 M3 for DM plant.
3.1.5	Heat of Compression (HOC) i.e. Rotary Drum type or Conventional Twin tower type.
3.1.6	All interconnecting piping, valves, fittings, supports/hangers, control air tubing (complete with valves and fittings between air receiver, compressor and local panel for each compressor), cooling water piping & valves for safe and satisfactory operation of air compressors.
3.1.7	Controls & interlocks.
3.1.8	All instruments including the electronic on line dew point meter with suitable sampling connection and isolation valve at the common outlet of the Air Drying Plants.
3.1.9	EOT Crane of 8T capacity (Electrically operated pendent controlled, overhead travelling type).
3.2	EQUIPMENT DESIGN CRITERIA
3.2.1	AIR COMPRESSORS
3.2.1.1.	The capacity of Instrument air compressor shall be 30 NM ³ /min. Delivery pressure will be 8.5 Kg/cm ² (g) at outlet of IA compressor & 8.0 kg/ cm ² (g) at ADP outlet. Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.
3.2.1.2.	The capacity of Service air compressor shall be 30 NM ³ /Min. Delivery pressure will be 8.5 Kg/cm ² (g) at outlet of SA compressor.
3.2.1.3.	Air compressors will be multi stage oil free, screw type.
3.2.1.4.	The compressors' capacity will be designed for 42.5 ⁰ C DBT and 75% RH at atmospheric pressure at site & at MSL of 350 - 375 m.
3.2.1.5.	Testing of compressor will be as per ISO: 1217.
3.2.1.6.	Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.
3.2.1.7.	The continuous motor rating (at 50 ⁰ C ambient) will be at least ten percent (10%) above the maximum load demand of the driven equipment under the entire operating range. When the driver


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is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.

3.2.1.8. Satisfactory operation in parallel will be ensured without any uneven load sharing, undue vibration, noise etc.

3.2.1.9. Noise level shall not exceed 85 dBA plus tolerances as per IS standard to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor. Required acoustic enclosures may be provided to meet the above condition. The discharge blow off silencer and intake silencers shall be designed to meet the above noise limitation level.

3.2.1.10. Compressed air velocity shall be 15 m/sec.

3.2.1.11. All the equipments shall be protected against external corrosion by providing suitable painting. The steel surfaces to be supplied with painting shall be thoroughly cleaned before applying painting by brushing, shot blasting etc. Galvanised surfaces shall not be applied with any painting.

3.2.1.12. Arrangement of motor and compressor shall be such that motor trial run can be taken in de-coupled condition.

3.2.1.13. Interconnections will be made from service air to instrument air system, upstream of air driers.

3.2.1.14. Each compressor shall be suitable for single compressor operation or parallel operation with other compressors. Further, the compressor would run either on loaded or unloaded condition depending upon the compressed air requirement without any unstability in performance.

3.2.1.15. The compressor sizing is selected duly considering, requirement of consumption points, margin for wear & tear losses (5%) & margin for leakages (10%), margin for contingency demand (10%). Pl. refer sizing calculation attached.

3.2.2 ROTORS

3.2.2.1. Rotors will be one-piece construction with a suitable forged carbon steel or stainless steel coated with corrosion resistant material to minimise leakage and wear.

3.2.2.2. The rotors will have an asymmetric profile, so as to keep leakage losses to a minimum and ensure high efficiency.

3.2.2.3. Highly precise timing gears will be mounted on the rotor shafts to maintain the rotors in correct relative position.

3.2.2.4. These gears will be designed to counteract the axial forces incurred in compression.

3.2.2.5. Rotors shall be dynamically balanced.

3.2.3 AIR DRYING PLANT

3.2.3.1. Air-drying plant shall be of heat of compression desiccant type (conventional or rotary drum type), drying by adsorption process through a desiccant medium.

3.2.3.2. Quality of outlet air from ADP shall be in accordance to ISO 8573-1 as follows.

a) Dew point at outlet of the air drying plant will be minus (-) 40° C at atmospheric pressure.

b) Dust particle size in instrument air shall be less than One (1) micron & max, particle conc. limited to 1mg/m3.

c) Oil content of Instrument air shall be less than 0.10 mg/m3.


3.2.3.3. Desiccant shall be silica gel / activated alumina as per manufacturer's standard.

3.2.3.4. Material of Construction (MOC) of rotary drum type HOC dryer shall be as per reputed manufacturer standard.

3.2.3.5. The pre-filters shall remove dust, water, and oil drops and shall protect the air dryers. Pre-filters shall be of the coalescing type.

3.2.3.6. The after-filters shall be dry type and shall remove particulates in the range of 1 to 5 microns.

Note: The requirement of pre-filter & after filter is applicable to conventional twin tower type of HOC dryer. Same is not applicable for Rotary drum type HOC dryer.

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3.2.4

INTER COOLER, AFTER COOLER & OIL COOLERS

3.2.4.1.

Inter cooler, after cooler & oil cooler shall be of water cooled with shell & tube type with water on the tube side. Inter cooler & after cooler shall be designed in accordance with sec. VIII, Div 1 of ASME code or equivalent.

3.2.4.2.

The coolers shall be designed for the max. heat load & at least 10 % design margin shall be provided in the tubes.

3.2.4.3.

Adequately sized safety valve shall be provided for both inter cooler & after cooler as per manufacturer practice.

3.2.4.4.

Each intercooler & after cooler shall be provided with moisture separator unit with suitable baffling. Electrically operated automatic drain trap station with bypass valve & isolation valves shall be provided for moisture separator for automatic draining of condensed moisture. Manual draining facility shall also be provided.

3.2.5

INTAKE FILTER

3.2.5.1

Heavy duty dry type suction air filters will be provided at the compressor inlet to prevent dust and dirt from entering the cylinders.

3.2.5.2

The filtering efficiency shall not be less than 99% for particles 3 micron & higher. Sound suppressing characteristics will be considered in the filter design.

3.2.6

AIR RECEIVER

3.2.6.1.

The capacity of each air receiver shall be 10 M³ (nominal) & 2 M³ (nominal) as per requirement (refer Cl. 3.1.4).

3.2.6.2.

The air receivers will be vertical self-supporting cylindrical vessels with supporting legs for resting on their foundation.

3.2.6.3.

Design Pressure for the air receiver shall be 12 kg/cm² (g) and 50degC respectively.

3.2.6.4.

The material of construction of shell, dished ends, flanges etc of the air receivers shall be of carbon steel as per IS: 2002 or equivalent.

3.2.6.5.

Air receiver shall be provided with nozzles, air release vents, safety valve, pressure gauge, temperature gauge, minimum 500 mm dia. manhole for inspection.

3.2.7

PIPING & VALVES (WITHIN COMPRESSOR HOUSE)

3.2.7.1.

All interconnecting compressed air piping shall conform to IS 1239 heavy galvanised/IS 3589 Gr 410 galvanised to IS- 4736 or equivalent. The fitting shall either be same as the parent material or malleable iron to IS-1879(galvanised). Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60 deg. C. The pipe joints will be screwed coupling type for sizes up to 50 NB and above 50 NB the same will be flanged.

3.2.7.2.

All the distribution valves shall be ball valve type. Necessary auto drain shall also be provided at strategic points.

3.2.7.3.

Water Piping shall be IS-2062 Gr. B/IS-3589 Gr.410/ IS-1239 Heavy.

3.2.7.4.

All Airlines shall be screwed connection and rubber lined pipes of flanged connection.

3.2.7.5.

VALVES

a)

Compressed Air Services:

♦

All airline valves shall be ball valve type. For compressed air application, valve material shall be galvanized cast carbon steel as mentioned below:

SIZE	BODY BONNET	DISC	STEM	HAND WHEEL	VALVE ENDS
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≥ 65 NB	ASTM A 216 Gr. WCB	ASTM A 216 Gr WCB	ASTM A479 Type 410-2	ASTM A47 Gr. 32510	FLANGED RAISED FACE
≤ 50 NB	ASTM A 105	13% Cr Steel (Ball)	ASTMA479 Type 410-2	ASTM A47 Gr. 32510	SCREWED TYPE

b) Water Service:

Cast iron valves with GM internals as per IS-780/equivalent and other applicable standards above 50 mm size. Gunmetal valves as per IS-778/equivalent up to size 50mm.

c) Auto drain trap for each air receiver shall be provided.

d) Moisture traps at strategic locations shall be provided in the distribution network.

4. LAYOUT CONSIDERATIONS

4.1.1 Air compressors will be located indoor in a separate compressor room and EOT crane arrangement will be provided so that the heaviest component can be handled during maintenance.

4.1.2 The air receivers will be located outdoors adjacent to the compressor room. Other receiver necessary maintenance access will be provided in the layout.

4.1.3 Complete ADP equipment shall be preferably mounted on a skid and located indoor.

5. OPERATION, CONTROL & INSTRUMENTATION

5.1.1 The necessary instrumentation and control has been provided for safe and trouble free operation of compressed air system.

5.1.2 Individual compressor control shall be through microprocessor based control system as per manufacturer's standard and overall control of compressed air system shall be through BOP C&I part of DDCMIS.

5.1.3 Depending upon operational requirement each compressor can be selected and operated in following mode

5.1.3.1. Local Mode: Individual compressor is operated from Local Integral Control System.

5.1.3.2. Remote Mode: Individual compressor is operated through DDCMIS OWS.

5.1.4 Group Control is envisaged to clock more or less equal number of running hours for each Instrument Air Compressor. Due to this feature in case of increase in air demand, the Unit which had clocked least no. of running hours shall be started and loaded. Similarly when the air demand goes down, the Unit which had clocked most no. of running hours shall be unloaded and stopped.

5.1.5 All the process inputs (digital or analog), other than specific to compressors are taken directly to DDCMIS.

5.1.6 The connectivity of Integral compressor control system with DDCMIS shall be provided through Hardwired / Soft link depending upon manufacturer's product standard.

Hardwired connectivity shall be provided for critical/Start/Stop signal for IA & SA compressor.

5.1.7 On tripping of the working compressor, the standby compressor shall come into operation automatically in case of very low pressure in the system.

5.1.8 Inter changeability of service air compressor to instrument air compressor in case of emergency shall be automatic. Refer enclosed P&ID for details.

5.1.9 The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system each compressor:-

- | | |
|---|--------------|
| (a) "Air temperature high" at inlet to last stage | Alarm & trip |
| (b) "Low lube oil pressure" | Alarm & trip |
| (c) "High Lube oil supply temperature" | Alarm & trip |
| (d) "High oil filter differential pressure" | Alarm |



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- (e) "Low lube oil level in lube oil sump" Alarm
- (f) "High inlet air filter differential pressure" Alarm & trip
- (g) "Low cooling water flow to air compressor" Alarm
- (h) "High HOC air drying plant differential pressure" - Alarm
- (i) "Low cooling water flow at return line of compressor" - Alarm
- (j) "Low cooling water inlet header pressure"-Alarm
- (k) "Low air pressure at discharge line of each compressor" - Alarm

Additional signals provided for monitoring purpose:

- (a) IA common header pressure - High/Low
- (b) SA common header pressure - High/Low

6. POWER SUPPLY ARRANGEMENT


- 6.1.1 The power supply (rated voltage, frequency, phase) of the equipments will be 3.3 KV, 415 V +/- 10%, 3ph, 50 Hz +5% to -5%. 10% combined variation of voltage and frequency.

7. REFERENCE DRAWINGS/DOCUMENTS

- 7.1.1 P & I Diagram for Compressed Air system (2 sheets –Alt-1 & -Alt-2)
- 7.1.2 Compressor operational philosophy - Annexure-II.

8. GENERAL

- 8.1.1 Compressed Air system shall be offered as turnkey basis meeting specification requirements.
- 8.1.2 Basis of design, all calculations, equipment selection criterion, layout drawings/schemes/G.A. drg. and documents like data sheet/Technical particulars etc. are subject to Customer & BHEL approval during detail engineering stage.
- 8.1.3 All drawings and documents shall be computer based.
- 8.1.4 All commissioning spares & consumables for trouble free operation shall be provided.
- 8.1.5 Bidder to clearly note that the instruments, valves etc as shown in the P&I Diagram is the bare minimum and any additional instruments/valves required to complete the system in line with Technical Specification shall be supplied by the bidder without any commercial implication.
- 8.1.6 Quality Plans attached are indicating minimum requirements for inspection and testing. Bidder shall note that quality plan is subject to Customer & BHEL approval during detail engineering Stage.
- 8.1.7 Grouting of foundation bolts etc. are in the scope of compressed air plant supplier.
- 8.1.8 The tools and plants required for erection of equipments shall be arranged by compressed air plant supplier.
- 8.1.9 Electrical scope for this package shall be as per electrical scope demarcation sheet enclosed elsewhere in the spec.
- 8.1.10 Special tools & tackles as required for regular maintenance shall be supplied by compressed air plant supplier.
- 8.1.11 Compressed air plant supplier to furnish drawings/documents as per the drgs. /documents distribution as per project requirement.
- 8.1.12 Performance test for compressors shall be carried out at shops only with type tested motor for the compressor. Dew point of ADP shall be demonstrated at site at specified capacity. All instruments required to conduct these test to be arranged by compressed air plant supplier.
- 8.1.13 Instrument for testing shall be calibrated by compressed air plant supplier before taking up testing.
- 8.1.14 For Control & Instrumentation portion, Compressed Air Plant supplier to follow Technical Specification for Control and Instrumentation along with this specification.

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8.1.15	Performance Guarantee & Acceptance Test procedure for Compressed Air System is enclosed in the Specification for reference.
8.1.16	Makes of equipments/items enclosed are for indicative purpose, some shall be subject to BHEL approval during detailed engineering stage.
9.	TERMINAL POINTS
9.1.1	Tapping point for cooling water line for Compressors shall be 10 m (approx.) from Compressor House.
10.	EXCLUSIONS
10.1.1	Items of works listed below are excluded from scope of the compressed air plant supplier.
10.1.2	Civil works including construction of compressor house, foundation of all compressor, air dryer and air receiver, pipe/cable trenches. However, minor civil works such as opening in wall, supports and inserts for pipes shall be by the Compressed air plant supplier.
10.1.3	Lighting and ventilation of compressor house.
10.1.4	Crane in the compressor house.
10.1.5	Compressed Air Distribution Piping running after the air receivers outside the compressor house (for further details refer P&ID).
10.1.6	Cooling water piping outside the compressor house. However, cooling water piping inside the compressor house is in compressed air plant supplier's scope.
10.1.7	HT panel / MCC.
11.	DRAWINGS & DOCUMENTS REQUIRED TO BE SUBMITTED BY THE BIDDER FOR TECHNICAL EVALUATION ALONG WITH THEIR TECHNICAL OFFER:
11.1.1	Scope of work along with system description, equipment being supplied including commissioning spares.
11.1.2	Bidder to furnish list of imported items with country of origin in a separate annexure along with their Technical Offer.
11.1.3	Bidder to clarify that there is no deviation from the tech specification as per format attached elsewhere in the Technical specification. If any deviation is there then same to be indicated separately under the heading as "DEVIATION SHEET (TECHANICAL)". Further, in case any deviation entails any price, then the same shall clearly be indicated. In case the amount is not mentioned in the schedule against any of the deviations mentioned in Deviation Sheet, it will be taken for granted that the same does not involve any change in the bid price.
11.1.4	Bidder shall also note that the deviation in any other form except above is not acceptable (i.e. in data sheet or other Annexure or elsewhere in the offer) and same shall not be considered for review/evaluation purpose/comment and it would be assumed that the system/material/equipment has been offered strictly in line with specification/requirements.
11.1.5	P&I Diagram of Compressed Air System along with control philosophy.
11.1.6	Space requirement / layout of compressor house.
12.	BIDDER TO NOTE THE FOLLOWING INFORMATION :
12.1.1	Bidders to indicate offered model in their offer and to submit backup document (e.g. performance test, etc.) matching FAD calculation along with the catalogue of the offered model to justify selection.
12.1.2	Compressor and air dryer shall be designed for cooling water (passivated DM water) with inlet temp of thermal 38 deg C & mechanical 50 deg C with terminal pressure 06 kg/sqcm(g) and rise in temp shall be limited to 10 deg C and pressure drop across Compressed Air System within terminal point shall be limited to 10 mwc. However, Compressors and dryers coolers shall be designed to withstand 12 kg/cm2 i.e., shutoff head of BHEL DM cooling water pumps.
12.1.3	Energy efficient LT motors as per Energy Efficient-1 as per IS 12615 (if applicable) shall be supplied.
12.1.4	Height of Air receivers shall be limited to 4M.

ANNEXURE -II

Operation of IA & SA Compressors

- **Normal IA Compressor & SA Compressor Operation:**

Initially all the Instrument Air compressors & Service Air compressors (i.e. Working + Standby Compressor) shall be started at a once (permissive checks shall be carried during initial start as per manufacturer practice). The pressure in the instrument air network starts building up. As, all the IA & SA compressors are under cascading mode i.e. the load - unload of the compressor shall be done automatically as per demand.

COMPRESSOR	COMPRESSOR LOADED (at set pressure) (bar)	COMPRESSOR UNLOADED (at set pressure) (bar)	REMARK
IA#1 & IA#4	7.2	7.5	In the example, IA#3, IA#6 & SA#3 has been considered as stand by compressor. As per actual requirement, provision shall be made available to select any of the compressor as standby compressor & the logic of operation (load-unload pressure setting) for working compressors to be modified accordingly. For this, change in the pressure settings of different compressors shall be done automatically without manual intervention. Note: Furnished values are indicative for general understanding only.
IA#2 & IA#5	7.0	7.3	
IA#3 & IA#6	6.7	7.1	
SA#1	7.2	7.5	
SA#2	7.0	7.3	
SA#3	6.7	7.1	

Note:

- 1.) Above operation shall be done through common Microprocessor based panel / PLC based panel as per manufacturer standard.

- **Interchangeability from SA TO IA automatically:**

As per P&ID Alternative-I:

Condition:- Working IA compressor break down & standby IA compressor unable to cope with IA network pressure.

As the IA compressor trips & the other IA compressors unable to meet the IA network pressure requirement. In such a case the Pressure Transmitters (QFB 12 CP 242) provided at the Instrument air intermediate header (downstream of air dryer) senses the IA header pressure & operate the pneumatic control valve provided as below:

Interchangeability for SA to IA	PNEUMATIC CONTROL VALVE - Open	PNEUMATIC CONTROL VALVE - Close	PT (QFB 12 CP 242) SET PRESSURE	REMARK
SA# 1 to IA# 1	PCV-1 & PCV -2	PCV -3	6.5	Note: Furnished values are indicative for general understanding only.
SA# 2 to IA# 3	PCV -4 & PCV -5	PCV -6	6.2	
SA# 3 to IA# 3	PCV -7 & PCV -8	PCV -9	5.9	

As per P&ID Alternative-II:

Condition:- Working IA compressor break down & standby IA compressor unable to cope with IA network pressure.

As the IA compressor trips & the other IA compressors unable to meet the IA network pressure requirement. In such a case the Pressure Transmitters provided at the Instrument air intermediate header (downstream of air dryer) senses the IA header pressure & operate the pneumatic control valve provided as below:

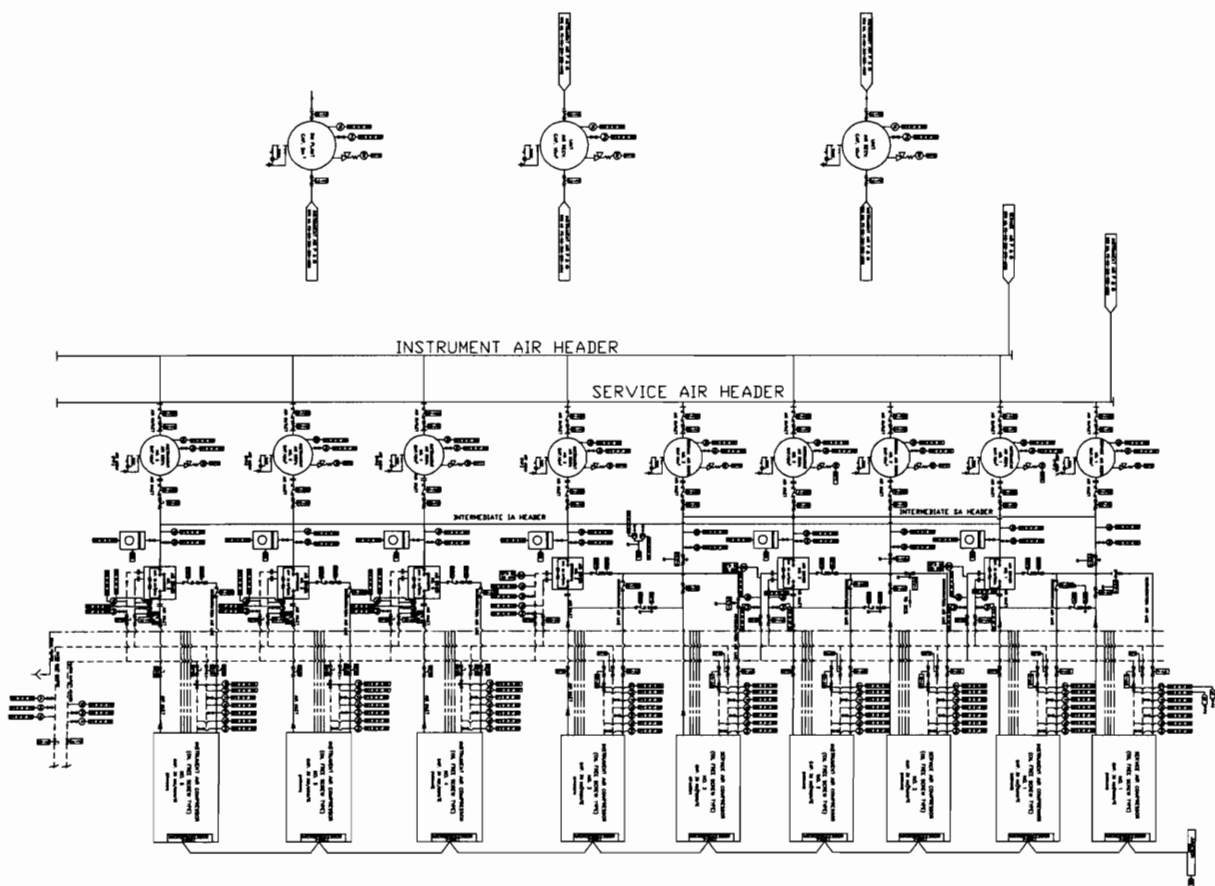
Interchangeability for SA to IA	PNEUMATIC CONTROL VALVE - Open	PT (QFB 12 CP 242) SET PRESSURE	REMARK
SA header to IA header before air dryer	PCV-1	6.5	Note: Furnished values are indicative for general understanding only.

Note:

1.) Interlocking arrangement for automatic interchangeability shall be through plant DCS. No separate local control panel (PLC / Relay based) envisaged for the same.

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FILE: C:\pccompress\pccompress\customer\2VCC\pccompress\alternative-1



LEGEND			
	BALL VALVE (OPEN)		TEMP. GAUGE
	BALL VALVE (CLOSED)		NON RETURN VALVE
	ISOLATION VALVE		WATER
	GLOBE VALVE (OPEN)		AIR
	GLOBE VALVE (CLOSED)		DRAIN
	RELIEF/SAFETY VALVE		Y TYPE FUNNEL
	PRESSURE GAUGE		FLOW SWITCH
	FLOW INDICATOR		PRESSURE TRANSMITTER
	ADT ASSLY. AUTO DRAIN TRAP ASSEMBLY		DEW POINT METER
	SIGHT GLASS		PNEUMATIC CONTROL VALVE (PCV)
	SOLENOID VALVE		FLOW CONTROL VALVE
	MANIPULATOR PANEL		STRAINER

- NOTES:-
1. THE GIVEN P&ID IS CONFINED TO INSTRUMENTS AND PIPING FOR COMPRESSOR HOUSE AREA ONLY.
 2. ALL INTERCONNECTING COMPRESSED AIR PIPING SHALL CONFORM TO IS 1239 (HEAVY GRADE) OR IS 3359 G-410 AND GALVANISED AS PER IS 4735.
 3. ALL COOLING WATER PIPING SHALL BE CONFORMING TO IS 1239 (PART-I, HEAVY GRADE).
 4. FITTINGS FOR AIR PIPING SHALL BE CONFORMING TO RELEVANT BIS STANDARD AND GRADE EQUIVALENT THAT OF PARENT PIPE GRADE.
 5. COMPRESSED AIR PIPING HANDLING HOT AIR WILL BE SUITABLY INSULATED SO AS TO RESTRICT SURFACE TEMPERATURE TO 60 deg C.
 6. ALL PRESSURE & TEMPERATURE GAUGE SHALL 150 mm DIA. TYPE.
 7. DRAIN PIPING UP TO THE NEAREST DRAIN POINT WITHIN THE AIR COMPRESSOR ROOM SHALL BE PROVIDED.
 8. THE CONTROL OF AUTOMATIC INTERCHANGEABILITY FROM SERVICE AIR TO INSTRUMENT AIR SHALL BE THROUGH DDCOMS.
 9. THE INSTRUMENTS INDICATED IN P&ID MAY VARY DEPENDING UPON THE SYSTEM REQUIREMENT & TO THE INSTRUMENT MANUFACTURER'S PRACTICE. INSTRUMENT IS TYPE OF PRESSURE OR OF GAS.
 10. DETAIL CONTROL & LOGIC SHALL BE SUBMITTED DURING DETAIL ENDS AFTER FINALIZATION OF C&S SUPPLIER.

ALTERNATIVE - 1

BAHUBHAR POWER CORPORATION LTD.
YERAMARU TPS (2 X 800 MW)

EVONIK ENERGY SERVICES (INDIA) LTD

PROJECTS ENGINEERING MANAGEMENT
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FLOW CONTROL VALVE	FCV	
SHUT-OFF VALVE		

10. DETAILED CONTROL & LOGIC SHALL BE SUBMITTED DURING DETAILED ENG. AFTER FINALIZATION OF CAS SUPPLIER.

RAICHUR POWER CORPORATION LTD
YERAMARU TPS (2 X 800 MW)

EVONIK ENERGY SERVICES (INDIA) LTD

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VOLUME – II B
SECTION – C.2
SPECIFIC TECHNICAL REQUIREMENTS
MECHANICAL



RAICHUR POWER CORPORATION LIMITED

YERAMARUS TPS - 2x800 MW

COMPRESSED AIR SYSTEM

SECTION: :D1.9

VOLUME-III

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SCOPE & SYSTEM DESCRIPTION

- 1.1 a) The compressed air system shall consist of service air and instrument air system. The air compressors shall supply oil free air at the design pressure at the after-cooler discharge flange. The compressed air shall be cooled by an after-cooler before entering the air receivers. From the air receivers, the compressed air shall be piped to the various systems requiring compressed air. ~~The plant is provided with Five (5) Nos. identical air compressors, Three (3) Nos. IA (2W+1S) of suitable capacity (not less than 45 NM³/Min at 8.0 kg/cm² (g) discharge pressure) and Two (2) Nos. SA (1W+1S) of suitable capacity (not less than 45 NM³/Min at 8.0 kg/cm² (g) discharge pressure).~~ The compressors shall have suitable interconnections with instrument/service air headers through pressure reducing valve (PRV). Operation of the air compressors shall be alternated to ensure even wear.

b) The ~~Three (3) nos. (2W + 1S)~~ Air Drying Plant shall be provided to supply moisture free air to IA System. Air-drying plant capacity to match air compressor capacity shall be provided. Air Drying Plant shall be heat of compression type (conventional twin tower type or Rotary Drum type) air dryers shall dry all instrument quality control air. One dryer for each instrument air compressor shall be in service at full load or at partial load during normal operation. However, only one tower from each dryer shall be used while the other tower is being reactivated as applicable to type of dryer. The air dryers shall have interconnection between service & instrument air. Automatic controls shall be provided to switch the airflow between the towers on each dryer as required for reactivation. The air dryers shall be provided with two parallel pre-filters, after-filters and other associated auxiliaries needed as applicable to type of dryer. The dust condition at the air dryer outlet shall be in the range of 1 to less than 5 microns.

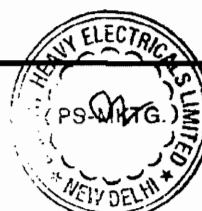
c) The pre-filters shall remove dust, water, and oil drops and shall protect the air dryers. Pre-filters shall be of the coalescing type.

The after-filters shall be dry type and shall remove particulates in the range of 1 to 5 microns. Bidder shall indicate in the proposal dust particle size after pre-filters and after-filters.

Note: The requirement of pre-filter & after filter is applicable to conventional twin tower type type of HOC dryer. Same is not applicable for Rotary drum type HOC dryer.

1.2 SCOPE OF WORK

The scope of work shall include the design, manufacture, assembly / pre-assembly, tests at manufacturer's works, shop painting, packing and transportation to site, erection and site testing of entire Compressed air system complete with all auxiliaries as specified hereinafter and as required for safe, reliable and trouble free operation in a manner acceptable to the Owner.





2.0 SELECTION CRITERIA

2.1 Type of Compressors

The type of compressors be screw type/centrifugal type and shall be of non oil lubricated type.

2.2 Capacity of Air Compressors

Capacity of air compressors shall be selected considering all the plant requirements. For ready reference, partial list of services is given below:

a) Plant / Service air

- Turbine generator building at all floors.
- Service building at all floors and workshop area.
- Boiler platforms including air required for air heater, air motor drive, pulverised coal sampling, feeder bulls eye cleaning, soot blower, atomising air, burner retraction.
- DM plant area
- Emergency DG sets
- CW Pump house
- Waste water recovery pump house
- ESP area
- Fuel oil pump house area
- Mill bay

One point at Boiler for RPCL use

b) Control / Instrument Air

- All pneumatic dampers / valves operation for boiler and accessories, TG and accessories and all other systems such as DM plant, excluding the coal handling system, compressed air requirement of ash handling system, etc.,

C) Instrumentation and Control system

- The plant air compressor would be used for instrument air supply also in emergency which could be during either excess demand of instrument air or during failure of all the instrument air compressors by interconnection of the instrument and service air headers. An Automatically operated control valve will be provided on this interconnecting pipeline.



**RAICHUR POWER CORPORATION LIMITED****YERAMARUS TPS - 2x800 MW****COMPRESSED AIR SYSTEM**

SECTION: :D1.9

VOLUME-III

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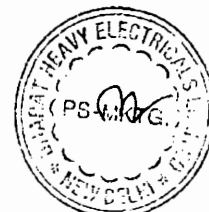
- The Free air delivery capacity to be fixed considering for dry bulb temperature of 42.5 C and 75% Related Humidity.
-
- The air compressor to be designed for continuous operation with high efficiency to satisfy the performance requirement. Continuous motor rating (500C ambient) will be atleast 10% above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration be made for losses in power transmission in addition to the above margin.

Sl.no.	Particulars	Working	Standby
1	Instrument air compressor with Accessories	4	2
2	Service air compressor with Auxiliaries	2	1
3	Capacity & discharge pressure for Service air compressor	Bidder to decide (Not less than 45 Nm ³ /min.for each compressor 8.0 kg/cm2(g))	
4	Capacity & discharge pressure for Instrument Air compressor.	30 NM3/MIN. for each compressor with discharge pressure of 8.5 kg/cm2 (g)	
5	Air receiver with all needed		
6	Air drying plant		
7	Miscellaneous	Surge (Unit) air receivers, piping valves, fittings & accessories	
8	Associated electrical & instrumentation		

The operation of compressed air system shall be through compressor mounted microprocessor based panel as per manufacturer standard. One electronic dew point meter shall be provided at outlet of each drier.

d) CODES AND STANDARDS

- IS – 6206 : Guide for selection, installation and maintenance of air compressor plants with operating pressure upto 10 bars
- IS - 5727 : Glossary of terms relating to Compressors and Exhausters
- IS – 5456 : Code of practice for testing of positive displacement type air compressors and Exhausters
- IS - 2825 : Code for Unfired Pressure Vessels
- IS - 7938 : Air Receivers for Compressed Air Installations
- IS - 4503 : Shell and Tube type Heat Exchanger





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IS -10431(Part I): Measurement of Air Flow of Compressor and Exhausters

IS – 1239 : Mild Steel Tubes and Fittings (Part I & II)

IS- 3589 : Specification for Electrically Welded Steel Pipes for Water, Gas and Sewage

IS- 4736 : Hot dip Zinc Coating for Steel Tubes

ANSI- B 16.5 : Steel Pipes Flanges and Fittings

Latest applicable IS to be followed.

2.3 Discharge Pressure

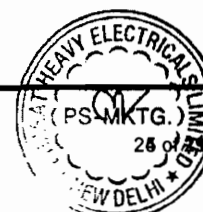
Suitable discharge pressure is to be selected, duly considering requirements of consumption points, pressure drops in driers, valves, piping, etc. and certain amount of leakages. For a plant of this nature, compressors with discharge pressure of 8.5 kg/cm² (g) are envisaged.

3.0 DESIGN REQUIREMENTS

3.1.0 Air Compressor design criteria.

- a) The Air compressors shall be packaged, centrifugal type/screw type air compressors complete with motors, intake filter-silencers, oil pumps oil reservoirs, moisture separators, after coolers, unloading valves with silencers, controls & control panels, mounted on a common base for each compressor separately.
- b) Compressors shall be water cooled.
- c) Ball-valves shall be provided at tap-off points from service air header. All valves shall be of SS 304 internals with CS body.
- d) Performance curves
 - i) Performance Curves shall be developed for design, average and minimum air compressor operating conditions based on the filter inlet air and cooling water supply conditions.
 - ii) The curves shall have delivered capacity in standard cubic meter per minute as the abscissa and brake horsepower, including speed increaser and discharge pressure as ordinates. The surge line and compressor rated point shall be indicated. Curves indicating the recommended operating points for loading/ unloading control shall also be developed.

Speed-torque curves shall also be developed.





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- e) **Performance:** The compressors shall perform as specified herein and as indicated in the performance curves. The compressors shall operate without vibration or noise in excess of the limits specified.

OPERATION CONTROL & INSTRUMENTATION

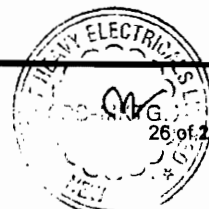
Operation of the compressed air system would be controlled from microprocessor based control panel mounted with each compressor. Each compressor would have "dual control" facility to permit operator selection of load-unload and start stop mode.

In addition to the above, one potential free NO contact would be provided at panel for following annunciation's to be monitored in DDCMIS.

1. Compressor tripped (for each compressor)
2. Instrument air header pressure low
3. Plant air header pressure low.

3.1.1 AIR DRYER DESIGN CRITERIA

- a) The desiccant air dryers shall be Heat of Compression type (twin tower type or rotary drum type) and shall be fully assembled with desiccant shipped separately; ready for installation and operation. Each dryer as applicable to type of dryer shall have two absorbing towers which, together, provide a 10 minute cycle time and sufficient capacity to continuously dry the volume of air entering under the service conditions specified. Two parallel full-capacity prefilters and afterfilters shall be furnished with the air dryers as applicable.
- b) The power cylinder for the tower transfer valve shall be designed to operate on air pressure as low as 4.2 kg/cm²g and shall be suitable for operation at 8.5 kg/cm²g, with a design pressure of 9.5 kg/cm²g
- c) Each air dryer shall be sized in accordance with condition as shown in data sheet.
- d) The operation of compressed air system shall be from compressor mounted microprocessor based panel.
- e) Necessary tests shall be carried out in addition to those specified in Inspection & Tests in accordance with relevant codes and standards..
- f) Impellers of screw type compressors shall be given an overspeed test at 115 percent of the maximum continuous speed of the compressor. Casings shall be hydrostatically tested at 1.5 times the maximum application pressure. Each compressor shall be assembled and tested at the factory to assure proper operation.
- g) The piping system shall be subjected to pneumatic leak test at 1.5 times the design pressure.
- h) All tests as per approved QAP





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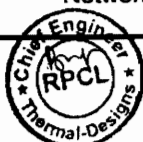
3.1.2 Suitable uprating factor shall be considered while arriving at compressor capacity.

3.1.3 The compressor outlets shall be connected to a respective header, namely Instrument air & Service air. An interconnection control valve shall be provided such that control / instrument air gets the priority under all conditions. The required control / instrument air shall be passed through air driers before conveying to consumption point.

4.0 LIST OF EQUIPMENT

- | | | |
|-----|----------------------------|---|
| 4.1 | Air receivers | Nine (9) nos. air receivers one for each compressor & two unit air receiver for each unit
The air receivers shall be vertical self supporting cylindrical vessels with supporting legs for resting on their foundation.
The capacity of each air receivers (both compressor house receivers & Unit air receiver) shall be 10M ³ nominal. |
| 4.2 | Air driers | Six (6) nos. (4 operating + 2 standby) |
| 4.3 | Accessories / Auxiliaries | Inter / after coolers, moisture separators etc. as required |
| 4.4 | Control panel | One (1) panel compressor mounted as per manufacturer standard each for Instrument air compressors and Service air compressors with alarm annunciation. Certain important annunciations / alarms shall be connected to main unit control panel room |
| 4.5 | Piping fittings and valves | Complete piping, fittings and valves for cooling water, compressed air lines and impulse lines* |
| 4.6 | Electrical works | The power supply (rated voltage, frequency phase) of the equipment, would be from 3.3KV for HT and LT power supply shall be fed from Unit/Station boards. All drive motors, switch gear units / starters, earthing, power / control / instrument cables and all miscellaneous works shall be as detailed elsewhere. |

*Suitable moisture traps at strategic locations be provided in the distribution Network.





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The material of construction for piping, fittings and valves shall conform to the relevant IS standards.

5.0 SPECIFIC GUARANTEES

5.1 Capacity of compressors at rated discharge pressure as per relevant codes and standards.

5.2 Quality of instrument/control air coming out of air drier.





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DATA SHEET-A

Service air Compressor Sizing Criteria

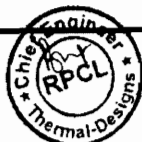
Item	Operating Conditions
Quantity	2 Nos. (1W+1S)
Minimum rated capacity of each compressor at design inlet conditions, *Nm ³ /min	45 (minimum) otherwise as decided by contractor
Pressure at discharge from after-cooler	
Operating Pressure kg/cm ² (g)	8
Maximum (compressor trip), kg/cm ² (g)	DDE (as per approved operational philosophy)
Temperature at discharge from after-cooler	
Design, °C	50
Maximum (compressor trip), °C	55
Noise level (At 1.5 m)	85 db
*Design inlet conditions shall be in accordance with site requirements.	

Instrument Air Compressor Sizing Criteria

Item	Operating Conditions
Quantity	3 Nos. (2W+1S)
Minimum rated capacity of each compressor at design inlet conditions, *Nm ³ /min	45 (minimum) otherwise as decided by contractor
Pressure at discharge from after-cooler	
Operating Pressure kg/cm ² (g)	8
Maximum (compressor trip), kg/cm ² (g)	DDE (as per approved operational philosophy)
Temperature at discharge from after-cooler	
Design, °C	50
Maximum (compressor trip), °C	DDE (as per approved operational philosophy)
Noise level (At 1m)	85 db
*Design inlet conditions shall be in accordance with site requirements.	

Air Dryer Sizing Criteria

Item	Operating Conditions
Quantity	One for each instrument air compressor
Capacity	Not less than 45 Nm ³ /min
Service period, minutes	5 (heatless) as applicable
Reactivation period, minutes	5 (heatless) as applicable
Dryer design pressure, kg/cm ² g	DDE (as per approved operational philosophy)
Inlet air conditions	
Design temperature °C	50



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Maximum temperature °C	DDE (as per approved operational philosophy)
Outlet air conditions	
Dew point, °C	-40

Service Air Receiver Sizing Criteria

Type	Vertical, Cylindrical with Torispherical Ends and with supporting Stands
Location	Outdoor
Quantity	One for each compressor
Capacity	10 M ³
Design pressure	12 kg/cm ² (g)
Hydraulic Test Pressure	18 kg/cm ² (g)
Design Code	IS-2825
Accessories	Base Plate, Manhole, Safety Valve, Instruments, Drain Traps, Air Release Vents etc.,

Dwp
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DATA SHEET-C

9.0 DRAWINGS/DATA / DESIGN CALCULATIONS TO BE FURNISHED BY THE CONTRACTOR DURING DETAILED ENGINEERING.

- (a) P&I Diagram for compressed air system
- (b) Distribution scheme for service / instrument air
- (c) GA drawing of compressor
- (d) Write up on air drier
- (e) P&I diagram for air drier
- (f) GA drawing for air drier
- (g) GA drawing of control panel
- (h) Write up on control system
- (i) GA drawing of compressor room
- (j) Drawings / data sheets for valves, instruments, filters, strainers, etc.
- (k) GA drawing for air receiver
- (l) GA drawings of inter and after coolers
- (m) Operation and maintenance Manuals



VOLUME – II B
SECTION – D
MECHANICAL



**TECHNICAL
SPECIFICATION
COMPRESSED AIR SYSTEM**

SPECIFICATION NO. PE-SS-EPC-555-A-001

VOLUME II B

SECTION D


SUB-SECTION A8

REV. 0

SHEET

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1.

GENERAL

1.1.1

This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the compressed air system, as specified hereinafter.

2.

SYSTEM DESCRIPTION

2.1.1

The compressed air system shall consist of instrument air compressors & air drying plant (ADP), plant air compressors, air receivers, control panels interconnecting compressed air piping, cooling water piping, instrumentation and control.

2.1.2

The compressors shall be arranged such that all the plant air compressors shall supply air to the upstream (header of instrumentation air of each ADP through an isolation and a non-return valve so that in the event of failure of instrument air compressor, the instrument are in ensured at all time continuously.

3.

DESIGN CRITERIA

3.1.1

The instrument air compressor will be designed to meet the instrument air requirements of all the equipments /plants/systems as specified elsewhere in the specification (excluding the compressed air requirement of Ash Handling Plant).

3.1.2

The Plant/Service air compressor will be designed to meet the plant/service air requirements of all the equipments / plants / systems as specified elsewhere in the specification (excluding the plant air requirement of Ash Handling Plant) or capacity be identical as that of the instrument air compressors whichever is higher.

3.1.3

Design margin of 25% is to be considered for IA & PA/SA requirement for sizing of the Instrument Air Compressor & Plant/Service Air Compressor.

3.1.4

Each compressor will be designed to deliver the nominal capacity at the required delivery pressure.

3.1.5

The compressors' capacity will be designed as mentioned under Section-C.

3.1.6

For Instrument Air, Delivery pressure will be 8.0 Kg/cm² (g) at ADP outlet.

3.1.7

For Plant / Service Air, Delivery pressure will be 8.5 Kg/cm² (g) at Compressor outlet.

3.1.8

Air compressors will be designed for continuous operation with high efficiency to satisfy the performance requirement.

3.1.9

The continuous motor rating (at 50^o C ambient) will be at least ten percent (10%) above the maximum load demand of the driven equipment under the entire operating range. When the driver is not directly coupled to the compressor, due consideration will be made for losses in power transmission, in addition to the above margin.

3.1.10

Velocity of air in the air piping shall be as mentioned under Section-C.

3.1.11

Velocity of water flow shall be limited to 2.5 m/sec and for gravity flow the same shall be limited to 1.5 m/sec.

3.1.12

For calculating friction loss in piping system: WILLIAM & HAZEN formula shall be used with C value as 100.

3.1.13


Noise level of compressors not to exceed as mentioned under Section-C.


3.1.14

Compressors to be designed for Continuous, Load-Unload and On-Off mode operation.

3.1.15

Satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, noise etc.

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4.		OIL FREE MULTISTAGE SCREW TYPE COMPRESSORS	
4.1		AIR COMPRESSOR SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS.	
4.1.1		Design / Construction	
		i) Compression chamber Wall thickness to withstand maximum design pressure.	
		ii) Casing with a large inlet port for fast filling and low air velocity.	
		iii) To provide suitable arrangement for cleaning of the cooling water jackets during maintenance of compressor.	
		iv) Dynamically balanced, one piece Rotors with asymmetric profile, to keep leakage losses to a minimum and ensure high efficiency.	
		v) Rotor shaft mounted, oil lubricated, highly precise timing gear shall be designed to counter act the axial forces incurred in compression.	
		vi) Life of Oil lubricated anti-friction type bearing be at least 8000 running hours.	
		vii) Shaft Seals of floating restrictive ring type design.	
		viii) The shaft seal rings and retainers shall be free for radial self-adjustment on the rotor shafts.	
		ix) Minimum design service factor for the integral, oil lubricated type, step-up Gear Box shall be of 1.5.	
		x) To provide safety valves on low pressure and high pressure stages.	
		xi) A direct driven positive displacement type oil pump connection to the main drive shaft is preferred. Alternatively a separate motor driven oil pump be provided.	
		xii) The lubrication system to include oil pump, oil filter, oil cooler and oil tank / sump.	
		xiii) Cooling shall be by closed circuit Demineralised water.	
		xiv) Compressor shall be directly coupled with constant speed squirrel cage induction motor conforming to the technical specification attached elsewhere.	
4.1.2		Material of construction	
		The materials of various components shall conform to the applicable BIS / BS / ASTM / DIN standard or any other reputed standards.	
		i) Compressor chamber: Cast iron coated with corrosion resistant material.	
		ii) Rotors: Forged carbon steel coated with corrosion resistant material	
		iii) Timing Gear: Low, Alloy Steel.	
		iv) Inlet throttle valve & Housing: Aluminium	
		v) Shaft Seals: High, Alloy Steel.	
		vi) Safety valves: Brass	
		vii) Water separator: Cast Iron	

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viii) Non-return valves: Stainless steel spring loaded type.

ix) Blow off valve: Stainless steel.

x) Unloading Cylinder header: Aluminium

xi) Tube of Blow off cooler / oil cooler: SS 304

xii) Outer casing of coolers: Carbon Steel

xiii) Gear box: Cast Iron

xiv) Gears: Alloy Steel.

However, Material of Construction of components of Screw Compressor of reputed manufacturer shall also be acceptable subject to BHEL/Customer's approval.

4.1.3 Accessories

Each compressor skid to include Suction filter, silencer, intercooler & After cooler with moisture separators, automatic drain traps, instruments, control panel Base plate, coupling guard. Foundation bolt, nuts, anti vibration pads, Eye bolts and operation and maintenance tools.

4.1.4 Control Philosophy

i) Each compressor be operatable under continuous, auto, "Load-Unload" or "On-Off" mode (i.e.) "Dual control modes".

ii) Any of the compressors shall be selectable at control panel to operate either for Base duty (Auto Load-Unload) or Standby duty (Auto On-Off) operation.

iii) In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall:

a) Operate the load-unload circuit at a predetermined set pressure.

b) Throttle the inlet valve.

c) Open the blow off valve.


Unloaded compressors to run in idling mode and when system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow-off valve.

iv) In "Stand-by" duty the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor shall be started to unloaded condition. After a suitable time delay, the compressor shall be fully loaded.

v) When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period, (set by a timer), the compressor may be loaded to; full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.

vi) The pressure and duration of time to be set shall be adjustable at site from the panel.

vii) Further all interlocks for safe and proper operation of the compressors shall be provided by the Bidder.

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viii) All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.

ix) Independent switches shall be used for alarms (annunciations) and tripping or interlock as far as possible.

x) An electrically operated automatic valve shall be provided on cooling water supply line of each compressor which will automatically shut off the cooling water supply, in case compressor is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of the compressor.

4.2 INTAKE FILTER AND SILENCER

Intake Air Filter and Silencer shall be comply with the following requirements:

4.2.1 Performance

i) Filtering efficiency minimum 99% down to 10 microns.

ii) Maximum pressure drop across filter at design flow rate in new condition be 250 mm of water column.

iii) Design Airflow rate corresponding to compressor airflow.

4.2.2 Quantity: One per compressor

4.2.3 Design air data

i) Dust concentration: 30 mg / M³

ii) Particle size in microns: Up to 10 microns

4.2.4 Type/Design: Heavy duty type

4.2.5 Construction

i) To provide densely packed, replaceable type paper as filtering media.

ii) Filter to be designed to have sound suppressing characteristics.

iii) Preferably Filter and silencer be combined type.

iv) Filter to take suction from outside not from compressor room.

4.3 INTER COOLER & AFTER COOLER

Inter cooler and After cooler shall comply with the following requirements:

4.3.1 Performance

i) Outlet temperature of air from intercooler to suit the equipment offered.

ii) Outlet temperature of air After cooler to be limited to 10 Deg.C of inlet cooling water temperature.


4.3.2 Type: Shell and tube type

4.3.3 Construction

i) Design code: TEMA class “C” or equivalent.

ii) With removable tube bundle type.

iii) With internal baffling.

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iv)

Design pressure in airside: 2 Kg / Cm² more than air inlet pressure.

v)

Design pressure in waterside: Not less than shut off head of DM cooling water pump.

4.3.4

Material

i)

Tube:

Admiralty brass or Aluminium brass or SS 304.

ii)

Shell:

SA 285 Gr.C or equivalent

iii)

Tube sheet:

SA 285 Gr.C or equivalent

iv)

Baffle:

Carbon steel

v)

Flanges:

Steel IS 2862.

4.3.5

Accessories

i)

To provide necessary vent & drain connections.

ii)

Moisture separation units with level gauge.

iii)

Automatic drain trap stations with bypass & isolating valves for moisture separators.

iv)

Safety valves

v)

Lifting eye bolts, tools & tackles if any.

4.3.6

Additional Data

After coolers are not to be fitted with instrument air compressors if bidder offers "Heat of compression" type air drying plants and the same shall be provided at down stream of ADP.

5.

RECIPROCATING OIL FREE COMPRESSOR (If applicable)

5.1

EACH OF THE COMPRESSORS SHALL COMPRISE BUT NOT BE LIMITED TO THE FOLLOWING

5.1.1

LP and HP cylinders as required to meet the compressor rating, intercoolers, automatic drain trap station, relief valves and other accessories.

5.1.2

Drive machinery including drive motor and accessories.

5.1.3

Frame lubrication system, complete with protective devices and instruments.

5.1.4

After cooler and moisture separator both complete with automatic trap station, relief valves and other accessories and instruments .

5.1.5

Air intake filter and silencer unit

5.1.6

Set of local instruments as applicable

5.1.7

Set of cooling water control valves.

5.1.8


Set of foundation bolts, nuts etc. for compressors, motors, after coolers, suction filters etc.

5.1.9


Control panel comprising of all relays, contactors, solenoid valves, pressure switches, instruments, pneumatic impulse air tubing annunciation window selector switches etc.

5.1.10


Flow indicator of jacket cooling water after the inter and after coolers

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5.1.11	Relief valves on the instrument and service air headers and also after the interconnection header between SA and IA headers.
5.1.12	Instruments like pressure / temperature gauges and switches as required for the following:- a) Pressure switches i) Compressor lube oil pressure low alarm ii) Compressor lube oil pressure very low trip iii) To load the compressor iv) To unload the compressor v) To start the compressor vi) To stop the compressor vii) Low water pressure alarm on common water inlet heater of the Compressor. viii) Very low water pressure trip on common water inlet heater of the Compressor. b) Temperature switches i) Air after after-cooler high alarm ii) Air after after-cooler very high trip iii) Compressor cylinder water outlet temperature high alarm iv) Compressor cylinder water outlet temperature very high trip. c) Pressure gauges i) After compressor inter-cooler ii) After compressor after-cooler iii) At water inlet common header of the compressors d) Temperature gauges i) After cooler water outlet ii) After cooler air outlet iii) Inter cooler water inlet iv) Inter cooler air outlet v) After air compressor cylinder jacket
5.1.13	Flow indicator of jacket cooling water after the inter and after coolers
5.1.14	Relief valves on the after coolers, intercoolers, instrument and service air headers and also after the inter connection headers between SA & IA headers, moisture separators etc.
5.1.15	Counter flanges, bolts, nuts and gaskets at all equipment/piping terminating points.

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5.1.16	Base plate/plates, support plates, anchor bolts and nuts, inserts, lifting lugs, eye bolts, etc. as required.
5.1.17	Set of special tools and tackles including tools boxes.
5.1.18	Cleaning, protection and painting
5.1.19	Initial fill of lubricating oil for compressors and filtering media for all filters.
5.2	CONSTRUCTION FEATURES
5.2.1	Air Compressors
	<p>a) Each compressor shall be multi stage, reciprocating, water cooled type. Compressor cylinder shall be closed grained cost Iron conforming to IS:210 FG 260 or equivalent. The cylinder shall be provided with renewable liners or recording allowance as per API-015, 1974. The crankshaft and connecting rods shall be of forged steel conforming to IS:1875 or equivalent and statically and dynamically balanced,. The service air compressors shall be lubricated / non lubricated type (as required in the data sheet A) whereas the instrument air compressors shall essentially be non lubricated type and the air delivered by these instrument air compressors shall be completely free of any oil, grease and other impurities. To ensure, this the piston rings shall be of Teflon and no lubricating oil shall be used in the cylinder. Special care shall be taken to prevent any oil from finding its way into the cylinders from the crank case.</p> <p>b) The piston rod packing shall also be of oil less self lubricating type. Any oil adhering to the piston rod shall be wiped off by suitable water rings. Suitable collar may also be fixed in the piston rod so that any trickling oil flow can be stopped from movement towards the cylinder.</p> <p>c) The intake filters with built in silencers shall be of dry reusable type located at the air intake connection to low pressure cylinder to remove any carried solid particles in air.</p> <p>d) Crank case shall be of rugged construction and shall have openings for access to all crank case machinery. A level indicator shall be provided for all crank case oil sump.</p> <p>e) Each compressor shall be driven preferably by direct coupled electric motors or otherwise through 'V' belt drives. The drive shall be provided with a safety guard.</p> <p>f) Flywheels shall be provided, if required, and shall be of adequate size to smoothen the effect of fluctuation of turning moment load during crank revolution.</p> <p>g) Compressor valves shall have large effective areas permitting low velocities. In case of on lubricating type compressors, valves disc. Shall be either of stainless steel to AISI 316 or 15% chrome steel heat treated, tempered and ground. The valve seats and guards shall be case hardens and valve spring shall be of stainless steel. Self lubricating valve guides and wear strips shall be used for noiseless operation and long life. The tenderer shall offer his standard materials of construction for the valve for lubricated type of compressor.</p> <p>h) To shut off cooling water flow through intercooler, compressor jacket and after coolers, operate lockable type gate valve (lockable in open position) shall be provided. These valves are to be shut off manually when required.</p>

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i) The crankshaft bearings shall be of antifriction type. A crankshaft driven positive displacement pump shall draw lubricating oil from the crankcase sump through a strainer and shall provide for forced lubrication to all the bearings.

j) The compressor lube oil pressure shall be built up within a predetermined time (adjusted by a timer) failing which the compressor shall automatically trip.

k) Provision shall be made for lubricating the parts wherever necessary to ensure smooth operation and freedom from undue wear.

l) Gear boxes and oil bath shall be provided with filling and drain plug of adequate size and shall also be provided with visual level indicators. Provision shall be made for efficient lubrication of all bearings, including ball and roller bearings by the use of separate grease cups, self sealing nipples or oil baths. Housing of ball and roller bearings shall be packed at the time of assembly. Necessary provision shall be made for preventing dust ingress into lubricated parts. A drawing showing all lubricant points and recommended lubrications to be used shall be supplied. The first fill of oil lubricant of correct grade shall be provided.

m) All lubrication systems fittings on all equipment supplied shall wherever possible be standardised. The grease nipples shall be of button head type or approved equal and shall conform to IS:4009.

n) The power ratings of the driver shall be selected such that the minimum margin of 15% is available over the power requirement to deliver rated capacity at rated pressure. When the drive is not directly coupled to the compressor, due account should be made for losses in power transmission in addition to the above margin. In case belt driven compressors, 5% belt loss should be considered over and above 15% spare margin in selecting the driven motor.

5.2.2 INTERCOOLER, AFTERCOOLER AND MOISTURE SEPARATOR

a) The intercooler shall be provided between the low and high pressure stages of the compressor. The after coolers and moisture separator shall be located between the compressor discharge and air receiver. Volume bottles shall be provided at LP cylinder discharge end and HP cylinder suction and discharge ends to take care of the pulsation or air flow. Both intercooler and after cooler shall be water cooled complete with standard accessories, such as safety valves moisture separator and automatic drain trap, bypass arrangement for automatic drain trap. The equipment shall be complete with the instrument mentioned elsewhere in this specification included in the scope of work. The inter cooler and after cooler shall be designed with adequate margin in heat transfer area. For design purpose a cleanliness factor of 0.85 shall be used in both cases.

b) The after cooler shall be designed such that the temperature of air leaving is not more than 80 deg. C above the cooling water inlet temperature.


c) Following material of construction shall be used.

i) Shell: ASTM A-285 Gr. C or approved / Equal

ii) Tubes: Copper as per BS-378 or admiralty brass to ASTM B-111 type B.

iii) Moisture separator: Galvanised, to prevent corrosion Internal.

d) The lower portion of moisture separator shall be provided with the gauge glass. Pressure drop in intercooler, after-cooler & moisture separator, shall be kept to a minimum. Pressure parts shall be designed as per IS:2825 or as per ASME section VIII Div. 1 Design of coolers shall be as per TEMA class C.

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e) Both intercooler and after cooler shall preferably be standardised in regard to tube material, tube outside diameter & tube length.

5.2.3 Oil Separator

a) In case compressed air is to be fed from the lubricated compressors to the pneumatic/control valves, then it would be desirable that the air is made oil free before it is fed to the pneumatic valves bypassing it through an air separator. (Please refer to data sheet A).

b) The oil separator shall be constructed from carbon steel in accordance with pressure vessel codes like ASME Section VIII Div. I or IS 2525. The design pressure of this same shall be indicated in Data Sheet A. The oil separator shall be able to remove the oil in the condensed form by impingement on a cartridge of synthetic wool to a degree as specified in Data Sheet A.

c) The design of the oil separator shall be such as to facilitate easy removal of the synthetic wool cartridge for cleaning. A drain valve shall also be provided.

d) The frequency at which the oil separator is to be drained and the time after which the synthetic wool should be either washed with a solvent or replaced shall be clearly indicated.

5.3 CONTROL AND INTERLOCK EQUIPMENT

5.3.1 COMPRESSOR CAPACITY CONTROL

a) Control system for each compressor shall be to maintain receiver pressure within the specified limits by load/unload control or on-off control (i.e. dual control as per data sheet 'A' which are briefly described below:-

b) The loading/unloading of the compressor is to be actuated through pressure switches located on the outlet header of each compressor. The compressor(s), in this mode of control would run continuously at constant speed but would be loaded and unloaded in steps of 100, 50% and 0% by closing and opening of the respective suction valves. This is to be achieved by means of a selector switch, having two position viz "Auto" and "Mechanical".

c) In the auto position the control will be through electro pneumatic means i.e. pressure switches while in the mechanical position, the control shall be through adjustable spring loaded mechanical governors.


d) Normally the selector switch for control for all the compressors will be in the 'Auto' position and the mechanical position is only a standby arrangement.

e) Another selector switch is to be provided for selecting the duty of the compressor viz. 'Main' or 'Standby' Duty. Depending upon the position selected in this selector switch, the compressor will run as a main compressor or be a standby.

f) In the ON-OFF mode of capacity control the compressor will always be loaded except during starting. The compressor is started automatically when the discharge header pressure falls below the set value by the pressure switch. The compressor is stopped when the discharge header pressure reaches upper set limit on another pressure switch. The first start of compressor will however, be manual. In the event of tripping of compressor on fault or manually, the compressor will not start automatically until the fault is reset and started manually.

5.3.2 COMPRESSOR PROTECTION

The control panel shall house an audio visual alarm system for each compressor in order to ensure safe operation of the compressors and to bring their abnormal

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operation to the notice of the operator. The items to be annunciated for IA & SA compressors shall include but not be limited to the following:-

- a) Receiver pressure high alarm
- b) Receiver pressure very high trip
- c) Receiver pressure low alarm
- d) Compressor lube oil pressure low alarm
- e) Compressor lube oil pressure very low trip
- f) Air temperature after aftercooler high alarm
- g) Air temperature after after-cooler very high trip
- h) Compressor cylinder water outlet temperature high alarm
- i) Compressor cylinder water outlet temperature very high trip.

6. AIR RECEIVERS

Air receivers shall comply with the following requirements.

6.1.1 Design

- i) Design pressure & temperature : 10 Kg/cm² & 50 Deg.C.
- ii) Outdoor located, vertical cylindrical vessel.
- iii) Design code : ASME Sec. VIII Div 1 or IS:2825 & IS 7938.
- iv) Welded Construction : Longitudinal seam in adjacent sections shall not be in same line.
- v) To provide gasketed inspection manhole of minimum 500 diameter.

Opening shall not pierce any seam & shall be as far as possible away from any welded seam.

6.1.2 Fabrication


- i) Welding as per relevant codes.
- ii) Filler material to have composition & structure as that of material welded.
- iii) Welding electrodes to be approved by Owner.
- iv) Electrodes to be dried before use.

6.1.3 Accessories

- i) To provide Relief valves to suit compressor capacity and set pressure of the same at least 10% above working pressure.
- ii) The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.
- iii) Drain connection with automatic trap stations.

6.1.4 Material

Shell End plates & flanges --- IS:2062 or Equivalent.

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7.

AIR DRYING PLANTS
Air Drying plants shall comply with the following requirements:

7.1

PERFORMANCE REQUIREMENTS

7.1.1

Normal flow rate: To match compressor capacity.

7.1.2

To be designed for continuous duty for dew point of outlet air at minus (-) 40 Deg.C at atmospheric pressure.

7.1.3

Quality of dry outlet air to conform to Instrument society of American standard S7.3 "Quality Standard for Instrument Air".

7.1.4

ADP to be placed upstream of the air receiver.

7.2

QUANTITY

7.2.1

One ADP for each Instrument air compressor.

7.3

TYPE / DESIGN

7.3.1

"Heat of Compression type ADP" either "Conventional Type" or "Rotary Drum type".

7.3.2

Drying by absorption method.

7.4

CONSTRUCTION OF CONVENTIONAL HEAT OF COMPRESSION TYPE ADP

7.4.1

Reactivation shall be by "Heat of Compression" method without any air purge loss. Hot unsaturated compressed air shall be used for regeneration of exhausted dessicant in case of "Heat of compression type ADP".

7.4.2

With two absorber tower per ADP for conventional type (One for drying while the other is under regeneration / standby modes).

7.4.3

Design drying cycle: 8 Hours.

7.4.4

Design regeneration cycle: Less than 8 hours including cooling period.

7.4.5

Indoor located.

7.4.6

With (minimum) 3 steps de-pressurisation.

7.4.7

To provide automatic tower change over control with provision for manual take over.

7.4.8

All pressure vessels to be designed as per IS:2825 or equivalent code.

7.4.9

All vessels to include required manholes / harid holes.

7.4.10

All hot vessels & pipelines to be insulated to restrict the outside temperature within 60 Deg.C with mineral wool (or equivalent), GI wire netting and aluminium cladding / over.

7.4.11

Quantity of dessicant to be calculated taking into account residual moisture content at the end of regeneration cycle. Design calculation with curves shall be submitted for approval of Owner.

7.4.12

Absorption capacity and density to be considered for silica gel shall not be more than 10% and 550 Kg/M³ respectively. In case of activated alumina the same shall be 8% (max) and 900 Kg/M³ (max.) respectively.

7.4.13


Minimum 20% of dessicant depth shall be provided as free board in adsorber vessels.


7.4.14


Adsorber vessels to be provided with suitable number of inspection / sight windows of peresplex for observation of adsorbent condition.

7.4.15

Dessicant filling and removal connection shall be provided.

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7.4.16	Non-lubricated two way three way / four way valves ball valves with pneumatic actuators be provided.		
7.4.17	In case of Heat of compression type adsorbers shall be sized so that even when the compressor is operating at 50% capacity, complete regeneration shall be achieved within the cycle time.		
7.4.18	Complete ADP equipments shall be preferably mounted on a skid.		
7.4.19	Required sample connections in piping be provided for sampling of air at desired locations.		
7.5	ACCESSORIES		
7.5.1	Prefilters and After filters: 2x100% with automatic drain trap filter arrangement & with ceramic candle type elements.		
7.5.2	Electric Heaters : 2x100% with thermostatic control for heater & facility for easy replacement of element.		
7.5.3	To provide suitable solenoid valves for depressurisation and re pressurisation of towers.		
7.6	MATERIAL		
7.6.1	Absorber vessels & its internals: MS Vessels as per IS; 2062 & Internals SS 304		
7.6.2	Regeneration air cooler shell tube(if applicable): SA-285 Gr.C or equivalent		
7.6.3	Blower casing: Carbon steel		
7.6.4	Blower blades & shaft: Stainless steel		
7.6.5	Relief valves: Brass or SS		
7.6.6	Tube of heat exchangers and Dehumidifier: Aluminium brass or SS		
7.6.7	Shell & tube sheet for the above: SA 285 Gr.C.		
7.6.8	Baffle: Carbon steel		
7.6.9	Dessicant: Silica gel / Activated Aluminium or as per manufacture's standard.		
7.7	CONTROL PHILOSOPHY		
7.7.1	Sequential operation of the adsorber towers be controlled automatically with a provision for manual take over.		
7.7.2	Automatic operation of adsorber tower under drying, operation of the other tower under regeneration, change over of towers, starting and stopping of blowers, slow depressurisation & re pressurisation of towers etc. shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.		
8.	INTER CONNECTING PIPING, FITTING AND VALVES		
	Inter connecting piping, fittings and valves shall confirm to the following requirements.		
8.1.1	All interconnecting compressed air piping shall conform to IS: 1239 (Heavy Grade) or IS: 3589 Gr. 410 and galvanised as per IS : 4736.		
8.1.2	Fittings for air piping shall be conforming to IS: 1239/IS:1879 and Grade equivalent that of parent pipe Grade.		

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8.1.3	Compressed air piping from air compressor to after cooler and other lines handling hot air will be suitably insulated so as to restrict surface temperature to 60deg.C. The pipe joints will be screwed coupling type for sizes upto 50 NB and above 50 NB the same will be flanged.		
8.1.4	All cooling water piping will be M.S. conforming to IS: 1239 (Part-I) (Heavy Grade).		
8.1.5	For Air line Ball Valves with Stainless Steel internals with Teflon seat shall be provided. Ball valves upto 50 NB shall be of Forged Carbon Steel Body with screwed connections. Ball valves above 50 NB shall be of Cast Carbon Steel Body with flanged connections.		
8.1.6	The check valves shall conform to IS: 3412.		
8.1.7	For water line Gate valves shall be provided. For size 50 NB and smaller carrying water the same shall conform to IS:778 with gun metal body and trim and for above 50 NB with carbon steel body and internals.		
9.	INSTRUMENTATION (GENERAL)		
9.1.1	Detailed specification for the Instrumentation shall be referred in the control and instrumentation section of this volume.		
9.1.2	The bidder shall include instruments / controls to facilitate safe, reliable and efficient operation for the system offered. The instrumentation control system offered by the bidder shall be subjected to approval of the Employer during detailed engineering.		
9.1.3	All Instrumentation and Control equipments required for Compressed air system such as primary and secondary instruments, control panels / cabinets, cable etc. shall meet the requirements specified in control and instrumentation section of the Volume.		
9.1.4	The protection and interlock system shall be subject to the approval of the Employer.		
9.1.5	All pressure and temperature conditions used for tripping the compressor shall be provided with pre-trip annunciation in the control panel.		
9.1.6	Following general philosophy shall be followed regarding instrumentation.		
	1) Pressure Indicators / Vacuum gauge:		
	a) At inlet outlet of each compression stage (air line).		
	b) At inlet and outlet of cooling water header.		
	c) At inlet and outlet of (air line) each heat exchangers of compressors & air drying plant (in air side).		
	d) At inlet and outlet of each adsorber vessel.		
	e) At each air receiver and at outlet header of compressor & air drying plant.		
	f) At inlet of each of the filters of compressors assembly and ADP system.		
	2) Pressure Switches (Individual for each function).		
	a) At inlet/outlet of each compressor stage of the compressor (for annunciation / interlock).		
	b) At each air receiver for:		
	i) High/Low pressure alarm, for start/stop control.		
	ii) For load/unload control.		

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iii) At common discharge outlet of compressor & air drying plant (for alarm)

c) At discharge of each compressor.

3) Temperature Indicators

a) At inlet and outlet of each heat exchangers / coolers of compressor and air-drying plant in the lube oil, air & cooling water circuits.

b) At inlet and outlet of electric heaters & exhaust (atmosphere) of regeneration air (for open through type ADP).

c) At inlet and outlet of each adsorber vessel.

d) At common discharge outlet of compressor & ADP.


4) Temperature Switches / Temperature Controllers


a) At inlet and outlet of each heat exchangers / coolers of compressor and air drying plant in the air & cooling water and lube oil circuits for low & high alarms, trip & interlock.

b) At outlet of electric heaters & exhaust of regeneration air (open through type ADP) for alarm & interlock.

c) At discharge of each compressors (before air receiver).


d) At common discharge outlet of air compressors & air-drying plant.

<div><div>लक्ष्मी एंजिनियर्स प्रा. लि.</div><div></div></div>	TITLE: COMPRESSED AIR SYSTEM DATA SHEET A	SPECIFICATION NO: PE-TS-Q11-555-A-001	
		VOLUME II B	
		SECTION D	SUB SECTION A8
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		SHEET 1 OF 1	
1.	AIR COMPRESSOR		
1.1.1	Discharge Pressure:	8.5 kg/cm ² (g)	
1.1.2	Type of Compressor:	Oil free Screw	
1.1.3	Type of Drive:	Direct / V-Belt	
1.1.4	Inter-connecting Air Piping	Galvanised	
1.1.5	Water Piping:	Carbon steel (Heavy)	
2.	AIR DRYING PLANT		
2.1.1	Air Drying capacity:	To match IA compressor capacity	
2.1.2	Duty:	Continuous	
2.1.3	Service:	Instrument Air	
2.1.4	Installation:	Indoor, Skid mounted	
2.1.5	Type of drying:	Adsorption	
2.1.6	Type of dryer:	HOC type	
2.1.7	Dessicant:	Activated Alumina / Silica gel	
2.1.8	Due point of outlet air:	(-) 40 ⁰ C at 1 ata Pressure	
3.	AIR RECEIVERS		
3.1.1	Design pressure:	10.5 kg/cm ²	
3.1.2	Location:	Outdoor	


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SL.NO.	ITEM	UNIT	PARTICULARS	
1.00.00	AIR COMPRESSOR		Instrument Air	Plant Air
1.01.00	GENERAL			
1.01.01	Manufacturer			
1.01.02	Model No.			
1.01.03	Type of Compressor			
1.01.04	Numbers offered	Nos.		
1.02.00	Guaranteed Performance			
1.02.01	Capacity of each Compressor	NM ³ /min		
1.02.02	Discharge Pressure at Compressor HP outlet	Kg/cm ²		
1.02.03	Discharge Pressure of Instrument Air at ADP outlet	Kg/cm ²		
1.02.04	Capacity considering design ambient condition (i.e., 45°C & 75% RH) (FAD)	M ³ /min		
1.02.05	Outlet Air Temperature after HP stage of compressor at design capacity	°C		
1.02.06	Outlet Air Temperature after aftercooler of Plant Air system.	°C		
1.02.07	Outlet Temperature after ADP for IA system	°C		
1.02.08	Input Power required at the compressor shaft at design condition	kW		
1.02.09	Input Power required at the compressor shaft at fully unloaded condition	kW		
1.02.10	Guaranteed Power consumption at motor input terminals at rated conditions (i.e., without any tolerance)	kW		
1.02.11	Motor Rating of Drive Motor	kW		
1.02.12	Drive Motor speed	rpm		

Name of Bidder / Vendor						
Project						
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Signature of Bidder / Vendor / Authorised Representative						
Date						


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	COMPRESSED AIR SYSTEM		Volume III	SUB SECTION A8
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1.03.00	Material of Construction					
1.03.01	Compressor Chamber					
1.03.02	Rotors					
1.03.03	Inlet Throttle Valve					
1.03.04	Housing of Valve					
1.03.05	Timing Gears					
1.04.00	Max. Weight to be handled / lifted during erection and during maintenance					
2.00.00	INTAKE AIR FILTER & SILENCER					
2.01.00	Type					
2.02.00	Efficiency with corresponding particle size in microns	%				
2.03.00	Pressure drop across filter at rated flow in new condition	MMWC				
2.04.00	Filtering Medium					
2.05.00	Silencer Feature incorporated					
3.00.00	Air Receivers					
3.01.00	Capacity	M ³				
3.02.00	Numbers offered	Nos				
3.03.00	Design Code					
3.04.00	Design Pressure	Kg/cm ²				
3.05.00	Material of Construction					
4.00.00	Intercooler, Aftercooler & Heat Exchangers of ADP		Intercooler	Aftercooler	Heat Exchanger for HOC type ADP	
4.01.00	Numbers per compressors or ADP offered	Nos				
4.02.00	Temperature					
4.02.01	Compressed Air inlet/outlet	°C				
4.02.02	Cooling Water inlet / outlet	°C				
4.03.00	Moisture separator provided as per	Yes / No				
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	specification?				
4.04.00	Level gauge, automatic drain trap etc provided as per specification?	Yes / No			
4.05.00	Material of Construction (Suitable for DM Water)				
4.05.01	Tube				
4.05.02	Shell				
4.05.03	Tube sheet				
5.00.00	Air Drying Plant				
5.01.00	General				
5.01.01	Manufacturer				
5.01.02	Type of HOC type ADP offered (Conventional / Rotary Drum type)				
5.01.03	Numbers of ADP offered	Nos.			
5.02.00	Guaranteed Performance				
5.02.01	Design airflow at plant inlet	NM ³ /min			
5.02.02	Guaranteed dew point at the outlet throughout the operating cycle at 1 kg/cm ²	°C			
5.02.03	Max. Pressure drop in air stream	Kg/cm ²			
5.02.04	Filters		Prefilter	Afterfilter	
a)	Manufacturer				
b)	Nos. per ADP	Nos			
c)	Type of element				
5.02.05	Electric Heater for ADP for temperature stabilization				
a)	Manufacturer & Type				
b)	Nos. Per ADP	Nos			
c)	Heating Element Rating	kW			
5.02.06	Power Consumption per Cycle for ADP (for Heaters)	kW			

Name of Bidder / Vendor						
Project						
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Signature of Bidder / Vendor / Authorised Representative						
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5.02.07	Material of Construction		
a)	Adsorber vessel		
b)	Dessicant		
c)	Heating Element		
d)	Filter element		
5.02.08	Net Weight		
a)	Net weight of all accessories of ADP including base frame		
b)	Total shipping weight of equipment supplied		
6.00.00	Interconnecting Pipes Valves Etc.		
6.01.00	Whether all piping valves pipe supports fitting sampling connections instruments and other accessories provided as per specified and as per system requirements?		

Name of Bidder / Vendor						
Project						
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VOLUME – II B
SECTION – D
ELECTRICAL



**TECHNICAL SPECIFICATION FOR
COMPRESSED AIR SYSTEM
(ELECTRICAL PORTION)**

SPECIFICATION NO. PE-TS-362-174-A001
VOLUME II B
SECTION-C
REV 01 DATE 24.07.08
PAGE 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

- 1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I to Section – C [Scope of Work (Electrical)].
- 1.2 Make of various equipment/ items in the scope of bidder shall be to approval of owner during detailed engineering stage without any commercial implications.
- 1.3 Bidder shall furnish all AC as well as DC loads required for the system at different voltage levels (eg. 415V AC, 240 V AC, 220 V DC etc.) of all types, such as motor feeders, supply feeders in PEM format along with the offer.
- 1.4 All electrical equipment shall be suitable for the power supplies, fault levels and climatic conditions indicated in project information enclosed with the specification.
- 1.5 All drawings, data sheets, Quality Plan, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per formats enclosed. The same shall be subject to approval without any commercial implications.
- 1.6 Technical requirements shall be as per specifications listed in Clause 4.1, 4.2 & 4.3 below.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet "Electrical Equipment Specification for Compressed Air System and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
 - b) List of Erection and Commissioning spares.
 - c) List of Erection & Maintenance tools & tackles.
 - d) Electrical load requirement in the load data format.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

- 4.1 Electrical scope between BHEL & vendor (Annexure-I).
- 4.2 Technical specification no. PE-SS-999-506-E101, Data Sheets (A & C) for 415V Electric Motors.
- 4.3 Quality Plan for motors.
- 4.4 Load data format (Annexure-II).

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: 2X800MW YERAMARAS SUPER CRITICAL TPP

PACKAGE: COMPRESSED AIR SYSTEM (MAX)

Date: 02.09.11

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1.	415V MCC	BHEL	BHEL	1. 415 V, 4W AC supply shall be provided by BHEL based on load data provided by vendor at contract stage. 2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.
2.	Local Push Button Stations (for motors)	BHEL	BHEL	Located near the motor
3.	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL BHEL/Vendor Vendor	1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by BHEL 3. Termination at BHEL equipment by BHEL 4. Termination at vendor equipment by vendor
4.	Any special type of cable like compensating, co-axial, prefab, MICC & fibre optical cables	Vendor	Vendor	
5.	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
6.	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Tinned brass conforming to BS: 6121 cable glands heavy duty type. 2. Aluminium Conductor Cables: Heavy duty Aluminium tubular terminal end for solder-less crimping 3. Copper Conductor Control Cables: Copper Cable lugs for control cable termination shall be PVC insulated sleeve type.
7.	Conduit and conduit accessories for cabling between one end/ both end equipments supplied by vendor	Vendor	Vendor	1. Cabling shall be through conduits. However vendor can use the trunk cable routes provided by BHEL (where available) for laying of cables as permitted by BHEL site engineers.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: 2X800MW YERAMARAS SUPER CRITICAL TPP PACKAGE: COMPRESSED AIR SYSTEM (MAX) Date: 02.09.11

					2. Conduits supplied by vendor shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. 3. Makes of conduits shall be subject to customer/ BHEL approval at contract stage. 4. Vendor shall provide plugs & sockets for wiring (if required).
S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS	
8.	Lighting	BHEL	BHEL		
9.	Equipment Grounding & Lightning Protection	BHEL	BHEL		
10.	Below grade grounding	BHEL	BHEL		
11.	Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to approval at contract stage.	
12.	Power supply arrangement (battery/ battery charger) for control system/ panel	Vendor	Vendor	Only 415 V AC/ 240 V AC supply to the power supply equipment for control system shall be provided by BHEL. All downstream equipment (eg. battery, battery charger, distribution board, cables etc.) shall be in the package vendor's scope.	
13.	Mandatory spares	Vendor	-	Vendor to quote as per specification.	
14.	Recommended O&M spares, E&C spares, erection & maintenance tools & tackle.	Vendor	-		
15.	Any other equipment/ material/ service required for completeness of system but not specified above (trouble free and efficient operation of the system).	Vendor	Vendor		
16.	a) Input cable schedules (C&I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing (including soft copy) in BHEL Cable Schedule format (to be provided to vendor during contract stage) for C & I system for the package shall be submitted by vendor during detailed engineering stage.	
17.	Equipment layout drawings	Vendor	-	Vendor shall furnish ACAD drawing indicating location and identification of all equipments requiring cabling, and shall incorporate cable routing details marked on the drawing as per PEM (E) interface comments..	
18.	Electrical equipment GA drawing	Vendor	-		

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PROJECT: 2X800MW YERAMARAS SUPER CRITICAL TPP

PACKAGE: COMPRESSED AIR SYSTEM (MAX)

Date: 02.09.11

- NOTES:
1. Make of all electrical equipments/ items supplied shall be of reputed make & shall be subject to approval of BHEL/ Customer after award of contract.
 2. All QPs shall be subject to approval of BHEL/ Customer after award of contract.
 3. For skid mounted system, 2 nos. (1W+1S) supply feeders of 415 V, 3 phase, 4 wire AC shall be provided by BHEL. Complete skid including changeover between feeders/starters/LCP/ inter-locks/protection devices /any other supply etc. shall be in bidder's scope only.



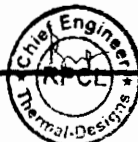
RAICHUR POWER CORPORATION LIMITED
YERAMARUS TPS - 2x800 MW

SECTION: D2.23
VOLUME-IV
Page 1 of 5

MOTORS

1.0 A.C. MOTORS

- 1.1 All HT motors shall be suitable for 11kV / 3.3kV, 3 phase, 50 Hz and LV motors shall be suitable for 415V, 3 Phase, 50 Hz power supply.
- 1.2 The motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher. Motors shall be capable of starting and accelerating the load with the applicable method of starting without exceeding acceptable winding temperatures when supply voltage is 80% of the rated voltage for motors. Mill motors with higher starting torque requirement shall start with minimum 85 % of rated voltage.
- 1.3 Motors shall be capable of developing the rated full load torque even if the supply voltage drops to 70% of the rated voltage. If such operation is envisaged for a period of one second, the pull out torque of the motor shall be atleast 205% of full load torque.
- 1.4 Motors shall withstand for 1 second the voltage and torque stresses developed due to the vector difference between the motor residual voltage and the incoming supply voltage equal to 150% of the rated voltage during fast change over of buses.
- 1.5 Starting current of all HT motors shall be 600 % inclusive of IS tolerance except for BFP motor and mill motor.
For BFP motor starting current shall be 500 % inclusive of IS tolerance.
For mill motor starting current shall be 600 % subject to IS tolerance.
- 1.6 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than the starting time at minimum permissible voltage specified above by atleast three seconds or 15% of the accelerating time whichever is greater. Provision of speed switch shall be avoided to the extent possible.
- 1.7 The degree of protection for the motor enclosure shall be IP-55 and IP-54 for outdoor & indoor respectively and terminal boxes shall be provided with atleast IP-55. For single core cable termination, gland plates shall be of non-magnetic material. All motors located in hazardous area shall have flame proof design.
- 1.8 All HT motors shall be provided with vibration pads for mounting vibration detectors.
- 1.9 Motors rated 1000 kW and above shall be provided with differential protection. These motors shall be provided with star connected stator windings. The 3 nos. current transformers, one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. The CTs shall be of relay accuracy and the CT characteristics shall be compatible with the differential relay. The additional 3 nos. CTs of identical characteristics shall be provided in the 11kV / 3.3 kV switchgear panel. kWh measurement shall be provided on all HT motor feeders.
- 1.10 Wherever provided, Motor can run without FOLS during coasting down to rest only.
- 1.11 For 11kV & 3.3kV motors, 6 nos. duplex/ 12 nos. simplex RTDs for winding shall be provided. Each bearing shall be provided with one no.PT-100 duplex type RTDs for temperature monitoring. These Motor are suitable for maximum 2 % harmonic.





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MOTORS

- 1.12 The maximum double amplitude vibrations for motors shall be as per IS:12075 .
- 1.13 Maximum noise level measured at a distance of 1 metre from the outer surface of the motor shall not exceed 85 dB (A).
- 1.14 Cable boxes of all 11kV & 3.3kV motors shall be provided with quick disconnecting type terminal connectors to facilitate easy disconnection and removal of the motors without requiring unsealing or otherwise disturbing the external cable connections and leaving the phase segregated terminal box intact.
- 1.15 The insulation system for 11000V & 3300 V AC motors shall withstand the negative or positive 0.3 / 3.0 microsecond wave (2.7 pu rated peak line to earth operating voltage) switching surges originating from non-effectively earthed power system. All 11000V & 3300 V AC motors shall have BIL and withstand frequency voltage as per relevant standards.

2.0 DC MOTORS

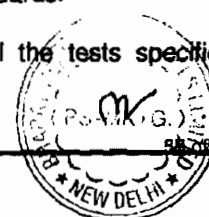
- 2.1 DC motors shall be suitable for the DC system voltage available in the plant. Motor shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is in the range of 85% to 110% of rated motor voltage. The field windings for the motors shall be continuously rated without forced ventilation.

3.0 ACTUATOR MOTORS

- 3.1 The actuator motors shall be designed for short time duty (S2) in accordance with IEC 60034-1.
- 3.2 Hand wheel operation shall be provided in addition to motor drive.
- 3.3 The DC and AC actuator shall be provided with accessories viz., Torque limit switch, end of travel switch, adjustable limit switch, hand wheel motor, thermostat, integral starter, valve position indicator, Manual-Auto lever with suitable locking arrangement, etc. Complete actuator shall be tested at factory as per IS 9334.
- 3.4 Two normally open and two normally closed or two changeover potential free contacts corresponding to open and close positions of the valve shall be provided.
- 3.5 Degree of protection for actuator motor enclosure shall be IP-55 and IP-67 for indoor and outdoor respectively.

4.0 TESTS

- 4.1 Tests on all types of motors shall be conducted as per relevant standard.
- 4.2 All type, routine & acceptance tests as per relevant IS shall be conducted on 11 kV & 3.3 kV motors. For LT motors, type test certificates for tests carried out earlier for each rating and frame size & make shall be furnished, and for all motors routine and acceptance tests shall be conducted as per relevant standards.
- 4.3 For 11000V and 3300V AC motors, in addition to all the tests specified above,





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MOTORS

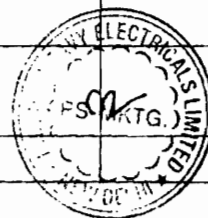
polarisation index test shall be carried out as a routine test on each motor (the minimum value of polarisation index for all motors shall be 2 when determined according to IS : 7816).

- 4.4 Noise level measurements shall be done on motor as a type test on each type and rating. Vibration measurement shall be done on all motors as a routine test.
- 4.5 Di-electric tests. Existing report of impulse test as per IEC 60034 15 shall be furnished.
- 4.6 All characteristic curves for the motors above 55kW (and lower rating critical drives identified during detailed engineering) including hot and cold withstand characteristics, starting time vs current, current vs speed, speed vs torque at 110%, 100% and 90% of rated voltage, negative withstand characteristics, rotor voltage vs rotor current curves (for wound motors), Efficiency, power factor, slip, current Vs output curve etc., shall be furnished.

5.0 TECHNICAL REQUIREMENTS

The motors shall comply with the particulars indicated below and CONTRACTOR shall furnish the details in respective column given below (to be separately submitted for different type & rating of the motor).

SL. NO.	DESCRIPTION	UNIT	SPECIFICATION REQUIREMENT	CONTRACTOR
I	AC Motors			
1.0	Application/Designation		*	
2.0	Manufacturer		*	
3.0	Type of motors/ frame size		Squirrel cage except for cranes	
4.0	Rated			
	(a) Output	kW	*	
	(b) Speed	rpm	*	
	(c) Voltage	V	*	
	(d) No.of Phases / Frequency		*	
	(e) System neutral		*	
5.0				
5.1	Type of Duty (IS-325 or equivalent)		*	
5.2	Duty designation (IS-325 or equivalent)		*	
6.0	Supply Conditions			





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MOTORS

	(a) Allowable variations in			
	(i) Voltage	%	± 10	
	(ii) Frequency	%	± 5	
	(iii) Combined	%	10(sum of absolute values)	
	(b) Permissible unbalance in supply voltage	%	2	
7.0	Current		*	
	(a) Full load	Amps	*	
	(b) Starting	% FL	*	
8.0	Method of starting		DOL	
8.1	Starting time	Sec	*	
	With rated Voltage			
	With min. Voltage			
	With Max. Voltage			
8.2	Safe stall time under hot/cold condition	Sec	*	
	With rated Voltage			
	With min. Voltage			
	With Max. Voltage			
9.0	Insulation			
9.1	Class of insulation		Class F with temperature rise limited to Class B	
9.2	Temperature rise by winding resistance method	Deg. C	temp. rise limited to Class B	
10.0	Type of cooling (IS : 6362)	Deg. C	TEFC for LV, TEFC / TETV/CACA/CAC W for 11/3.3 KV motors.	
11.0	Degree of protection (IS:4691 or equivalent)		Refer Clause 1.7	
12.0	Suitable for outdoor operation	Yes / No	*	
13.0	Normal winding connection	Star / Delta	*	
14.0	Permissible No. of equally spread starts per hour under normal service conditions		*	
15.0	Efficiency (%)	%	*	



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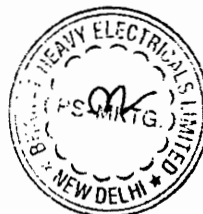
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MOTORS

	Full load			
	75 % Load			
	50 % Load			
	25 % Load			
16.0	Power Factor		*	
	Full Load			
	75 % Load			
	50 % Load			
	25 % Load			
17.0	Torque		*	
	Starting			
	Maximum (Pullout)			
	Pull up			
18.0	Motor reactance (pu)		*	
	Subtransient			
	Transient			
	Steady state			
15.0	Fault level	kA/sec	*	
II	DC MOTORS			
16.0	Rated Voltage	V	220 V DC	
17.0	Class of Insulation	:	Class F with temperature rise limited to class B	
18.0	Temperature rise	:	Class F with temperature rise limited to class B	
19.0	Method of starting	:	*	
Items under AC motors which are applicable for DC motors shall also be listed				

NOTE :

** Information shall be furnished by contractor during detailed engineering.





TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS


SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005 SHEET : 1 OF 4

1.0 INTENT OF SPECIFICATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.



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The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 Running Requirements

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 Stress During bus Transfer

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.



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- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7. **Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.
- Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.



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- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).
- i) Current vs. time at rated voltage and minimum starting voltage.
- ii) Speed vs. time at rated voltage and minimum starting voltage.
- iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
- iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

PE-6666-2



P E M

SPECIFICATION No. PES-505-02

VOLUME IIB

SECTION D

REV. No. 1

DATE 17-10-92

SHEET

OF

**GENERAL TECHNICAL REQUIREMENTS
OF
MV MOTORS**

SPECIFICATION No.

PES-505-02



MV MOTORS

SPECIFICATION No. PES-505-02

VOLUME IIB

SECTION D

REV. No. 1

DATE 17-10-92

SHEET 1

OF 13

1.0 GENERAL

1.1 This specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's works and packing of medium voltage (MV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

1.2 Motors having a voltage rating of 1000V and above are referred to as medium voltage (MV) motors.

2.0 CODES AND STANDARDS

Unless otherwise specified, the latest revisions of codes/standards specified in Annexure-I enclosed are applicable and shall be referred to.

3.0 DESIGN REQUIREMENTS3.1 General Requirements

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet A and project information (SECTION-B). Outdoor duty motors shall be suitable for outdoor application in extreme site conditions outlined in Volume II Section B. The design ambient temperature shall be as indicated in DATA SHEET 'A'.

3.2 Supply Voltage and Frequency

3.2.1 Unless otherwise specified in Data Sheet 'A'/Section C, voltage & supply variation shall be as follows :

Voltage variations $\pm 10 \%$

Frequency variations $\pm 5 \%$

Combined voltage and frequency variation (sum of absolutes) 10%

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.2.3 When the motors are operating at the extreme conditions of voltage and frequency variations as given in Data Sheet-A, the temperature rise may be exceeded by 10°C for motors of output upto and including 1000 kW and 5°C for motors of output exceeding 1000 kW.

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the driven equipment. Motors shall be continuously rated at the design ambient temperature specified in DATA SHEET 'A' and other site conditions specified in Volume II, Section-B. Motor ratings shall have at least a 10 % margin over the continuous maximum demand of



P E M

MV MOTORS

SPECIFICATION No. PES-505-02

VOLUME 11B

SECTION D

REV. No. 1

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the driven equipment under entire operating range including voltage & frequency variations specified.

3.4 Starting Requirements

3.4.1 Motors shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly coordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.4.2 Motors shall be capable of starting and accelerating the load with direct-on-line starting. The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be constant value of 80 % rated voltage except for mill motors for which it shall be 85% rated voltage.

3.4.3 The locked rotor current of the motors shall not exceed six times full load current for all auxiliaries except BFP motor, where the starting current is limited to 4.5 times full load current, subject to tolerance as given in IS:325.

3.4.4 The following frequency of starts shall apply:

- a) Two starts in succession with the motor initially at temperature not exceeding the rated load operating temperature.
- b) Three equally spread starts in an hour, the motor initially at a temperature not exceeding the rated load operating temperature (not to be repeated in second successive hour).

3.4.5 Locked rotor withstand time of hot motors at 110 % rated voltage shall be as follows:

- a) For motors with starting time upto 20 seconds. : At least 2.5 sec more than the starting time.
- b) For motors with starting time above 20 seconds. : At least 5 sec more than the starting time.

The starting time of the motor referred above is at minimum voltage. Only in extreme cases where the above requirement cannot be complied with, speed switch of suitable type shall be provided to bypass the locked rotor protection for a preselected time during starting of the motors, subject to mutual agreement between the purchaser and the supplier. The speed switches shall be of approved make and shall have 1NO+1NC or 2 changeover contacts, single pole double throw snap action contacts having maximum interrupting capacity of 5 Amps at 240 V AC and 0.5 Amps at 220 V DC. Provision of speed switch is to be clearly brought out in the offer for purchaser's acceptance.



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3.5 Running Requirements

3.5.1 Motors shall run satisfactorily at a supply voltage of 75 % of rated voltage for 5 minutes with full load without injurious heating.

3.5.2 Motors shall not stall due to voltage dip in the system causing momentary drop in voltage to 70 % of the rated voltage.

3.6 Stress During Bus Transfer

3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 100 % of the rated voltage when the motor residual voltage has dropped down to 50 % and is in phase opposition to the applied voltage during the auto bus transfer.

3.7 Noise Level

Maximum noise level measured at a distance of 1.5 meters from the outline of the motor shall not exceed 85 db (A) as per BS-4999 Part 51.

3.8 Vibration

The double amplitude of motors vibration shall be within the limits specified in IS: 12075 or as agreed between manufacturer and supplier.

4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of protection : Motors shall conform to degree of protection IP: 55 as per IS: 4691, without any sealing compound at joints.

4.2 Enclosure and Cooling

4.2.1 a) Motors of rating less than 2000 kW shall have one of the following enclosure and cooling:

(i) Totally enclosed fan cooled (TEFC) conforming to IC 0141 as per IS 6362.

(ii) Totally enclosed, tube ventilated (TETV), integral heat exchanger conforming to IC 0151 as per IS:6362.

(iii) Totally enclosed closed air circuit air cooled (CACA) mounted heat exchanger conforming to IC 0161 as per IS: 6362. However, motors below 1000 kW will be subject to purchaser's approval. For BFP motor rating less than 2000 kW, CACW motor can also be accepted subject to purchaser's approval.

b) Motor of rating 2000 kW and above shall have one of the following enclosure and cooling:



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(i) Totally enclosed, closed air-circuit water cooled (CACW) machine mounted heat exchanger conforming to ICW 37 A 81 as per IS:6362.

(ii) Totally enclosed, closed air-circuit, air cooled (CACA) machine mounted heat exchanger conforming to IC 0161 as per IS:6362 subject to purchaser's approval.

(iii) Totally enclosed tube ventilated (TETV), integral heat exchanger conforming to IC 0151 as per IS:6362.

4.2.2 In case of motors with enclosure of closed air circuit water cooled type (CACW), the following provisions shall be made:

- a) Suitable visual indication for detecting the tube failures.
- b) Visual indication for observing flow of water.
- c) Flow switch for initiating alarm under no flow conditions. The switch shall be provided with two contacts.
- d) Cooling materials of the cooler tube and tube plates shall be suitable for the cooling water specified in Data Sheet-A.

4.2.3 In case of motors with enclosure of closed air circuit water cooled type (CACW), the following shall be provided in connecting pipe line external to the cooler:

- a) Temperature gauge for inlet and outlet water temperature and air temperature.
- b) Cooling water pressure switch with two contacts.

The above are not in the scope of motor supplier.

4.2.4 Motors shall be designed with cooling fans suitable preferably for both directions of rotation.

4.2.5 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.2.6 For motor having CACA or CACW enclosure, a dial type capillary thermometer shall be provided to measure the temperature of motor internal air circuit at its maximum hot point. Separate temperature switch shall be provided for alarm indication. The temperature switch shall be single pole double throw type and the contacts rating shall be 2 Amp at 240 V AC and 0.5 Amp at 220 V DC.

4.2.7 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point, with two number drain holes with plugs one on either end of the motor.



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4.3 Class of Insulation

Tropicalised insulation material of class 'F' shall be used for the motors. Motor windings shall be given special treatment to render them non-hygroscopic and oil resistant. For class 'F' insulation the temperature rise shall be limited to that of class 'B'.

4.4 Bearings

Bearing shall be of roller type, except where motor and shaft loading indicate otherwise. Vertical motors shall have combined thrust and guide bearings in upper bracket and guide bearing in lower bracket. The thrust bearing designed to carry all axial thrust conditions imposed by the driven equipment as given in Data sheet-A. Anti-friction bearing shall also be acceptable in case motors have to take thrust due to its own rotor weight only.

4.4.1 Anti Friction Bearings

4.4.1.1 Anti-friction type bearings shall be of ball/roller type. These shall be pressure grease gun lubricated and fitted with grease nipple and grease relief devices. Bearings shall be so constructed that the loss of grease and its creeping along the shaft into the motor housing is prevented. Dirt and water getting into the motors shall also be prevented.

4.4.1.2 The minimum life of ball/roller bearings shall not be less than 30,000 working hours.

4.4.1.3 For the motors equipped with ball/roller bearings adequate means shall be provided during stand-still period to prevent the brinelling effect. During transport and shipping such motors shall receive a special bearing insert or a suitable arrangement to block the movement of rotor.

4.4.2 Sleeve Bearings

4.4.2.1 Sleeve bearings shall be of the split type, readily accessible and replaceable. These shall be either ring-oil lubricated type or forced-oil lubricated type. If forced-oil lubrication is used, the lubricating oil system shall be common to both motor and the driven equipment. The forced-oil lubricating system comprising oil pump, oil tank, piping, oil coolers, valves, etc. shall not be supplied along with motors. These shall be arranged separately by the purchaser.

4.4.2.2 Motors with sleeve bearings shall be fitted with a sight gauge marked with the proper oil level and shall be supplied with the oil fill and oil drain plugs. Proper means shall also be provided for observing oil-ring rotation when the motors are running.

4.4.2.3 When the forced-oil lubrication is provided for the bearings, ring-oil lubrication shall also be provided for starting and emergency shut down which shall be adequate for starting the motors and allowing continuous operation for at least 10 minutes without the forced-oil lubrication system in operation and without damage to the bearing.



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4.4.3 Combined Thrust and Guide Bearings

- 4.4.3.1 For vertical motor combined thrust and guide bearings shall be provided to withstand the normal downward thrust due to operating loads and rotor weight as well as the maximum anticipated upward thrust. The guide bearings shall be of sleeve type. Both thrust and guide bearings shall be housed in a common upper bracket and a guide bearing in lower bracket. In upper bracket, the oil for thrust and guide bearings shall be common.

4.4.4 General requirements for Bearing

- 4.4.4.1 Except in the case of totally enclosed motors, means of access shall be provided to the rotor air gap, without disturbing the bearing housings, to permit the use of air gap gauges to check bearing wear.

- 4.4.4.2 In case of independently supported bearings, motor and bearing pedestals shall be fitted on a common base plate.

- 4.4.4.3 Flow of shaft currents through bearings shall be positively blocked in all motors rated above 1000 kW as also in smaller motors where considered necessary by the manufacturer. In the case of pedestal mounted bearings, both bearing shall be insulated, and an earth bonding link shall be provided at the driving end, the link shall be removable for insulation testing. Where the bearings are mounted directly in the motor end frames, the non-driving end shall be permanently insulated. It shall be possible to carry out maintenance without damaging the insulation. All oil and water pipes, direct-driven oil pumps etc., shall be insulated where necessary to prevent flow of any shaft current. The insulation provided to avoid shaft currents, shall be meggered at 500 volts at manufacturer's work.

In case of water cooled oil bearings, proper insulation shall be provided at the connecting point of water pipe to bearing bodies to prevent the bearings leakage current through the water pipes.

- 4.4.4.4 Sleeve and thrust bearings shall be provided with temperature gauges of mercury in-steel type with micro-switch with a minimum of one meter flexible capillary and having alarm and trip contacts. The contacts rating shall be 2 Amps at 240 V AC or 0.5 Amp at 220 V DC.

- 4.4.4.5 Sleeve and thrust bearings shall be provided with duplex platinum resistance temperature detectors (RTD) for remote indication of bearing temperature. The DC resistance of the RTDs shall be 100 Ohms at 0°C. The RTDs shall be of three wire type. The terminals of the RTDs shall be brought out to the winding RTDs terminal box or in a separate terminal box. The bearing RTDs terminals shall be marked as B1, B2, etc.

4.5 Winding Resistance Temperature Detectors(RTDs)



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Motors shall be provided with a minimum of six Nos. RTDs of platinum resistance duplex type or 12 Nos. simplex type having a DC resistance of 100 Ohms at 0 deg C. The RTDs shall be embedded in the stator windings at locations where highest temperature are expected. The RTDs shall be of three wire type. The terminal box, shall be complete with removable front and cable gland plate. RTD leads shall be marked as 1,2,3 etc.

4.6 Terminals and Terminal Boxes

- 4.6.1 Terminal, terminal leads, terminal boxes, windings details and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet - A for a duration of atleast 0.25 second.

The test reports for terminal boxes shall be furnished for approval.

- 4.6.2 Unless otherwise specified or approved, main phase terminal boxes shall be positioned on the left hand side of the motor when viewed from the non-driving end. The main terminal box location shall be subject to purchaser's approval.

- 4.6.3 Motors with rating of 2000 kW and above shall be star connected and six leads shall be brought out. Line and neutral terminals of these motors shall be located in separate terminal boxes having provision for mounting differential protection current transformers.

- 4.6.4 Power terminal boxes shall have a phase separated (not phase segregated) construction. However, for motors which would have single core cables, three separate terminals boxes, one for each phase would also be acceptable. A minimum clearance of 100 mm between the lugs/bare live parts of different phases and 90 mm between lugs/bare live parts and earth shall be provided in the terminal boxes for 6.6 kV motors. For high voltages the clearances shall be subject to purchaser's approval.

The distance between gland plate and the terminal studs shall not be less than 500 mm. The terminal boxes shall be capable of withstanding a system fault level specified in Data Sheet-A for at least 0.25 seconds. A suitable provision of releasing the pressure developed during faults shall be made. Terminal boxes shall be suitable for top and bottom entry of cables.

- 4.6.5 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A, B & C OR U, V & W respectively, motors shall rotate in desired direction when viewed from the non-driving end as specified in data sheet-A.

- 4.6.6 Motor, terminals and terminal leads shall be fully insulated with no bare live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

- 4.6.7 Degree of protection for terminal boxes shall be same as that of motors as specified in Clause 4.1.



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4.6.8 Dessicator shall be fitted inside the terminal box and shall have an indicating head visible from outside the box.

4.6.9 Detachable cable box shall be fitted on the main phase terminal box and the design of cable box shall be suitable for terminating the cables specified in Data Sheet - A.

Details of cable boxes shall be submitted for approval. Cable boxes shall be mounted in such a way that the incoming cable does not foul with the foundation block. Double compression nickel plated brass cable glands for all terminal boxes and copper cable lugs for main terminals shall be included in bidder's scope.

4.6.10 Separate terminal boxes shall be provided for RTDs, CTs and space heaters. Detachable gland plates with double compression glands shall be provided in terminal boxes.

4.6.11 Main phase terminal boxes shall be suitable for 180 deg. rotation.

4.7 Earth Terminals

Two separate earth terminals suitable for connecting copper or MS strip grounding conductor of size given in Data Sheet - A shall be provided on the motor frame.

4.8 General

4.8.1 Motor provided for similar drives shall be inter-changeable.

4.8.2 Motors and their enclosures shall be constructed to permit easy dismantling and reassembly at site. All heavy parts should have means for attaching the lift tackle.

4.8.3 Rotors shall be dynamically balanced.

4.8.4 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the normal direction of rotation of the motors.

4.8.5 Suitable foundation bolts are to be supplied alongwith the motors.

4.8.6 Motors shall be provided with eye bolts, lugs or other means to facilitate safe lifting.

4.8.7 The CTs for differential protection for motors shall be arranged by purchaser but the mounting and connections are to be done by the motor supplier.

5.0 SPACE HEATERS

All motors shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be connected to a supply of 240 V AC, single phase 50 Hz.



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The leads from space heaters of each motor shall be brought out to a separate terminal box. Space heaters shall be mounted inside the motor in accessible place so that their removal and replacement is simple.

6.0 NAME PLATE

Motors shall have anodized brass/stainless steel name plate with all particulars as per IS: 325. The rating plate shall also indicate the following additional information :

- a) Maximum continuous rating in kW and corresponding temperature rise, as applicable for cooling medium temperature specified in Data Sheet -A.
- b) Bearing identification numbers (In case of ball/roller bearing and recommended lubricant)

7.0 PAINTING

- a) Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 as per IS:5. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. Motors frame shall also be painted to withstand corrosion.
- b) All fasteners used in the construction of the equipment shall be either of corrosion resistant material or heavy cadmium plated. Current carrying fasteners shall be either of stainless steel or high tensile brass or copper.

8.0 SHOP INSPECTION AND TESTS8.1 Stage Inspection and Tests

All materials, components and equipment covered by this specification shall be procured, manufactured as per approved standard quality plan and shall be complied with.

8.2 Type tests

First motor of each type and rating shall be subjected to tests as per IS:325. In addition to this, the following tests shall also be done on first motor of each type and

- a) Over speed test at 20% overspeed for 2 minutes.
- b) Polarization index test. The test value shall be more than 2 when determined as per IS:7816
- c) Degree of protection as per IS 4691. Type test for D.O.P. of similar enclosure design can also be subject to purchaser's approval.



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- d) Measurement of noise level as per BS:4999 Part 51.
- e) Tan delta and dielectric loss measurement on each phase of motor stator winding.

8.3 Routine Tests

All motors shall be subjected to routine tests as per IS:325. All motors except the one which has been subjected to type test shall be subjected to the following tests in addition to the routine tests:

- a) Measurement of stator resistance.
- b) Verification for direction of rotation relative to phase sequence of the supply.
- c) Measurement of vibration as per IS: 12075.
- d) Axial play for the rotor having sleeve bearing.

8.4 The following additional Special Tests shall also be conducted:

- a) Surge withstand test on the sample coils at $(4u+5)$ kV and with at least five impulses of 1.2/50 micro sec. wave where u is the line to line voltage in kV.
- b) Surge withstand test at 25.5 kV (PEAK) with 0.3/3 micro sec wave on 6.6 kV motor sample coils with at least five such impulses. For 11 kV motor sample coils, the test voltage value shall be mutually agreed between purchaser & manufacturer.

9.0 SITE TESTS

9.1 Site checks/tests shall be done at site by the equipment supplier (by purchaser in case of supply contract) to ascertain the compliance of the motor with specification and the test specification and the test certificates as per relevant standards and other tests as agreed with BHEL site.

- a) Measurements of insulation resistance.
- b) Measurements for starting current.
- c) Check on motor vibration.
- d) Polarization index.
- e) Correctness for phase sequence.



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10.0

PERFORMANCE GUARANTEES

Bidders shall guarantee that motors offered shall meet the rating and performance requirements as stipulated in this specification and as confirmed by them in technical data sheets and motor characteristics curves. In case the performance of motors at site is not as per the performance guarantee, the bidders have to replace the motors at site free of cost. Regarding performance guarantee refer section 'C' of specification also.

11.0

DRAWINGS

11.1

Drawings to be submitted with offer:

- a) Data Sheet B
- b) Dimensional outline drawing.
- c) Standard Quality Plan (Enclosed in Vol. III) after putting signature and seal of acceptance.
- d) Field Quality Plan for quality checks to be observed at site during erection, testing and commissioning, as per standard BHEL format.
- e) Test certificates for equipment of similar rating and design.
- f) Clause wise deviations, if any.

11.2

Drawings/Data to be submitted after award of contract

- a) Data Sheet C
- b) Final Quality Plan & Field Quality Plan
- c) OGA drawing showing the position of terminal boxes, earthing connections, temperature sensing devices, etc.
- d) Arrangement drawing of terminal boxes.
- e) Characteristic Curves
 - (i) Current versus time at rated voltage and minimum starting voltage.
 - (ii) Speed versus time at rated voltage and minimum starting voltage.
 - (iii) Torque versus speed at rated voltage and minimum voltage. For the motors with solid coupling the above curve i), ii), & iii) to be furnished for the motors coupled with driven equipment. In case motors with flexible coupling, above curves to be furnished with and without coupling. The torque speed curve of driven equipment to be shown with torque speed curve of motor.



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(iv) Thermal withstand curve at hot and cold conditions.

(v) Power factor, efficiency, current, slip versus load curves.

f) O & M manual

12.0 INSTALLATION AND MAINTENANCE MANUAL

12.1 The installation and maintenance manual of motor shall contain the following:

- a) Application of motor
- b) Technical Data
- c) Salient constructional features
- d) Instruction to be followed on receipt of motors at site
- e) Handling and slinging
- f) Storage and reconservation
- g) Instructions for foundation
- h) Erection procedure and check
- i) Earthing
- j) Drying out
- k) Commissioning procedures and site tests
- l) Routine, periodic and preventive inspection and maintenance procedures
- m) Assembly and disassembly of terminal box, rotor, stator, coolers, bearings, RTD etc.
- n) Safety rules
- o) Possible faults, their causes and remedies
- p) Routine and type test reports
- q) Catalogs, literatures and drawings

13.0 SPARES

13.1 Recommended list of spares for commissioning and for operation and maintenance of the motors for a period of three (3) years shall be furnished.



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13.2

A minimum of the following commissioning and O & M spares are to be included in the offer:

a) Commissioning Spares:

- (1) One set of driving end (DE) and nondriving end (NDE) bearings for each type of frame size of motor.

b) Operation and maintenance (O & M) spares.

- (1) One set of driving end (DE) and nondriving end (NDE) bearings for each type of frame size of motor.

- (11) One number bearing oil temperature indicator.

- (111) One number cooling air temp. indicator.

13.3

Bidder shall also quote for any other spares not listed above but necessary for commissioning or for operation and maintenance.

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ANNEXURE-I

LIST OF APPLICABLE CODES & STANDARDS

1.	INDUCTION MOTOR - THREE PHASE	[] IS325 [] BS4999 [] IEC34-1
2.	DESIGNATION FOR TYPE OF CONSTRUCTION & MOUNTING ARRANGEMENT OF ROTATING ELECTRICAL MACHINES	[] IS2253 [] BS4999-107 [] IEC34-7
3.	TERMINAL MARKING FOR ROTATING ELECTRICAL MACHINERY	[] IS4728 [] BS4999-108 [] IEC34-8
4.	DESIGNATION OF METHODS OF COOLING FOR ROTATING ELECTRICAL MACHINES	[] IS6362 [] BS4999-106 [] IEC34-6
5.	DIMENSIONS OF SLIDE RAIL FOR ELECTRIC MOTORS	[] IS2968 [] []
6.	GUIDE FOR TESTING THREE PHASE INDUCTION MOTORS	[] IS4029 [] BS4999-143 []
7.	DEGREES OF PROTECTION PROVIDED BY ENCLOSURES FOR ROTATING ELECTRICAL MACHINES	[] IS4691 [] BS4999-105 [] IEC34-5
8.	CODE OF PRACTICE FOR CLIMATE PROOFING	[] IS3202 [] BSCP1014 []
9.	MEASUREMENT AND EVALUATION OF VIBRATION OF ROTATING ELECTRICAL MACHINES	[] IS12075 [] BS4999-142 [] IEC34-14
10.	CLASSIFICATION OF HAZARDOUS AREAS FOR ELECTRICAL INSTALLATION	[] IS5572 [] [] IEC79
11.	NOISE MEASUREMENT	[] IS6098 [] BS4999-51 [] IEC34-9
12.	STANDARDISATION OF MOTOR FOR AUXILIARIES	[] CBIP-40 [] BS5000-40 []
13.	PREFERRED NUMBERS	[] IS1076 [] []

NOTES:

- EQUIPMENT, ASSOCIATED ACCESSORIES, COMPONENTS/PARTS, RAW MATERIAL AND TESTS SHALL IN GENERAL CONFORM TO
[] IS [] BS [] IEC
- OFFERS CONFORMING TO OTHER AUTHORITATIVE STANDARDS
[] MAY ALSO BE CONSIDERED
[] MAY NOT BE CONSIDERED

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DATA SHEET - A

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SPECIFIC TECHNICAL REQUIREMENTS

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- 1.0 Design ambient temperature : 50 °C
- 2.0 Driven equipment :
(as specified in specification)
- 3.0 Minimum kW rating of MV motors : > 160 kW
- 4.0 Details of Supply system
- a) Rated voltage : 6600 V, \pm 10 %
 - b) Rated frequency : 50 Hz, \pm 5 %
 - c) Combined Voltage and frequency variation (sum of absolutes) : 10 %
 - d) System fault level at rated voltage : 40 kA
 - e) Short time rating of MV switchgear : 40 kA for 3 sec.
 - f) Short time rating for terminal boxes : 40 kA for 0.25 sec.
 - g) MV system grounding : ~~Isolated / high resistance / low resistance~~
- 5.0 Applicable standard : As per annexure-I enclosed
- 6.0 Minimum voltage for starting
- a) Mill Motor : _____ % of rated voltage
 - b) Other Motors : 80 % of rated voltage
- 7.0 Locked Rotor current
- a) Excluding tolerance
 - i. BFP motor : 4.5 times rated current
 - ii. Other motors : 6.0 times rated current
 - b) Including tolerance : \pm 20 % on all motors
- 8.0 Type of power cables
- a) Insulation : ~~PVC~~ / XLPE
 - b) Sheathing : ~~PVC~~ / FRLS PVC
 - c) Voltage grade : 6.6 KV ~~Earthed~~ / Unearthed
 - d) Armouring : Armoured / ~~unarmoured~~

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DATA SHEET - A

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SPECIFIC TECHNICAL REQUIREMENTS

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- e) Conductor : Copper / ~~aluminium stranded~~
- f) Screening : ☒ Conductor screened /
☒ Insulation screened
- 9.0 Cable sizes :
- a) power cable for motor : Later sq. mm
- b) power cable for space heater : minimum 2.5 sq. mm PVC armoured Cu
- c) Control cable for RTD : 2 pair 0.5 sq. mm Cu
- d) Control cable for BTD : 2 pair 0.5 sq. mm Cu
- 10.0 Grounding
- a) Conductor size : 50X6 mm
- b) Material : G S FLAT
- 11.0 Space heater supply : 240 V, single phase
- 12.0 Painting : As per clause No. 7.0
- 13.0 Location of main phase terminal boxes :
- 14.0 Cooling water specification :
- 15.0 Additional tests :
- 16.0 Axial thrust in case of vertical motors (as specified by driven equipment vendor) :
- 17.0 Direction of rotation when viewed from non-driving end : Anti-clockwise / Clockwise
- 18.0 Insulation : CLASS F (ALL INSULATED WINDING) SHALL BE OF COPPER

DATA SHEET - C				SPECIFICATION No. _____	
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INSTRUCTIONS TO VENDOR		1. This data sheet shall be filled up on the basis of finally agreed points of Data Sheet B, Bid Clarifications and MOM with the bidder. 2. This data sheet shall be submitted by successful bidder after award of contract.			
1.0	Manufacturer	:			
2.0	Type and frame size & design code no.	:			
3.0	Nos. required	:			
4.0	Application	:			
5.0	Specification & codes	:			
6.0	Capacity	:			
	a) for specified climatic conditions	:			
	b) at 40 °C ambient temp.	:			
7.0	Location of installation	:	Indoor / Outdoor		
8.0	Type of enclosure & ventilation:	:			
9.0	Degree of protection	:			
10.0	Type of duty	:			
11.0	a) Rated voltage	:		V	
	b) No. of phases	:			
	c) Frequency	:		Hz	
12.0	Permissible variations in	:			
	a) Voltage	:		%	
	b) Frequency	:		%	
	c) Combined voltage & frequency (sum of absolute values)	:		%	
13.0	At rated voltage & frequency	:			
	a) Full load current	:		A	
	b) Full load speed	:		rpm	
Name of vendor			Project		
Revision number	0	1	2	3	68 of 298, 78/0/12 26
Vendor's signature					

DATA SHEET - C				SPECIFICATION No. _____	
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c) No load current :				A	
14.0	Minimum permissible voltage during starting to bring the driven equipment up to rated speed		:	_____ % of rated voltage	
15.0	Maximum permissible time at minimum permissible voltage during running at full load		:	_____ minutes running at _____ % of rated voltage	
16.0	Maximum permissible time at 75% of rated voltage during running at full load		:	min.	
17.0	Whether motor stalls at 70% of rated voltage (refer clause 3.5.2)				
18.0	Efficiency & power factor at		:	Efficiency	P.F.
	a)	Full load	:		
	b)	50% of full load	:		
	c)	25% of full load	:		
	d)	No load	:		
	e)	At start	:		
19.0	Stator winding				
	a)	Connection	:		
	b)	Type & nos. of terminals brought out	:		
	c)	Resistance between terminals at 20 °C	:		ohms
	d)	Resistance per phase at 20 °C	:		ohms
20.0	Starting current as percentage of full load current				
	a)	with IS tolerance	:		%
	b)	without IS tolerance	:		%
Name of vendor			Project		
Revision number	0	1	2	3	68 of 298, 78/0/12
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MV MOTORS

VOLUME 11B

SECTION D

SHEET 3

OF 11

- 21.0 Torque at full load : kg.m
- 22.0 Break away torque as percentage:
of full load torque %
- 23.0 Pull up torque as percentage :
of full load torque %
- 24.0 Pull out torque as percentage :
of full load torque %
- 25.0 Starting time in sec. without
mechanism coupled or mechanism
coupled through hydraulic
coupling when it may be presumed
that load is transferred to
motor shaft only after attaining
almost full speed
- a) with rated voltage : sec.
- b) with 80% of rated voltage: sec.
- c) with 110% of rated voltage: sec.
- 26.0 Starting time in sec. with
mechanism coupled through
flexible coupling
- a) with rated voltage : sec.
- b) with 80% rated voltage : sec.
- c) with 110% rated voltage : sec.
- 27.0 Safe stall time (Hot motor)
- a) at rated voltage : sec.
- b) at 80% rated voltage : sec.
- c) at 110% rated voltage : sec.
- 28.0 Safe stall time (Cold motor)
- a) at rated voltage : sec.
- b) at 80% rated voltage : sec.
- c) at 110% rated voltage : sec.

Name of vendor

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Revision number

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DATA SHEET - C				SPECIFICATION No.	
MV MOTORS				VOLUME IIB	SECTION D
				SHEET 4	OF 11
29.0	Whether speed switch is provided, if required	:	YES / NO		
30.0	Limiting rotor temp. to determine safe stall time	:			
31.0	Permissible maximum accelerating: time (hot motor) at full load	:			
	a) at rated voltage	:	sec.		
	b) at 80% rated voltage	:	sec.		
	c) at 110% rated voltage	:	sec.		
32.0	Permissible maximum accelerating: time (cold motor) at full load	:			
	a) at rated voltage	:	sec.		
	b) at 80% rated voltage	:	sec.		
	c) at 110% rated voltage	:	sec.		
33.0	Insulation	:			
	a) Class of insulation	:			
	b) Tropical and fungicidal treatment (mention treatment) given	:			
34.0	Whether insulation is suitable for 6.6 kV earthed system	:			
35.0	Temp. rise under normal and abnormal conditions over 50 °C ambient temperature	:			
	a) By resistance method	:	<div style="display: flex; justify-content: space-between;"> _____ °C over cooling water temp. of _____ °C </div>		
		:	<div style="display: flex; justify-content: space-between;"> _____ °C over cooling air temp. of _____ °C </div>		
	b) By thermometer method	:	<div style="display: flex; justify-content: space-between;"> _____ °C over cooling water temp. of _____ °C </div>		
		:	<div style="display: flex; justify-content: space-between;"> _____ °C over cooling air temp. of _____ °C </div>		
Name of vendor			Project		
Revision number	0	1	2	3	66 of 299, 78/0/12
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MV MOTORS

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SECTION D

SHEET 5

OF 11

- 36.0 Method of starting :
- 37.0 Permissible starting duty cycles :
- 38.0 Stator thermal time constant :
- 39.0 Maximum permissible voltage : _____ % of rated
during high speed bus voltage for _____
transfer & its duration duration
(describe special design feature)
- 40.0 Time required for voltage to decay down to following values when driving voltage is removed
- a) 50% : sec.
- b) 40% : sec.
- c) 25% : sec.
- d) 0% : sec.
- 41.0 Method of cooling :
- 42.0 Details of water cooling system
- a) No. of coolers :
- b) Water requirement per cooler : LPM
- c) Losses removed by cooler :
- d) Max. permissible temp. : °C
of cooling water at inlet
- e) Maximum permissible temp. : °C
of cooling water at outlet
- f) Maximum permissible : kg/sq.cm
pressure at water outlet
- g) Water pressure drop through :
the cooler

Name of vendor

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MV MOTORS

VOLUME IIB

SECTION D

SHEET 6

OF 11

h) Temp. of cold air coming:
out & entering the machine
for permissible cooling
water temperature

°C

i) Temp. rise of air passing:
through machine at full
load

°C

j) Air pressure drop through:
the cooler

k) Temp. rise of water :
through cooler

°C

l) Protection against :
leakage of water

m) Arrangement to ensure the:
water flow

43.0 Bearings

a) Number :

b) Type :

c) Lubrication System :

d) Quantity of lubricant :
required for both the
bearings

e) Life at rated speed :

hrs.

f) Recommended lubricant :

g) Bearing end play :

h) Inlet oil pressure :

i) Temp. rise of oil through:
bearing

°C

j) Max. permissible temp :
of oil

°C

k) Max. permissible temp. :
of bearing

°C

Name of vendor

Project

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DATA SHEET - C				SPECIFICATION No.	
HV MOTORS				VOLUME II B	SECTION D
				SHEET 7	OF 11
1)	Permissible running time :				without forced oil at full load & full speed
m)	Whether bearings are provided with 3 wire, platinum RTD having 100 ohm resistance at 0°C for remote temp. indication				YES / NO
n)	Whether bearings are provided with local temp. indicator having two adjustable contacts rated for 2A at 240V AC or 0.2A at 220V DC				
o)	If forced lube oil system provided				
	i. Qty. of lubricant required for initial filling				
	ii. Recommended period after which lubricant should be replaced				
	iii. Bearing cooling water requirement				
	iv. Max. permissible bearing cooling water inlet temp.				°C
	v. Max. permissible bearing cooling water outlet temp.				°C
44.0	Terminal designation corresponding to direction of rotation (facing driving end)				
45.0	Whether separate terminal boxes provided for				
a)	Main terminals				YES / NO
Name of vendor			Project		
Revision number	0	1	2	3	
Vendor's signature					

DATA SHEET - C				SPECIFICATION No.	
MV MOTORS				VOLUME IIB	SECTION D
				SHEET 8	OF 11
	b)	Space heaters	:	YES / NO	
	c)	Winding temp. detectors	:	YES / NO	
	d)	Bearing temp. detectors	:	YES / NO	
	e)	Moisture detectors	:	YES / NO	
	f)	Neutral terminals	:	YES / NO	
46.0 Main terminal box details					
	a)	Type & Nos.	:		
	b)	Fault level permissible for 0.25 sec.	:	MYA	
	c)	Rating of each	:		
	d)	Total power requirement	:		
	e)	Voltage	:	V	
47.0 Details of 3 wire, platinum RTD having 100 ohm resistance at 0°C for winding temp. & bearing temp. detectors					
	a)	Type	:		
	b)	Nos. provided	:		
	c)	Location	:		
48.0 Whether differential protection provided. If yes,					
	a)	no. of CTs supplied along with motors	:		
	b)	CT details	:		
		i. CT ratio	:		
		ii. Knee point voltage	:		
		iii. Short ckt. with-stand capacity	:		
49.0 Type of mounting :					
Name of vendor			Project		
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DATA SHEET - C				SPECIFICATION No.	
MV MOTORS				VOLUME 11B	SECTION D
				SHEET 9	OF 11
50.0	Shaft orientation	:			
51.0	Shaft extension	:			
52.0	Grounding pads, sizes, nos. & location	:			
53.0	Method of coupling to driven mechanism	:			
54.0	GD sq. value				
	a) of the motor	:			
	b) of the mechanism referred to the motor shaft	:			
55.0	Thermal inertia of the motor	:			
56.0	Whether the speed switch provided	:	YES / NO		
57.0	Details of speed switch, if provided	:			
58.0	Compliance with testing requirements	:	YES / NO		
59.0	Lifting Device	:			
60.0	Weight				
	a) Weight of stator (wound)	:			
	b) Weight of rotor (wound)	:			
	c) Weight of base plate	:			
	d) Weight of Copper	:			
	e) Net weight of motor	:			
61.0	Shipping details				
	a) Shipping dimensions	:			
	b) Shipping weight	:			
Name of vendor				Project	
Revision number	0	1	2	3	
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SHEET 10

OF 11

62.0 Whether dial type capillary :
thermometers with temperature
switch provided

- a) In cold air / water path :
b) In hot air / water path :
c) For measurement of oil :
temp. for bearings

63.0 Characteristic curves attached

- a) Speed vs current at : YES / NO
rated voltage
b) Speed vs torque at 110%, : YES / NO
100%, 90% and 80% of
rated voltage
c) Thermal withstand curve : YES / NO
for hot & cold conditions
d) Efficiency vs load : YES / NO
e) p.f. vs load : YES / NO
f) Current vs time : YES / NO
g) Negative phase sequence : YES / NO
curve

64.0 Drawings attached

- a) General arrangement of : YES / NO
motor
b) Main terminal box showing : YES / NO
Boards's incoming cables
c) Instruction manuals : YES / NO

65.0 Other Documents Attached

- a) Final Quality Plan : YES / NO
b) Final Field Quality Plan : YES / NO

Name of vendor			Project		
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SECTION D

SHEET 11

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65.0 List of Spares

Commissioning Spares

O&M Spares

Name of vendor

Project

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SPECIFIC ELECTRICAL REQUIREMENT FOR CAS

SL.NO.	PARAMETERS	UNIT	LT MOTORS	HT MOTORS
	MOTOR			
1	DESIGN AMBIENT TEMP	DEG. C	50	50
2	VOLTAGE SUPPLY AND VARIATION	KVOLT	0.415± 10%	11/3.3± 10%
3	FREQUENCY WITH VARIATION	Hz	50± 5%	50± 5%
4	COMBINED VOLTAGE & FREQUENCY VARIATION (sum of absolute values)		10%	10%
5	MAX ACCEPTABLE RATING OF MOTOR	KW	AT 415 V 174 KW & below	AT 3.3 KV 175 KW upto & including 1499 KW AT 11 KV 1500 KW & above
6	SYSTEM FAULT LEVEL AND ITS DURATION	KA	50kA, 1sec	50kA, 3sec
7	SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION		50 KA, 0.25 sec	50 KA, 0.25 sec
8	CLASS OF INSULATION & TEMP RISE LIMITED TO		Class-F and temp rise limited to Class-B	Class-F and temp rise limited to Class-B
9	MIN. STARTING VOLTAGE		80%	80%
10	MOTOR RATING FOR SINGLE PHASE SUPPLY		0.2 kW & Below	--
11	MAXIMUM LOCKED ROTOR CURRENT	% OF FLC	600% subject to 20% tol.	600% inclusive of IS tol.
12	ACCEPTABLE NOISE LEVEL	DB	Noise level for all motors shall be limited to 85dB(A) at 1 m	Noise level for all motors shall be limited to 85dB(A) at 1 m
13	TYPE OF STARTER PROVIDED IN MCC		DOL	DOL
14	DOP OF ENCLOSURE		IP-55 & IP-54 for outdoor & indoor resp.	IP-55 & IP-54 for outdoor & indoor resp.
15	SPACE HEATER REQUIREMENT	<30kW	30KW & ABOVE	YES
16	PAINT SHADE		during detailed engineering	during detailed engineering
17	SPECIAL REQUIREMENT		n.a	n.a

	TITLE	SPECIFICATION NO.
	<p align="center">MOTOR</p> <p align="center">DATA SHEET - C</p>	VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 1 OF 2


S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c)	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB)		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		


NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			


	TITLE	SPECIFICATION NO.
	<p align="center">MOTOR</p> <p align="center">DATA SHEET - C</p>	VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		SHEET 2 OF 2


S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	


NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			


		QUALITY PLAN		CUSTOMER :				PROJECT				SPECIFICATION :			
				BIDDER/ VENDOR				TITLE				NUMBER :			
				SYSTEM				QUALITY PLAN				SPECIFICATION			
				CAT.				REFERENCE DOCUMENT				TITLE			
SL. NO.	COMPONENT/OPERATION	SHEET 1 OF 2		CHARACTERISTICS CHECK	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	6	7	8	9	10	11	REMARKS		
1	2	3	4	5	6	7	8	9	10	11					
1.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUF'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	-					
2.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	3	-					
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	3	-					
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	3	-					
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	3	2.1	2.1	NOTE -1			
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-				
BHEL															
PARTICULARS				BIDDER/VENDOR											
NAME															
SIGNATURE															
DATE															
BIDDER'S/VENDORS COMPANY SEAL															


		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :			
		SHEET 2 OF 2		BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION : TITLE :			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	SYSTEM CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ITEM AC ELECT. MOTORS BELOW 75KW (LV)	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS
1	2	3	4	5	6	7	8	9	10	11	
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	3	1	-
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.											
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE				BIDDER'S/VENDORS COMPANY SEAL					


		QUALITY PLAN SHEET 1 OF 9		CUSTOMER :		PROJECT		SPECIFICATION :			
				BIDDER/ :		TITLE		NUMBER :			
				VENDOR :		QUALITY PLAN		SPECIFICATION :			
				SYSTEM		NUMBER PED-506-00-Q-007/2		TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS	
1	2	3	4	5	6	7	8	9	10	11	
1.0	RAW MATERIAL & BROUGHT CONTROL										
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
BIDDER'S/VENDORS COMPANY SEAL											


		QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :			
				BIDDER/ VENDOR		TITLE		NUMBER :			
				SYSTEM		QUALITY PLAN		SPECIFICATION :			
				CAT.		NUMBER PED-506-00-Q-007/2		TITLE			
SL. NO.	COMPONENT/OPERATION	SHEET 2 OF 9	CHARACTERISTIC CHECK	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS	
1	2	3	4	5	6	7	8	9	10	11	
1.5	SHAFT (FORGED OR ROLLED)		MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
			MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2
			MA	MEASUREMENT	100%	-DO-	MANUF'R'S DRG.	LOG BOOK	3	-	-
			CR	UT	-DO-	ASTM-A388	MANUF'R'S SPEC.	-DO-	3	2	1
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S		MA	VISUAL	-DO-	MANUF'R'S DRG. SPEC.	MANUF'R'S DRG. SPEC.	-DO-	3	-	FOR DIA OF 55 MM & ABOVE
			MA	-DO-	-DO-	-	NO BREAKAGE ON OTHER PHY. DESIGN	-DO-	3	-	-
			MA	MEASUREMENT	SAMPLE	MANUF'R'S DRG./ SPEC.	MANUF'R'S DRG. / SPEC.	-DO-	3	-	-
			MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	-
BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME								
			SIGNATURE								
			DATE								
BIDDER'S/VENDORS COMPANY SEAL											


		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION :					
								NUMBER :					
								TITLE					
								SPECIFICATION :					
SL. NO.	COMPONENT/OPERATION	SHEET 3 OF 9	CHARACTERISTIC CHECK	SYSTEM CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			VOLUME III REMARKS
										AGENCY	AGENCY		
											P	W	
1		2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.		1. SURFACE COND. 2. OTHER CHARACTERISTICS	MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3	-	-	
1.8	SHEET STAMPING (PUNCHED)		1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
			2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUF'S DRG.	MANUF'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
			3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS		1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3	-	-	
			2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH. TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3/2	-	2	
BHEL				PARTICULARS			BIDDER/VENDOR						
				NAME									
				SIGNATURE									
				DATE									
											BIDDER'S/VENDORS COMPANY SEAL		


<div></div>		CUSTOMER :		PROJECT		SPECIFICATION :					
QUALITY PLAN		BIDDER/ VENDOR		TITLE		NUMBER :					
SHEET 4 OF 9		SYSTEM		QUALITY PLAN		TITLE					
CHARACTERISTIC CHECK		ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)		SECTION		VOLUME III					
SL. NO.	COMPONENT/OPERATION	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS	
								P	W		V
1	2	3	4	5	6	7	8	9	10	11	
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	Log Book	3	-	-	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG.	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-
1.11	SLIP RING	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	-DO-	3	-	-	-
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC.	-DO-	3	-	-	-
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	3	-	-	-
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	-DO-	-DO-	3	-	-
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	-DO-	3	-	-	-
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
						BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION :		
		SHEET 5 OF 9		BIDDER/ : VENDOR		QUALITY PLAN		NUMBER :		
		CHARACTERISTIC CHECK		SYSTEM CAT.		ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)		TITLE		
		SL. NO.	COMPONENT/OPERATION	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS
1	2	3	4	5	6	7	8	9	10	11
2.0	IN PROCESS									
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3	-
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	3	-
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ASTM-E165	MANUF'S SPEC./BHEL SPEC./	-DO-	3	- 1
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANUF'S SPEC./BHEL SPEC./RELEVANT STAND	BHEL SPEC./SAME AS COL.7	LOG BOOK	3	-
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	3	- 2
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	3	-
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	3	-
BHEL										
PARTICULARS			BIDDER/VENDOR							
NAME										
SIGNATURE										
DATE										
BIDDER'S/VENDORS COMPANY SEAL										

			CUSTOMER :			PROJECT			SPECIFICATION :			
			BIDDER / VENDOR :			TITLE			NUMBER :			
QUALITY PLAN			SYSTEM			QUALITY PLAN			SPECIFICATION :			
SHEET 6 OF 9			ITEM: AC ELECT. MOTORS 75kW & ABOVE (LV & MV)			NUMBER PED-508-00-Q-007/2			TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10	11		
2.4	SHEET STACKING	1.COMPLETENESS 2.COMPRESSION & TIGHTENING 3.CORE LOSS & HOTOPOT	MA	MEASUREMENT	SAMPLE	MANUFRRS SPEC.	MANUFRRS SPEC.	Log Book	3	-	-	
2.5	WINDING	1.COMPLETENESS 2.CLEANLINESS 3.IR-HV-IR 4.RESISTANCE 5.INTERTURN INSULATION 6.SURGE WITH STAND AND TAN. DELTA TEST	CR	MEASUREMENT ELECT. TEST	100%	MANUFRRS SPEC./BHEL SPEC.	MANUFRRS SPEC./BHEL SPEC.	Log Book	3	-	-	(FOR MOTORS OF 2MW AND ABOVE)
2.6	IMPREGNATION	1.VISCOSITY 2.TEMP. PRESSURE VACCUUM 3.NO. OF DIPS	MA	PHY. TEST PROCESS CHECK	AT STARTING	-DO-	-DO-	Log Book	3	-	-	
BHEL												
PARTICULARS												
BIDDER/VENDOR												
NAME												
SIGNATURE												
DATE												
BIDDER'S/VENDORS COMPANY SEAL												

			QUALITY PLAN			CUSTOMER :			PROJECT			SPECIFICATION :		
SHEET 7 OF 9			BIDDER/ VENDOR			TITLE			NUMBER :			SPECIFICATION :		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT. SYSTEM	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION		VOLUME III			
									P	W	V	REMARKS		
1	2	3	4	5	6	7	8	9	10	11				
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION 1.COMPACTNESS & CLEANLINESS	MA MA	-DO- VISUAL	-DO- 100%	-DO- -DO-	-DO- -DO-	Log Book Log Book	3 3	- -	2 -			
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS	CR CR	-DO- MALLET TEST & MV TEST	-DO- -DO-	-DO- -DO-	-DO- -DO-	Log Book Log Book	3 3	- -	- -			
2.9	COMPLETE ROTOR ASSEMBLY	3.HV 1.RESIDUAL UNBALANCE 2.SOUNDNESS OF DIE CASTING	MA CR	ELECT. TEST DYN. BALANCE	-DO- -DO-	-DO- MFG SPEC./ ISO 1940	-DO- MFG. DWG.	Log Book Log Book	3 3	- 2	1	VERIFICATION FOR MV MOTOR ONLY		
2.10	ASSEMBLY	1.ALIGNMENT 2.WORKMANSHIP 3.AXIAL PLAY 4.DIMENSIONS	MA MA MA MA	MEAS. VISUAL MEAS. -DO-	-DO- -DO- -DO- -DO-	-DO- -DO- -DO- MFG.DRG./ MFG SPEC.	-DO- -DO- -DO- MFG. DRG/ RELEVANT IS	Log Book Log Book Log Book Log Book	3 3 3 3	- - - -	- -			
		5.CORRECTNESS, COMPLETENESS, TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	3	-	-			
BHEL			PARTICULARS			BIDDER/VENDOR								
			NAME											
			SIGNATURE											
			DATE						BIDDERS/VENDORS COMPANY SEAL					

			QUALITY PLAN		CUSTOMER :		PROJECT		SPECIFICATION :			
			BIDDER/ VENDOR		TITLE		NUMBER :		SPECIFICATION :			
SHEET 8 OF 9			SYSTEM		ITEM: AC ELECT. MOTORS 75kW & ABOVE (LV & MV)		TITLE		SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10	11		
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3. VIBRATION 4. OVERALL DIMENSIONS AND ORIENTATION 5. DEGREE OF PROTECTION 6. NAME PLATE DETAILS 7. EXPLOSION FLAME PROOFNESS (IF SPECIFIED) 8. PAINT SHADE, THICKNESS & FINISH	MA	ELECT. TEST	1/T/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	3	1	1,2	NOTE - 1
			MA	-DO-	100%	-DO-	-DO-	-DO-	3	1,2	1,2	NOTE - 2
			MA	-DO-	100%	IS-12075	IS-12075	-DO-	3	1,2	-	
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	3	2,1	-	
			MA	ELECT. & MECH. TEST	1/T/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	3	-	2,1	TC FROM AN INDEPENDENT LABORATORY NOTE-3
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	3	2,1	-	
			MA	EXPLOSION FLAME PROOF TEST	1/T/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	3	-	2,1	NOTE-3
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	3	2,1	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE				BIDDER/SVENDORS COMPANY SEAL					

		CUSTOMER :				PROJECT :				SPECIFICATION :		
		BIDDER/ VENDOR :				TITLE :				NUMBER :		
QUALITY PLAN		NUMBER PED-506-00-Q-007/2				TITLE :				SPECIFICATION :		
SHEET 9 OF 9		ITEM: AC ELECT. MOTORS 75KW & ABOVE (LV & MV)				SECTION :				VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT. SYSTEM	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V	REMARKS
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.
4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION WITH THE CUSTOMERS, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

BHEL	PARTICULARS	BIDDER/VENDOR
	NAME	
	SIGNATURE	
	DATE	
		BIDDER/SVENDORS COMPANY SEAL

VOLUME – II B
SECTION – D
C&I

C&I SPECIFICATIONS FOR MAUX PACKAGES :

1. The requirements given below are to be read in conjunction with detailed Technical specification & data sheets-A enclosed elsewhere in the specification. In case of any contradiction between requirements spelt out herein (in Section-C) & those in Section-D, the former shall prevail. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre-bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.
2. The Bidder shall provide complete and independent control and instrumentation system with all accessories and associated equipments for FUEL OIL SYSTEM and shall be realized in hot redundant PLC based control system.
3. PLC shall be connected to DCS through dual redundant serial link with TCP/IP protocol OPC compliant for monitoring. The data communication system shall include a redundant Ethernet LAN having two identical but separate networks with redundancy for all communication controllers, network interfaces, Ethernet switches, and communication cable etc. and each network shall support full duplex communication with TCP/IP protocol having deterministic response.
4. Time synchronization of PLC with DCS is to be carried out. Necessary hardware/software for same at PLC end to be provided by vendor.
5. PLC shall be connected to DCS through dual redundant serial link with MODBUS on RS485 protocol for monitoring.
6. Fibre optic cable from PLC to DCS is excluded from bidder scope.
7. Each PLC has to be accompanied by a LIU (Light interface unit/Fibre patch chord) which has multi mode SC couplers / adapters.
8. Mounting of all interfacing hardware (information outlets, LIU/Patch Panel) and connectivity from PLC to LIU/patch panel (cabling, all interfacing etc) at PLC end, will be in PLC vendor scope.
9. The bidder to furnish the list of instruments and list of drives / loads along with their bid.
10. The Electric valve actuator, if applicable, shall be with integral starter.
11. Control valves shall have pneumatic actuators.
12. The UPS output Power supply shall be as per PLC specification.
13. Instrumentation Cable scope has been defined elsewhere in the specification.
14. PG/DPG/PS/PT (chemical/diaphragm seal for oil/chemical application).
15. LT mounted on tanks shall be DP type with chemical/diaphragm seal.
16. All transmitters & electronics items will be explosion proof / intrinsically safe as per hazardous area classification



**SPECIFICATION FOR
CONTROL & INSTRUMENTATION FOR AUX
PACKAGES**

SPECIFICATION NO.:

VOLUME II B

SUB SECTION D1

REV. NO. DATE :

SHEET OF

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems

2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

Standard Deliverables of C&I department for MAX Packages for customer submission

S ⁱ no.		Drawing no.	Drawing/Document title	Category	Remarks
A	1	PE-DM-XXX-145-1900	CONTROL SYSTEM FOR MECHANICAL AUXILIARY SYSTEMS	A	
B			FOR MAUX PACKAGES WITH PLC BASED CONTROL SYSTEM		
	1	PE-V9-XXX-YYY-1911	PLC DATA SHEET	A	
	2	PE-V9-XXX-YYY-1912	PLC CONFIGURATION DIAGRAM	A	
	3	PE-V9-XXX-YYY-1915	PANEL EXTERNAL GA DRAWING	A	
	4	PE-V9-XXX-YYY-1917	CONTROL DESK LAYOUT/GA DRAWING	A	
	5	PE-V9-XXX-YYY-1921	LIST OF SIGNAL EXCHANGE WITH PLANT DCS (BOTH HARDWIRED & SERIAL INTERFACE)	A	IF DCS IS BY CUSTOMER
	6	PE-V9-XXX-YYY-1928	PLC QUALITY PLAN	A	
C			FOR MAUX PACKGES WITH RELAY BASED CONTROL SYSTEM		
	1	PE-V9-XXX-YYY-1950	LOCAL CONTROL PANEL DATA SHEET	A	
	2	PE-V9-XXX-YYY-1952	PANEL EXTERNAL GA DRAWING	A	
	3	PE-V9-XXX-YYY-1955	LIST OF HARDWIRED SIGNAL EXCHANGE WITH DCS	A	IF DCS IS BY CUSTOMER
D			FOR MAUX PACKAGES WITH DCS CONTROL		
	1		NIL		

Note:

- 1 Deliverables at 'A' above shall be for a project
- 2 Deliverables at 'B', 'C', 'D' shall be for each applicable MAUX packages

Control Interface for Drives :

1. Control interface for LT drives :

Following signal exchange shall take place between LCP/PLC and MCC

- i. Drive Start / Stop command to MCC
- ii. Drive ON & OFF feedback from MCC.
- iii. MCC Disturbance (Thermal Overload ,control supply fail, EPB operated, MCC isolated) feedback from MCC
- iv. Current measurement for drives $\geq 30\text{KW}$ & Critical Drives $< 30\text{KW}$.

2. Control interface for Valve Actuator (with integral starter) :

Following signal exchange shall take place between LCP/PLC and Actuator:

- i. Drive Open / Close command to Actuator
- ii. Drive Opened / Closed Feedback from Actuator.
- iii. Actuator Disturbance / Fault feedback from Actuator
- iv. Position feedback from Actuator (for inching type of valve)

3. Control interface for Solenoid valves:

Following signal exchange shall take place between LCP/PLC and Solenoid valve:

- i. Drive energize / De-energize command to Solenoid valve
- ii. Open LS / Close LS feedback from Solenoid valves

SPECIFICATION NO. PES-145-36	
VOLUME II-B	
SECTION D	
REV. NO. 02	DATE: July 19, 2008
SHEET 1	OF 9

SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM

TITLE:



1. SCOPE

This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection and commissioning of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O cards, power supply packs etc.), Operator workstations (OWS), Printers, Annunciation system, UPS, cables and all other equipments and accessories required for completeness of the system as mentioned in different sections of this specification.

2. GENERAL

2.1. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function).

2.2. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The system shall have self-diagnostic features. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B.

2.3. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware / software interface for two-way transfer of signals.

2.4. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Data sheets).

2.5. In case OWS is provided, HMI functions like Trends, Curves, Bar charts, Historical storage of Data, Logs and reports etc. shall be provided in addition to Plant-schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.

2.6. It shall be possible to use the same OWS as programming station.

2.7. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.

2.8. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.

2.9. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.


3. TECHNICAL REQUIREMENTS

Details of various PLC system components shall be inclusive of but not limited to the following:


3.1. CODES AND STANDARDS

3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.


- 3.1.2. PLC shall conform to IEC: 1131
- 3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.
- 3.2. CONTROL PANEL
- 3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like indicators, ammeters etc. and facia windows for critical alarms.
- 3.2.2. The salient features of construction shall be:
- Sheet material: Cold rolled sheet steel
 Frame thickness: Not less than 3.0mm
 Enclosure thickness: Not less than 2.0 mm for load bearing sections (mounted with instruments) and Not less than 1.6 mm for others
 Gland plate thickness: 3.0mm
 Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.
- 3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicoid, with engraved lettering.
- 3.2.4. 25 x 6 mm Copper ground bus to be provided for each panel.
- 3.2.5. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.
- 3.2.6. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet for PLC system"-Data Sheet-A&B.
- 3.2.7. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

		TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM	
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- 3.3. PROCESSORS**
- 3.3.1. The microprocessors shall be 32 bit, and Hot redundant.
- 3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.
- 3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.
- 3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.
- 3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.
- 3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.
- 3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.
- 3.3.8. The memories shall be field expandable.
- 3.4. INPUT / OUTPUT Modules**
- 3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.
- Analog Input Module: 16
 - Analog Output Module: 16
 - Binary Input Module: 32
 - Binary Output Module: 32
 - Analog Input/output combined: 16
 - Binary Input/output combined: 32
- 3.4.2. On line I/O replacement: All I/O cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.
- 3.4.3. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.

		SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM		TITLE:	
				SPECIFICATION NO. PES-145-36	
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TITLE: SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM			
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3.4.4. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per "Data sheet A & B for PLC System". In case coupling relays are located in PLC Panel, the same shall be in PLC vendor's scope of supply.

3.4.5. Status feedback from MCC shall be in the form of potential free contact.

3.5. DATA BUS/ I/O BUS

3.5.1. The Data bus connecting PLC and HMI work stations shall be TCP/IP on Ethernet.

3.5.2. The Data bus and I/O bus communication medium shall be twisted pair shield copper conductor for indoor locations and those areas not subjected to induced signals. Repeaters/signal amplifiers shall not be used. Copper conductor cable used shall be Category-5 or better. The communication medium shall be Fibre optic cable in the event any portion of communication cable run is in outdoor or where distances are beyond 500 meters.

3.6. OPERATOR WORK STATION (OWS)

3.6.1. The OWS and Keyboard shall be desktop mounted and shall be used for controlling, monitoring and programming function.

3.6.2. Colour CRT(s) with keyboard and mouse shall be as per Data Sheet-A&B. CRT shall have graphic display facility.

3.6.3. The OWS shall be with Windows based operating system having necessary Engineering/Configuring software.

3.7. PRINTER

Printers shall be provided as per Data Sheet-A&B.

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SECTION D	
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SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM

TITLE:



- 3.8. COMMUNICATION WITH PLANT DCS**
- 3.8.1. The PLC system shall be provided with hardwired/serial interface for communication with plant DCS.
- 3.8.2. Serial communication to / from DCS where provided shall be engineered to ensure that signal communication time from / to DCS shall not exceed 1 seconds for control / feedback.
- 3.8.3. Serial communication to DCS shall be OPC (Data access 2.0), Ethernet based TCP/IP Protocol. Alternatively the serial communication shall be MODBUS protocol on RS 485 network.
- 3.8.4. Data transmitted from PLC to DCS shall include all information necessary for the DCS graphic displays to monitor and control the process equipment and PLC. Such data may include pertinent analog and digital status information, interlock, alarms and maintenance conditions. Data transmitted from DCS to the PLC shall include necessary signals to provide operator control interface from DCS for the process/ equipment being controlled by PLC.
- 3.8.5. Bidder to include 'Light interface units, converters, Ethernet switch, accessories at PLC end for connectivity to other system. The bidder's terminal point shall be Ethernet port in case of copper medium connection to DCS or LIU in case of fiber optic medium for connectivity with plant DCS. In case distance between PLC & DCS is greater than 1.8 Km, single mode of optical fiber cable with compatible accessories shall be used. For distance less than 1.8 Km multimode optical fiber ports shall be used.

3.9. POWER SUPPLY Scheme

- 3.9.1. PLC Panel and I/O Cabinets: PLC system shall be provided with 2x100% UPS fed from Two Nos. redundant 415V, 3-ph feeders, as per the scheme PE-SD-999-145-001, sh-08 of 08. Each UPS shall have 30 minutes back up. Input feeder failure shall be monitored in the PLC system. Necessary redundant power pack and transformers shall be provided (in the PLC panel) to derive the power supply for control desk, PLC panel and input / output cabinets etc
- 3.9.2. Remote I/O panels: Similar power supply arrangement as for PLC panels shall be provided if it is not possible to extend the power cable from UPS of PLC panels.
- 3.9.3. Each OWS and associated HMI peripherals shall be provided with a feeder from either one of the UPS

4. DRAWING/DOCUMENT AND DATA TO BE FURNISHED AFTER AWARD OF THE CONTRACT:

4.1. For Approval:

- PLC system configuration drawing along with functional write-up.
- Input/Output signal list.
- BOM of PLC
- List of PLC controlled devices
- Control panel/control desk GA drawings.
- Control desk/panel component layout drawing.
- Control panel/control desk Foundation detail and cutout drawings
- Power distribution scheme.

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SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM

TITLE:



- 4.2. For information:
- Block logic diagrams.
 - Annunciation list.
 - PLC control room layout drawing.
 - List of soft signal exchange with Plant DCS.
 - List of mandatory spares
 - Quality plan
 - Data Sheet-C
 - CRT display
 - Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

- Cable schedule and cable interconnection drawing(in BHEL approved format)
 - Between Field and PLC
 - Between Field and MCC
 - Between MCC and PLC
- Electronic earthing requirements.
- Panel Heat dissipation data
- Product/component catalogues.
- Operation & Maintenance Manual on CDs.
- Softcopy of Final/As-built drawings on CDs.
- Calculation for Processor, Memory & Data bus loading

The above list is the minimum requirements. Additional documents/calculations required shall be finalized during contract stage.

5. DRAWINGS AND DOCUMENTS TO BE SUBMITTED ALONG WITH THE BID

- Proposed PLC system configuration drawing with write-up
- Product catalogues and specifications for PLC as well as HMI application.
- Proposed power supply schemes for PLC system, peripherals, and Remote I/O panels.

6. TESTING AND INSPECTION

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
- Surge protection test as per IEC-225-4
 - Dry heat test as per IEC-68-2-2
 - Damp Heat test as per IEC-68-2-3

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SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM

TITLE:



- Vibration Heat test as per IEC-68-2-6
- Electrostatic discharge test as per IEC-801-2 or equivalent
- Radio frequency immunity test as per IEC-801-6 or equivalent
- Electromagnetic immunity test as per IEC-801-3 or equivalent

7. SPARES AND CONSUMABLES

- 7.1. Commissioning Spares and consumables
- The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.
- 7.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

7.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

7.4. Special Tools & Tackles

The bidder shall supply all Special Tools & Tackles 'as required' during Start-up and further maintenance of the system, as part of the main equipment supply.

7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 10 years after guarantee period.

8. MARKING AND PACKING

8.1. Marking:

A stainless steel name-plate shall be permanently fixed on each equipment giving its Tag/serial Number and salient technical specification.

8.2. Packing:


All equipment/materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in transit and storage in open.

9. PERFORMANCE AND GUARANTEE

<p>Form No. PEM-6666-0</p>		<p>SPECIFICATION NO. PES-145-36</p>	
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TITLE:

**SPECIFICATION FOR
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The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-II B Section - B or Section - C.

10. APPLICABLE DATA SHEET FORMS

This document shall be read with the following data sheet forms :

- Data Sheet A & B for PLC system - PE-DC-999-145-1036-1
- Data Sheet C for PLC system - PE-DC-999-145-1036-2

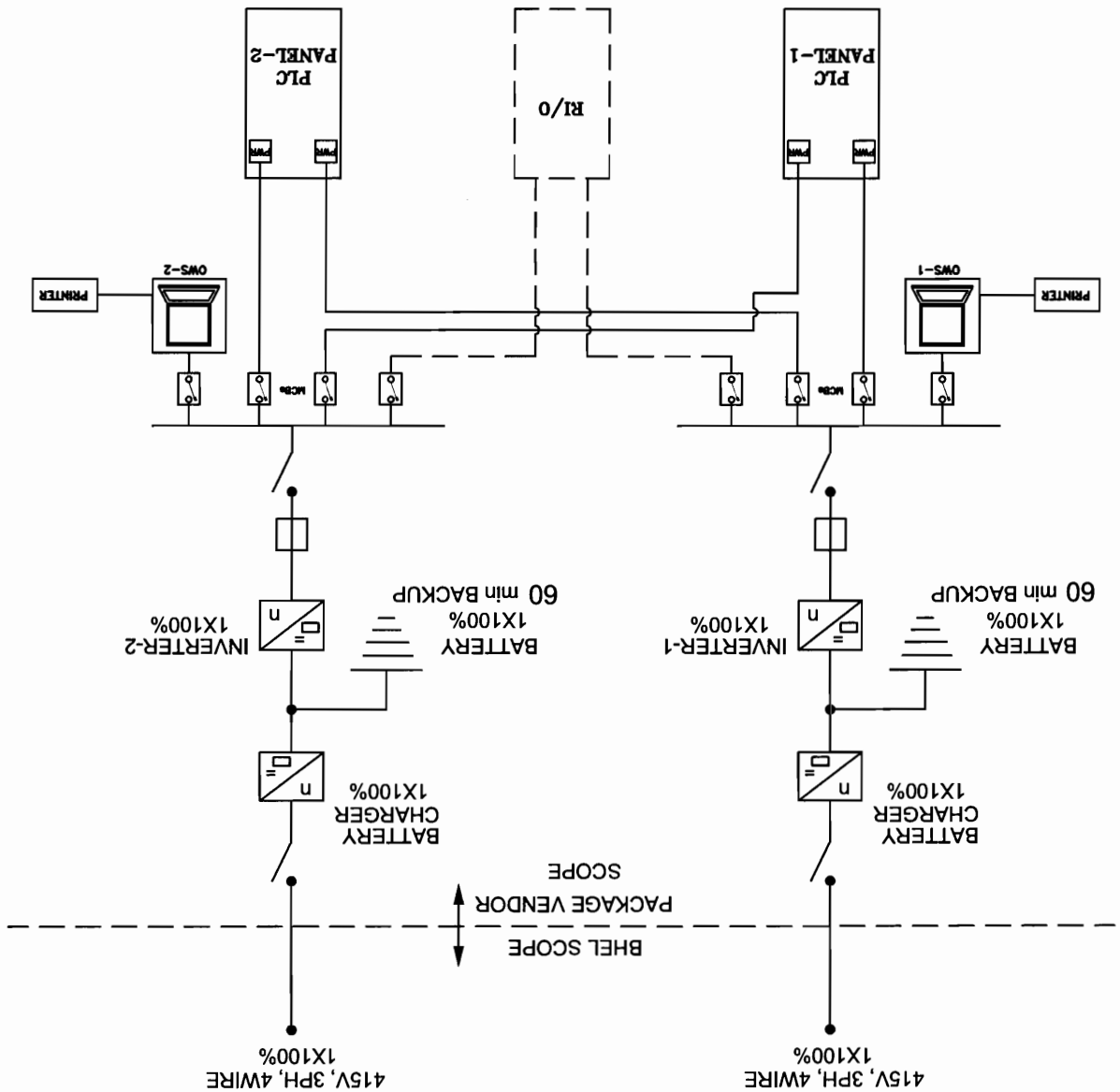
SHEET 09 OF 09		REV 00	
DRG. NO. PE-SD-999-145-001			
I	DEPT	NAME	SIGN
	DRN	GA	DATE
	DSGN	SSB	26.08.07
	CHD	AK	26.08.07
	APPD	AK	26.08.07
	AK		


BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI



TYPICAL POWER SUPPLY ARRANGEMENT FOR PLC BASED CONTROL SYSTEM

UPS SCHEME



		DATA SHEET FOR PLC SYSTEM		SPECIFICATION NO.:		VOLUME	II B
				SECTION		D	
				REV. NO.		02	
				DATE:		19.07.2008	
SHEET		1	OF	1	Data Sheet No.: PES-145-36-DS1-0		
Data Sheet A & B							
DATA SHEET-A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)							
DATA SHEET - B (TO BE FILLED BY BIDDER)							

PROJECT		2X800 MW - Yermarus STPP	
SERVICE			
QUANTITY		<input type="checkbox"/> UNITS <input checked="" type="checkbox"/> COMMON	
LOCATION		<input checked="" type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR	
MAKE / MODEL NO.		BIDDER TO INDICATE	
PROCESSOR		REDUNDANT WITH HOT STANDBY	
DATA BUS (HMI)		<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC	
DATA BUS (I/O - CPU)		<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC	
DATA BUS (REMOTE I/O - CPU)		<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC	
FIELD CONTACTS INTERROGATION VOLTAGE		<input checked="" type="checkbox"/> 24 V <input type="checkbox"/> 48 V	
LOCATION OF COUPLING RELAYS		<input type="checkbox"/> MCC <input checked="" type="checkbox"/> PLC PANEL	
DESKTOP OWS QUANTITY		<input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO <input type="checkbox"/>	
DESKTOP MONITOR TYPE		<input type="checkbox"/> 19" <input checked="" type="checkbox"/> 21" TFT/CRT MONITOR	
PRINTER (A4) - QUANTITY		INKJET LASER BW COLOR INKJET COLOR LASER _____ _____ _____ 01	
PRINTER (A4) - MODEL		INKJET LASER BW COLOR INKJET COLOR LASER _____ _____ _____ 01	
PROGRAMMING / CONFIGURATION FACILITY		A) <input type="checkbox"/> HAND HELD B) <input checked="" type="checkbox"/> ENGINEERING SOFTWARE <input type="checkbox"/> ONE OWS <input type="checkbox"/> ALL OWS	
SAFETY STANDARD			
COMPUTER FURNITURE		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
QUANTITY		BIDDER TO INDICATE	
CLASS OF PROTECTION		<input checked="" type="checkbox"/> IP-55 <input type="checkbox"/>	
REMOTE I/O PANEL		<input type="checkbox"/> YES <input type="checkbox"/> NO	
COLOUR		AS PER IS-5 SHADE	
BACK-UP DESK		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	
MIMIC		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	
CONTROL HARDWARE		<input type="checkbox"/> PB <input type="checkbox"/> INDICATORS <input type="checkbox"/> FACIAS Nos. _____ <input type="checkbox"/> OTHERS	
HARDWIRED		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	
PURPOSE		<input type="checkbox"/> CONTROL <input checked="" type="checkbox"/> MONITORING	
MEDIUM		<input type="checkbox"/> UTP <input type="checkbox"/> FIBRE OPTIC <input type="checkbox"/> OTHERS	
TIME SYNCHRONIZATION SIGNAL FORMAT		<input type="checkbox"/> PULSE <input type="checkbox"/> RS-485 <input checked="" type="checkbox"/> IRI-G-B	
SOFTLINK		<input type="checkbox"/> MODBUS <input checked="" type="checkbox"/> OPC	
SERIAL LINK		COMMUNICATION PORT TYPE	
PLC PANEL		BIDDER TO INDICATE LOAD DATA	
POWER SUPPLY INPUT FEEDER		BIDDER TO INDICATE LOAD DATA	



DATA SHEET FOR PLC SYSTEM

SPECIFICATION NO.:

VOLUME II B

SECTION D

REV. NO. 02

DATE: 19.07.2008

SHEET 1 OF 1

Data Sheet No.: PES-145-36-DS2-0

Data Sheet C

DATA SHEET - C
(TO BE FILLED BY BIDDER AFTER AWARD OF CONTRACT)

GENERAL*	PROJECT	
	SERVICE	
	QUANTITY	
	LOCATION	
PLC EQUIPMENT	MAKE / MODEL NO.	
	PROCESSOR	
	DATA BUS (HMI)	
	DATA BUS (I/O - CPU)	
	DATA BUS (REMOTE I/O - CPU)	
	FIELD CONTACTS INTERROGATION	
	VOLTAGE	
	LOCATION OF COUPLING RELAYS	
	DESKTOP OWS QUANTITY	
	DESKTOP MONITOR TYPE	
	PRINTER (A4) - QUANTITY	
	PRINTER (A4) - MODEL	
	PROGRAMMING / CONFIGURATION FACILITY	
	SAFETY STANDARD	
	COMPUTER FURNITURE	
	QUANTITY	
	CLASS OF PROTECTION	
	REMOTE I/O PANEL	
	COLOUR	
	BACK-UP DESK	
MIMIC		
CONTROL HARDWARE		
COMMUNICATION TO OTHER SYSTEM	HARDWIRED	
	PURPOSE	
	MEDIUM	
	TIME SYNCHRONIZATION SIGNAL FORMAT	
	SOFTLINK	
	SERIAL LINK	
POWER SUPPLY INPUT FEEDER	PLC PANEL	
	REMOTE I/O PANEL	

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FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

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iii) Type (Hot or Cold)

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Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard. Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

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6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.

- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.

- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:— Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

- ii). Engineering features:-

- a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

- iii). HMI features:-

- Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

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ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.




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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	Materials /Components	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps										
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Signal Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

LEGEND:	* CR	- Critical characteristics	\$	P	- Agency Performing the Test.	1	- BHEL
	MA	- Major characteristics		W	- Agency Witnessing the Test.	2	- Vendor
	MI	- Minor characteristics		V	- Agency Verifying the Test.	3	- Sub-vendor

<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  <p>भारतीय वैद्युत मशीन</p> </div> <div style="text-align: center;"> <p>STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER</p> </div> </div>										QUALITY PLAN NO.: PE-QP-999-145-1036			
VOLUME IIB													
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]	Remarks			
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	<div style="display: flex; justify-content: space-around;"> <div>P</div> <div>W</div> <div>V</div> </div>				

LEGEND:			§		
* CR	- Critical characteristics		P	- Agency Performing the Test.	1 - BHEL
MA	- Major characteristics		W	- Agency Witnessing the Test.	2 - Vendor
MI	- Minor characteristics		V	- Agency Verifying the Test.	3 - Sub-vendor



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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
2.0	Assembly											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

§ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ⁵			Remarks
									P	W	V	
3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desktop Verification	Operation of PLC driven annunciator system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics⁵ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.1 - BHEL
2 - Vendor
3 - Sub-vendor

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INSTRUMENTS QUALITY PLANS



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STANDARD QUALITY PLAN
FOR
PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	Material / Components											
1.1	Casing, Bourdon tube, and Movement	1. Chemical composition 2. Workmanship, finish and dimensions	MA	Chemical Test	One Sample from each lot	Approved drg. / data sheet / BHEL Spec.	Relevant raw material std.	Test Certificate	3/2	---		2.1# # Compliance certificate to be verified.
			MA	Visual, Measurement	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Inspection Report / Log Book	3/2	---		2.1#
1.2	Switch⊕	Contact type & number	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate/ Inspection Report	3	---		2.1# ⊕Applicable for gauge with switch device
2.0	Assembly	1. Marking – Tag No., Model, Range 2. Workmanship 3. Dial size, scale graduation 4. End connections	MA	Visual	100%	- do -	- do -	Inspection Report	2	1		---
			MA	Visual	100%	- do -	- do -	- do -	2	1		---
			MA	Visual	100%	- do -	- do -	- do -	2	1		---
			MA	Measurement	100%	- do -	- do -	- do -	2	1**		1
		⊕5. Switch – contact type & nos.	MA	Visual	100%	- do -	- do -	Inspection Report	2	1		---
3.0	Routine Test	1. Calibration, accuracy, Hysteresis, overload, set point adjustment⊕ / repeatability	CR	Measurement	100%	- do -	- do -	- do -	2	1**		1

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

§ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-Vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

QUALITY PLAN NO.: PE-QP-999-145-1026	
VOLUME	IIB
SECTION	D
REV. NO.	01
SHEET	2
DATE:	16.05.2007

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]				Remarks
									P	W	V		
		2. Hydraulic Test	CR	Measurement	100%	Approved drg. / data sheet / BHEL Spec.	No Leakage	Inspection Report	2	1**	1		
		Ø3. IR, HV	CR	Measurement	100%	Relevant standard	Relevant standard	- do -	2	1**	1		
4.0	Type Test	1. Enclosure Protection Class	CR	Verification	Each type	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate	2	---	1*		•Type Test Certificate to be verified
		2. Blow out disc	CR	Verification	Each type	- do -	- do -	- do -	2	---	2*		
		Ø3. Switch contact rating	CR	Verification	Each type	- do -	- do -	- do -	2	---	2*		
5.0	Painting	Shade & Finish	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec. / Manufacturer's std.	Approved drg. / data sheet / BHEL Spec. / Manufacturer's std.	Inspection Report	2	---	2		
6.0	Packing	Soundness	MA	Visual	100%	- do -	- do -	- do -	2	---	---		

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W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-Vendor



PEM :: C&I

STANDARD QUALITY PLAN
FOR
PRESS AND DIFF PRESS SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-1031	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	16.05.2007
SHEET	1 OF 3

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
1.0	Raw Material/ Component Sensing Element, Casing, Contact, Process Connection	1. Chem. Composition	MA	Chemical Analysis	1 sample from each lot	BHEL Spec. / Approved data sheet	Relevant material standard	Test Report	3/2	—	2.1	Relevant compliance certificate to be verified.
		2. Make, Marking, Damage and Cracks	MA	Visual	100%	BHEL spec. / manufacturer standard	BHEL spec. / manufacturer standard	Log Book	2	—	—	
		3. Leakage (Element Conn.)	MA	Pressure Test	100%	Manufacturer standard	No Leak	Log Book	2	—	—	
		1. No. and type of contacts	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Log Book	3/2	—	2.1	
2.0	Final Inspection	2. Continuity	CR	Electrical	100%	Manufacturer standard	To have continuity	Log Book	3/2	—	2.1	
		1. Marking: Range, Model, Tag No. Sl.No.	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	—	
2.1	Assembly	2. Correct assembly, workmanship and finish	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	1	—	10% to be witnessed by BHEL - do -

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W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

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PEM :: C&I

STANDARD QUALITY PLAN FOR PRESS AND DIFF PRESS SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-1031	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	16.05.2007
SHEET	2 OF 3

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
		3. Connection	MA	Visual & Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	—	10% to be witnessed by BHEL
		4. Scale Marking	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	—	- do -
		5. Cleanliness	MA	Visual	100%	Manufacturer standard	Free from scratches dirt etc.	Log Book	2	1	—	- do -
		6. Overall Dimension	MA	Measurement	100%	BHEL Spec. / Approved drg.	BHEL Spec. / Approved drg.	Inspection Report	2	1	—	- do -
		1. Overload	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
		2. Repeatability	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
2.2	Routine Test	3. Set point adjustment	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
		4. Differential	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -

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1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR PRESS AND DIFF PRESS SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-1031	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	16.05.2007
SHEET	3 OF 3

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		5. Contact Rating	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	—	1	Manufacturer compliance certificate to be verified.
		6. Insulation Resistance & HV	CR	Electrical	100%	Relevant standard	Relevant standard	Test Report	2	1	1	10% to be witnessed by BHEL
		7. Calibration Test	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
		8. Accuracy Test	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
2.3	Type Test	1. Weatherproofness	CR	Measurement	1 sample / design	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	3/2	—	1	Vendor to furnish test report for verification
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	—	

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MI - Minor characteristics

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W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR RESISTANCE TEMPERATURE DETECTOR AND THERMOWELL

QUALITY PLAN NO.: PE-QP-999-145-1025	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	15.03.99
SHEET	1 OF 2

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	Raw Material / Component											
1.1	Resistance sheath	Material composition	CR	Chemical testing	Sample	Approved data sheet, BHEL Spec.	Relevant material std.	Test Certificate	3,2	---		2,1▲ ▲Relevant compliance certificate to be verified.
1.2	Protective Sheath	Material composition	MA	Chemical testing	Sample	Approved data sheet, BHEL Spec.	Relevant material std.	Test Certificate	3,2	---		2,1▲
1.3	Terminal Head	Material composition	MA	Chemical testing	Sample	Approved data sheet, BHEL Spec.	Relevant material std.	Test Certificate	3,2	---		2,1▲
1.4	Thermowell⊕	1. Chemical properties	CR	Chemical composition	One sample / Lot	Approved data sheet, BHEL Spec.	Relevant material std.	Test Certificate	3,2	---		2,1
		2. Dimensions (wall thickness concentricity of bore, OD & length)	MA	Measurement	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection report	2	1•		1 •BHEL to witness 25% Samples
		3. Threading	MA	Thread matching	100%	Approved data sheet/drg., BHEL Spec.	Approved data sheet/drg., BHEL Spec.	Inspection Report	2	2,1•		1
		4. Leak Test	CR	Hydro test at 1.5 times design press.	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection Report	3,2	2/1		---
2.0	Final Inspection											
2.1	RTD Assembly	1. Workmanship	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	2	2,1•		1
		2. Marking	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	2	2,1•		1

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

§ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

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PEM :: C&I

STANDARD QUALITY PLAN FOR RESISTANCE TEMPERATURE DETECTOR AND THERMOWELL

QUALITY PLAN NO.: PE-QP-999-145-1025	
VOLUME	IIB
SECTION	D
REV. NO.	00
SHEET	2
OF	2
DATE:	15.03.99

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
2.2	Routine Tests	3. Dimensions	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	2.1	1	
		1. Calibration (Resis Vs. Temp.)	CR	Measurement	100%	Approved dfg. IS:2848	BHEL Spec. IS:2848	Test Report	2	2	1	
		2. Insulation Resistance	MA	Electrical	100%	IS:2848	IS:2848	Test Report	2	1	—	
		3. Resistance Tolerance	MA	Thermal Elect.	100%	IS:2848	IS:2848	Test Report	2	1	—	
2.3	Type Test	4. Thermal Response time	CR	Measurement	Sample	IS:2848	IS:2848	Test Certificate	2	1	—	
		1. Immersion error Test	MA	Measurement	Sample	IS:2848	IS:2848	Test Certificate	3/2	—	1	
		2. Thermoelectric Effect	MA	Measurement	Sample	IS:2848	IS:2848	Test Certificate	3/2	—	1	
		3. Vibration Test	CR	Measurement	Sample	IS:2848	IS:2848	Test Certificate	3/2	—	1	
3.0	Packing	4. Enclosure protection test	CR		Sample	BHEL Spec.	BHEL Spec., Approved data sheet.	Test Certificate	3/2	—	1	* Test certificates to be verified.
		Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	—	

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V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

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PEM :: C&I

STANDARD QUALITY PLAN
FOR
LEVEL SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-1033	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	15.03.99
SHEET	1 OF 3

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	Raw Material/ Component											
1.1	Non Wetted Parts	Physical, Chemical properties	MA	Physical, Chemical Analysis	1/ Cast	BHEL Spec/ Approved drg. / data sheet	Relevant material standard	Test Report	3/2	—	—	2.1*
1.2	Float Assembly & Wetted Parts	Physical for float only & chemical properties for all wetted parts including float assembly	MA	Physical, Chemical Analysis	1/Batch	AISI:316 / BHEL spec. / drg. / Approved data sheet	AISI:316 / BHEL spec. / drg. / Approved data sheet / Relevant material std.	Test Certificate	3/2	—	—	2.1*
1.3	Chamber	Dimensions & leak tightness	MA	Measurement, visual, hyd. test	100%	BHEL Spec/ Approved drg. / data sheet	BHEL Spec/ Approved drg. / data sheet	Internal inspection report	3/2	2	1	
1.4	Float	Leak tightness	MA	Hyd. test	100%	BHEL Spec/ Approved drg. / data sheet	No leakage	Internal inspection report	3/2	2	1	
1.5	Switch	1.. Make, type and rating	MA	Visual	100%	BHEL / Mfr. spec.	BHEL / Mfr. spec.	Internal inspection report	3/2	—	—	2.1
2.0	Final Inspection	2. Contact Continuity	CR	Electrical	100%	BHEL / Mfr. spec.	BHEL / Mfr. spec.	To have continuity	3/2	—	—	2.1
2.1	Assembly	1. Marking: Range, Model, Tag No. Sl.No.	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	—	

LEGEND: * CR - Critical characteristics
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MI - Minor characteristics

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W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN
FOR
LEVEL SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-1033

VOLUME IIB

SECTION D

REV. NO. 00 DATE: 15.03.99

SHEET 2 OF 3

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ⁵			Remarks
									P	W	V	
		2. Correct assembly, workmanship and finish	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	1	—	
		3. Connection	MA	Visual & Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	—	
		4. Scale Marking	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	—	
		5. Cleanliness	MA	Visual	100%	Manufacturer standard	Free from scratches dirt etc.	Log Book	2	1	—	
		6. Overall Dimension	MA	Measurement	100%	BHEL Spec. / Approved drg.	BHEL Spec. / Approved drg.	Inspection Report	2	1	—	
		1. Overload	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1❖	1	❖BHEL to witness 25% sample.
2.2	Routine Test	2. Repeatability	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1❖	1	
		3. Set point adjustment	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1❖	1	

LEGEND: * CR - Critical characteristics
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MI - Minor characteristics5 P - Agency Performing the Test,
W - Agency Witnessing the Test,
V - Agency Verifying the Test.1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN
FOR
LEVEL SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-1033	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	15.03.99
SHEET	3 OF 3

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		4. Differential	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1 ♦	1	
		5. Contact Rating	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	---	1	Manufacturer compliance certificate to be verified.
		6. Insulation Resistance & HV	CR	Electrical	100%	Manufacturer standard	Manufacturer standard	Test Report	2	1 ♦	1	
2.3	Type Test	1. Weatherproofness	CR	Measurement	1 sample / design	BHEL Spec. / Approved data sheet	IS : 2147 / NEMA-4	Test Report	3/2	---	1	Vendor to furnish test report
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	

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MI - Minor characteristics

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W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



STANDARD QUALITY PLAN FOR THERMOCOUPLE WITH THERMOWELL

PEM :: C&I

QUALITY PLAN NO.: PE-QP-999-145-1003	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	15.03.99
SHEET	1 OF 2

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	Raw Material / Component											
1.1	Thermocouple wires	Material composition	CR	Chemical testing	Sample	BHEL Specs. / Appd. data sht.	Relevant material standards	Test Certificate	3/2	---		2.1 [▲]
1.2	Protective Sheath	Material composition	MA	Chemical testing	Sample	BHEL Specs. / Appd. data sht.	Relevant material standards	Test Certificate	3/2	---		2.1 [▲]
1.3	Terminal Head	Material composition	MA	Chemical testing	Sample	---	Relevant material standards	Test Certificate	3/2	---		2.1 [▲]
1.4	Thermowell ⊕	1. Chemical properties	CR	Chemical test	Sample	BHEL Specs / Approved data sheet	Relevant material standard	Test Certificate	3/2	---		2.1 [▲]
		2. Dimensions (wall thickness concentricity of bore, OD and length)	MA	Measurement	100%	BHEL Specs / Approved drgs.	BHEL Specs / Approved drgs.	Log Book	2	1 [▲]		1
		3. Threading	MA	Thread matching	100%	BHEL Specs / Approved data sheet.	BHEL Specs / Approved data sheet.	Inspection Report	2	2.1 [▲]		1
		4. Leak Test	CR	Hyd. test at 1.5 times design press.	100%	BHEL Specs / Approved data sheet.	BHEL Specs / Approved data sheet.	Inspection Report	3/2	2.1		---
												⊕ IIR certificate if specified to be verified.

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

§ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL.
2 - Vendor
3 - Sub-vendor



STANDARD QUALITY PLAN
FOR
THERMOCOUPLE WITH THERMOWELL

PEM :: C&I

QUALITY PLAN NO.: PE-QP-999-145-1003	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	15.03.99
SHEET	2 OF 2

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
2.0	Final Inspection	Thermocouple Inspection	MA	Visual	100%	BHEL Specs	BHEL Specs.	Log Book	2	2.1*	1	•BHEL to witness 25% samples.
			MA	Visual	100%	BHEL Specs	BHEL Specs / Approved drgs.	Log Book	2	2.1*	1	
			MA	Measurement	100%	BHEL Specs / Approved drgs.	BHEL Specs / Approved drgs.	Log Book	2	2.1*	1	
			MA	Measurement	100%	---	Compliance	Test Report	2	2.1	---	
2.2	Routine Tests	1. Continuity and Polarity	MA	Measurement	100%	---	Compliance	Test Report	2	2.1	---	
			CR	Thermal & Elect	100%	BHEL Specs	Relevant standards	Test Report	2	2.1	---	
			MA	Thermal & Elect	100%	---	Relevant standards	Test Report	2	1	---	
			MA	Thermal & Elect	10%	BHEL Specs / Approved data sheet	Relevant standards	Test Report	2	2	1	
2.3	Type Tests	Enclosure protection test for Head	CR	Testing	Sample	BHEL Specs	BHEL Specs / Approved data sheet	Test Certificate	3/2	---	1	
			MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

[§] P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-Vendor

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PEM :: C&I

**STANDARD QUALITY PLAN
FOR
PRESSURE / DP/LEVEL TRANSMITTER**

QUALITY PLAN NO.: PE-QP-999-145-1001	
VOLUME	IIB
SECTION	D
REV.NO.	00
DATE:	12.10.99
SHEET	1 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	RAW MATERIAL INSPECTION											
1.1	Body/Casing, Cable Gland and Mounting Bracket	1. Chemical & Mech. Properties 2. Dimensions 3. Visual 4. Degree of Protection (if applicable) 5. Leak Tightness	MA MA MA CR	Analysis Measurement Visual IS-2147 IS-2148	1 / Lot 10% Min. 3 Nos. 100% 1 / Type	Tech. Specn. Data Sheet, Mfr. standard Manufacturer drg. BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet	Tech. Specn. Data Sheet, Mfr. standard Manufacturer drg. BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet	Test certificate Log Book Log Book Test certificate Log Book	3 2 2 3 2	— — — — —	2 — — 2 —	Compliance report verification by BHEL.
1.2	Sensor (Diaphragm, Capsule, Bellows, Strain, Gauge, Capacitance etc.)	1. Material Properties (Chemical & Mechanical) 2. Dimension 3. Performance 4. Type Test	MA MA CR CR	Analysis Measurement Function Mech. & Elect.	1 / Lot 1 / Lot 100% 1/Type	BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet BHEL Spec. / Approved data sheet	Test certificate Test certificate Test certificate Test certificate	3/2 2 2 2	— — — —	2 — — —	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

[§] P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL or their agent
2 - Vendor
3 - Sub-Vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	12.10.99
SHEET	2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.3	Gasket	1. Dimension 2. Sheer Hardness	MA	Measurement Analysis	Sample	Manufacturer standard Manufacturer standard	Manufacturer standard Manufacturer standard	Test certificate Test certificate	3/2	---	2	
1.4	Electrical & Electronic Components	1. Marking & Rating	MA	Visual	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		2. Electrical Parameters	CR	Electrical Tests	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		3. Dimensions	MA	Measurement	10%	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
		4. Solderability	MA	Electrical	3 / Type	Manufacturer standard	Manufacturer standard	Log Book	2	---	---	
1.5	PCBs	1. Visual	MA	Visual	100%	---	---	---	3/2	---	2	
		2. Dimensions	MA	Measurement	10%	Manufacturer standard	Manufacturer standard	Log Book	3/2	---	2	
		3. Type Test	CR	Mech. & Elect. Tests	1 / Type / Batch	IS:7405 BS:4025	IS:7405 BS:4025	Test certificate	3/2	---	2	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

[§] P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL or their agent
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001	
VOLUME	IIB
SECTION	D
REV. NO.	00
SHEET	3
OF	7
DATE:	12.10.99

Sl. No.	Component / operation	Characteristics Checked	* Gate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
2.0	In-Process Inspection											
2.1	Electrical Unit											
2.1.1	Etched PCB	1. Dimension – Trade width, Gap etc. 2. Defect of undercuts 3. Quality and plating of plating through holes. 4. Screen printing	MA MA CR CR	Measurement Visual Visual Visual	Sample Sample 100% 100%	Manufacturer standard Manufacturer standard Manufacturer standard Manufacturer standard	Manufacturer standard Manufacturer standard Manufacturer standard Manufacturer standard	Inspection report Inspection report Inspection report Inspection report	2 2 2 2	— — — —	— — — —	Compliance verification report by BHEL
2.1.2	Component Mounting and soldering	1. Correctness of components 2. Mounting and orientation 3. Soldering defects and finish	MA MA CR	Visual Visual Visual	100% 100% 100%	Manufacturer standard Manufacturer standard Manufacturer standard	Manufacturer standard Manufacturer standard Manufacturer standard	Inspection report Inspection report Inspection report	2 2 2	— — —	— — —	
2.1.3	Assembled PCBs	Functional check	CR	Electrical checks before & after soaking*	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	—	—	
*Soaking means subjecting PCB (Assembled) at 70 Deg. C for 72 hours at energised condition and rapid temperature cycle test at 70 Deg. C and (-) 20 Deg. C for 30 minutes at each temp. (Five such cycles).												

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STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	12.10.99
SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
2.1.4	Conformal coating	Uniformity and finish of conformal coating on both sides	CR	Visual	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	--	--	Compliance verification report by BHEL
2.2	Mounting, Fitting, Assembly of various mechanical parts	1. Correct Mounting	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	--	--	
		2. Defects	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	--	--	
		3. Dimensions	MA	Measurement	100%	Manufacturer standard	Manufacturer standard	Log Book	2	--	--	
2.3	Interconnection – Sensor to Electronic unit	Correctness of Interconnection	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	--	--	
2.4	Interconnection – Pneumatic unit / Electronic unit and output / Local indicator.	Correctness of Interconnection	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	--	--	

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STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	12.10.99
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
3.0	Complete Transmitter	1. Workmanship	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		2. Dimension	MA	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		3. Type / Model	CR	Visual	10%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		4. Range	CR	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		5. Calibrated Range	CR	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		6. Local Indicator / Scale marking	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		7. Process connection type	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		8. Wetted parts material	MA	Analysis (Chemical, Mechanical)	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	—	1	
		9. Mounting bracket type	MA	Visual / Dimension	10%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		10. Calibration	CR	Electrical / Pneumatic	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report / Log Book	2	1	—	
		11. Soaking	CR	Electrical	100%	BHEL Spec.	BHEL Spec.	Inspection report / Log Book	2	1	—	

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STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001
VOLUME IIB
SECTION D
REV. NO. 00 DATE: 12.10.99
SHEET 6 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
3.2	Acceptance Tests	1. Accuracy	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		2. Repeatability	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		3. Dead Band	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		4. Hysteresis	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		5. HV & IR	CR	Electrical	100%	Manufacturer standard	Manufacturer standard	Inspection report	2	1	1	
		6. Linearity	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		7. Supply voltage variation effect	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		8. Temperature variation effect over range	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	
		9. Over range	CR	Electrical	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection report	2	1	1	

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STANDARD QUALITY PLAN FOR PRESSURE / DP/LEVEL TRANSMITTER

QUALITY PLAN NO.: PE-QP-999-145-1001	
VOLUME	IIB
SECTION	D
REV. NO.	00
SHEET	7
OF	7
DATE:	12.10.99

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference of documents	Acceptance of Norms	Format of Records	Agency ⁵			Remarks	
									P	W	V		
3.3	Type Test	1. Surge withstand capability	CR	Elect. & Mech	1 / Type	ANSI-C.37	ANSI-C.37	Inspection Report	3	—	—	2,1	
		2. Radio frequency interference	CR	Elect. & Mech	1 / Type	ANSI-C.37	ANSI-C.37	Inspection Report	3	—	—	2,1	
		3. Vibration effect	CR	Elect. & Mech	1 / Type	BHEL Spec.	BHEL Spec.	Inspection Report	3	—	—	2,1	
		4. Electro Magnetic field effect	CR	Elect. & Mech	1 / Type	BHEL Spec.	BHEL Spec.	Inspection Report	3	—	—	2,1	
		5. Degree of protection	CR	Mech. & Elect.	1 / Type	IS:2147	BHEL Spec.	Inspection Report	3	—	—	2,1	
		6. Explosion proofness (if applicable)	CR	Mech. & Elect.	1 / Type	IS:2148	BHEL Spec.	Inspection Report	3	—	—	2,1	
		7. Dry Heat	CR	Thermal	1 / Type	IS:9000	ANSI-C.37	Inspection Report	3	—	—	2,1	
		8. Damp Heat	CR	Thermal	1 / Type	IS:9000	ANSI-C.37	Inspection Report	3	—	—	2,1	
4.0	Packing	1. Packing Material	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	—	—	2	85 Deg. C for 16 Hrs. 40 Deg. C; 6 cycle
		2. Packaging and Marking	MA	Visual & Measurement	100%	Manufacturer standard	Manufacturer standard	Log Book	2	—	—	2	

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STANDARD QUALITY PLAN FOR LEVEL GAUGES

PEM :: C&I

QUALITY PLAN NO.: PE-QP-999-145-1028	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	01.11.2000
SHEET	1 OF 2

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.0	Material / Components											
1.1	Body, Cover, Interns, Flanges, Gaskets	1. Physical, Chemical Properties	MA	Physical, Chemical Test	One Sample from each lot	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate	3/2	—	2.1#	# Compliance certificate to be verified.
		2. Workmanship, finish and dimensions	MA	Visual, Measurement	100%	Manufacturing standards / drgs.	Manufacturing standards / drgs.	Inspection Report / Log Book	3/2	—	2.1#	
1.2	Glass Tube	Strength, Transparency, dimensions	MA	Toughness & Thermal shock, Visual, Measurement	one sample from each lot	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate/ Inspection Report	3	—	2.1#	
2.0	Assembly	1. Marking – Tag No., Model, Range	MA	Visual	100%	- do -	- do -	Inspection Report	2	1	—	
		2. Workmanship	MA	Visual	100%	- do -	- do -	- do -	2	1	—	
		3. Scale graduation	MA	Visual	100%	- do -	- do -	- do -	2	1	—	
		4. Glass Opaque painting	MA	Visual	100%	- do -	- do -	- do -	2	1	—	For Reflex type
		5. Dimensions and end connections	MA	Measurement	100%	- do -	- do -	- do -	2	1	—	
3.0	Routine Test	1. Calibration	CR	Measurement	100%	- do -	- do -	- do -	2	1**	1	**10% quantity with minimum of 1 piece / type & size
		2. Hydro Test	CR	Measurement	100%	- do -	No Leakage	- do -	2	1**	1	

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3 - Sub-vendor



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STANDARD QUALITY PLAN
FOR
TEMPERATURE GAUGE AND THERMOWELL

QUALITY PLAN NO.: PE-QP-999-145-1027			
VOLUME	IIB		
SECTION	D		
REV. NO.	01	DATE: 16-05-2007	
SHEET	1	OF	4

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ⁵			Remarks
1.0 Raw Material / Component												
1.1	Capillary Bulb and Thermowell	1. Chemical composition	CR	Chemical analysis	one sample/ lot	BHEL spec. / approved data sheet	Relevant raw material std.	Test report	3/2	---	2.1	Relevant compliance certificate to be verified by BHEL
		2. Marking,	MA	Visual	100%	BHEL spec. / Mfr. Standard	BHEL spec. / Mfr. Standard	Log Book	2	---	---	
		3. Dimensions	MA	Measurement	100%	BHEL spec. / approved doc	BHEL spec. / approved doc	Log Book	2	---	---	
		1.2 Casing and Bezel	MA	Chemical analysis	Sample	BHEL spec.	BHEL spec.	Test report	3/2	---	2.1	Relevant compliance certificate to be verified by BHEL
		2. Defects	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Log Book	2	---	---	
		3. Dimension	MA	Measurement	Sample	BHEL spec. / approved doc.	BHEL spec. / approved doc.	Log Book	2	---	---	
		4. Threading	MA	Thread matching	100%	-----do-----	-----do-----	Log Book	2	---	---	
		1.3 Dial	MA	Measurement and Visual	Sample	BHEL spec.	BHEL spec.	Log Book	2	---	---	
		2. Colour	MA	Visual	100%	BHEL spec.	BHEL spec.	Log Book	2	---	---	
		3. Resistance to dry heat and hot water	MA	Oven & Bath	Sample	Mfr. Standard	Mfr. Standard	Test report	3/2	---	---	
		1. Size, range, scale length, least-count, spacing and graduation.	MA	Measurement and Visual	Sample	BHEL spec.	BHEL spec.	Log Book	2	---	---	
1.4												
1.5												
1.6												
1.7												
1.8												
1.9												
1.10												

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STANDARD QUALITY PLAN
FOR
TEMPERATURE GAUGE AND THERMOWELLQUALITY PLAN NO.: PE-QP-999-145-1027
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 16-05-2007
SHEET 2 OF 4

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ⁵			Remarks
									P	W	V	
1.4	Complete sensing element	1. Correct assembly and workmanship.	MA	Visual	100%	Mfr. Standard drawing	Mfr. Standard drawing	Log Book	2	—	—	
		2. Dimensions	MA	Measurement	100%	Mfr. Standard drawing	Mfr. Standard drawing	Log Book	2	—	—	
		3. Welding & other defects	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Log Book	2	—	—	
1.5	Thermowell ⊕	1. Dimensions of wall thickness, concentricity of bore OD & Length.	MA	Measurement	100%	BHEL spec. / approved data sheet / Drg.	BHEL spec. / approved data sheet / Drg.	Log Book	2	1	1	BHEL to witness 10 % random samples.
		2. Leak Test	CR	Hyd. test at 1.5 times of design pressure.	100%	BHEL spec. / approved data sheet / Drg.	BHEL spec. / approved data sheet / Drg.	Inspection report	3/2	2.1	1	⊕ IBR cert. wherever specified to be verified.
		3. Threading	MA	Thread matching	100%	BHEL spec. / approved data sheet / Drg	BHEL spec. / approved data sheet / Drg	Inspection report	2	2.1	1	BHEL to witness 10% samples.
2.0	Final Inspection											
2.1	Assembly	1. Correct assembly, workmanship and finish	MA	Visual	100%	BHEL spec. / approved data sheet	BHEL spec. / approved data sheet	Inspection report	2	1	—	

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LEGEND: *		CR	- Critical characteristics	5		P	- Agency Performing the Test.	1	- BHEL
		MA	- Major characteristics			W	- Agency Witnessing the Test.	2	- Vendor
		MI	- Minor characteristics			V	- Agency Verifying the Test.	3	- Sub-vendor



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STANDARD QUALITY PLAN
FOR
TEMPERATURE GAUGE AND THERMOWELL

QUALITY PLAN NO.: PE-QP-999-145-1027			
VOLUME	IIB		
SECTION	D		
REV. NO.	01	DATE: 16-05-2007	
SHEET	3	OF	4

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		2. Mounting and connection	MA	Visual ad measurement	100%	-----do-----	-----do-----	Inspection report	2	1	---	
		3. Dial Scale	MA	Visual	100%	-----do-----	-----do-----	Log Book	2	1	---	
		1. Cleanliness	MA	Visual	100%	-----do-----	Free from scratches, dirt etc.	Log Book	2	---	2	
		5. Marking (S.No., Tag No.)	MA	Visual	100%	BHEL spec. / approved data sheet	BHEL spec. / approved data sheet	Log Book	2	1	---	
2.2	Routine Test	1. Accuracy	MA	Measurement	100%	BHEL spec. / Approved data Sheet.	BHEL spec. / Approved data Sheet.	Test Report	2	1	1	BHEL to witness 10% random Samples.
		2. Overload	CR	Measurement	10%	125% of FSD for range upto 400 Deg. C. 110% of FSD for range between 400 to 500 Deg. C. 100% of FSD for range above 500 Deg. C.	No Damage	Test Report	2	1	---	

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PEM :: C&I

STANDARD QUALITY PLAN
FOR
TEMPERATURE GAUGE AND THERMOWELL

QUALITY PLAN NO.: PE-QP-999-145-1027			
VOLUME	IIB		
SECTION	D		
REV. NO.	01	DATE: 16-05-2007	
SHEET	4	OF	4

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
		3. Response Time	MA	Measurement	10%	ASME PTC19.3	ASME PTC19.3	Test Report	2	1	1	BHEL to witness 10% random samples.
2.3	Type Test	1. Ambient temperature compensation 0-60 Deg. C	MA	Measurement	Sample	Bulb at constant temp. & case temp varied 0-60 Deg. C	No variation in measurement	Test Certificate	2	---	1	Existing test certificate (Not more than 5 year old) shall be furnished.
		2. Weather proofness	CR	Measurement	Sample	BHEL spec. / Approved data sheet.	BHEL spec. / Approved data sheet.	Test Certificate	3/2	---	1	---do---
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	Refer Note-1

Note: 1. In the absence of BHEL specification for painting, vendor to obtain BHEL's approval on their painting specification / procedure.

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STANDARD QUALITY PLAN FOR TEMPERATURE SWITCH

QUALITY PLAN NO.: PS-QP-999-145-1032	
VOLUME	IIB
SECTION	D
REV. NO.	00
SHEET	1 OF 2
DATE:	02.11.2000

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.0	Material / Components											
1.1	Casing, Sensing Element and Thermowell	1. Physical, Chemical Properties	MA	Physical, Chemical Test	One Sample from each lot	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Test Certificate	3/2	—	2.1#	# Compliance certificate to be verified.
		2. Workmanship, finish and dimensions	MA	Visual, Measurement	100%	Manufacturing standards / drgs.	Manufacturing standards / drgs.	Inspection Report / Log Book	3/2	—	2.1#	
1.2	Switch	Contact type & no.	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	- do -	3	—	2.1#	
2.0	Assembly	1. Marking – Tag No., Model, Range	MA	Visual	100%	- do -	- do -	Inspection Report	2	1	—	
		2. Workmanship	MA	Visual	100%	- do -	- do -	- do -	2	1	—	
		3. Scale graduation	MA	Visual	100%	- do -	- do -	- do -	2	1	—	
		4. Dimensions and end connections	MA	Measurement	100%	- do -	- do -	- do -	2	1**	1	**25% quantity with minimum of 1 piece / type & size
3.0	Routine Test	5. Switch – contact type & nos.	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Inspection Report	2	1**	1	
		1. Calibration, accuracy, repeatability, overload, set point adjustment, differential	CR	Measurement	100%	- do -	- do -	- do -	2	1**	1	

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PEM :: C&I

STANDARD QUALITY PLAN
FOR
TEMPERATURE SWITCH

QUALITY PLAN NO.: PS-QP-999-145-1032			
VOLUME	IIB		
SECTION	D		
REV. NO.	00	DATE: 02.11.2000	
SHEET	2	OF	2

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
4.0	Type Test	2. Hydro Test	CR	Measurement	100%	Approved drg. / data sheet / BHEL Spec.	No Leakage	Inspection Report	2	1**	1	•Type Test Certificate to be verified
		3. IR, HV	CR	Measurement	100%	- do -	Approved drg. / data sheet / BHEL Spec.	- do -	2	1**	1	
		1. Enclosure Protection Class (weather proof-ness, explosion proof-ness, etc.)	CR	Verification	Each type	- do -	- do -	Test Certificate	2	—	1•	
		2. Ambient temperature compensation (0 - 60°C)	CR	Verification	Each type	- do -	- do -	- do -	2	—	1•	
5.0	Painting	3. Switch contact rating	CR	Verification	Each type	- do -	- do -	- do -	2	—	1•	
		Shade & Finish	MA	Visual	100%	- do -	- do -	Inspection Report	2	1**	1	
6.0	Packing	Soundness	MA	Visual	100%	- do -	- do -	- do -	2	—	—	

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V - Agency Verifying the Test.1 - BHEL
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STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

QUALITY PLAN NO.: PE-QP-999-145-1056	
VOLUME	IIB
SECTION	D
REV. NO.	01
SHEET	1
DATE: 18-05-2007	

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	—	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	—	—	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	—	—	
		4. Waviness	MA	Visual	100%	Factory Standard / Sample	No Waviness	Log Book	2	—	—	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	—	—	
		6. Mill marking	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	2	—	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	—	—	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	—	—	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	—	—	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	—	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	—	—	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	—	—	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics§ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.1 - BHEL
2 - Vendor
3 - Sub-vendor

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

QUALITY PLAN NO.: PE-QP-999-145-1056

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 18-05-2007

SHEET 2 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	—	—	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	—	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2	— — — — — —	— — — — — 1	+ for relay & contactors only @ for all components except relays & contactors.
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

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STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

QUALITY PLAN NO.: PE-QP-999-145-1056

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 18-05-2007

SHEET 3 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

QUALITY PLAN NO.: PE-QP-999-145-1056

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 18-05-2007

SHEET 4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
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STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

QUALITY PLAN NO.: PE-QP-999-145-1056			
VOLUME	IIB		
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REV. NO.	01	DATE: 18-05-2007	
SHEET	5	OF	7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ‡			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		2. Component layout (neatness, accessibility & safety)	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

QUALITY PLAN NO.: PE-QP-999-145-1056

VOLUME IIB

SECTION D

REV. NO. 01

DATE: 18-05-2007

SHEET 6 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
4	Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
5	Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	1	
6	Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
7	Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
8	Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
9	Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	1	
10	Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	1	
11	Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	1	
12	Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	1	

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

QUALITY PLAN NO.: PE-QP-999-145-1056

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 18-05-2007


SHEET 7 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Gate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency *			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg. relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg. relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	—	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation 2. Instrument Calibration 3. Temperature rise	CR CR CR	Electrical Electrical Electrical	100% 10% 100%	BHEL approved spec. / drg. BHEL approved spec. / drg. BHEL approved spec./drg. & relevant IS.	BHEL approved spec. / drg. BHEL approved spec. / drg. BHEL approved spec/drg & relevant IS.	Inspection Report Inspection Report Inspection Report	2 2 2	1 1 1	1	


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2 - Vendor
3 - Sub-vendor

		DATA SHEET FOR LOCAL PANELS		TAG No. Qty	
				Data Sheet No.: PES-145A-DS1-0	
				Data Sheet A & B	
				DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	
				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
SPECIFICATION NO.:		VOLUME		SECTION	
REV. NO.		DATE:		SHEET 1 OF 2	

GENERAL	MANUFACTURER			
	CONSTRUCTION	<input checked="" type="checkbox"/> FOLDED <input type="checkbox"/> WELDED		
TECHNICAL	INPUT POWER SUPPLY	<input type="checkbox"/> 240V 50 Hz AC <input type="checkbox"/> 220V DC <input checked="" type="checkbox"/> 415V 3 PHASE (4 wires)		
	NO. OF FEEDERS	<input type="checkbox"/> ONE <input type="checkbox"/> TWO		
	CONTROL SUPPLY	<input type="checkbox"/> 110V AC <input type="checkbox"/> 220V AC <input type="checkbox"/> 220V DC		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)	<input type="checkbox"/> NOS. (AS REQUIRED)		
	PAINT TYPE	<input checked="" type="checkbox"/> EPOXY <input type="checkbox"/> SYNTHETIC ENAMEL <input type="checkbox"/> POWER COATED		
	PANEL COLOUR (EXTERNAL)	<input type="checkbox"/> <input type="checkbox"/> LIGHT GREY (Shade 631 IS-5) <input type="checkbox"/> OPALINE GREEN (Shade 275)		
	FINISH	<input type="checkbox"/> SEMI MATT <input type="checkbox"/> GLOSSY <input checked="" type="checkbox"/> SEMI GLOSSY		
	PANEL COLOUR (INTERNAL)	<input type="checkbox"/> OFF WHITE <input type="checkbox"/> WHITE <input type="checkbox"/> CREAM		
	FINISH	<input type="checkbox"/> SEMI MATT <input type="checkbox"/> GLOSSY <input checked="" type="checkbox"/> SEMI GLOSSY		
	CLASS OF PROTECTION	<input type="checkbox"/> <input checked="" type="checkbox"/> IP-54		
	CONTROL HARDWARE	<input type="checkbox"/> RELAY BASED <input checked="" type="checkbox"/> PLC	As per Requirement	
	FOUNDATION ARRANGEMENT	<input type="checkbox"/> FOUNDATION BOLTS <input type="checkbox"/> ANCHOR FASTENERS		
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE	<input checked="" type="checkbox"/> PRESSURISED <input type="checkbox"/> UNPRESSURISED	As per Requirement	
	CABLE GLAND	<input type="checkbox"/> SINGLE COMPRESSION <input checked="" type="checkbox"/> DOUBLE COMPRESSION		
PREPARED BY		CHECKED BY	APPROVED BY	NAME SIGNATURE DATE COMPANY SEAL

		DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.:	
				VOLUME	
				SECTION	
				REV. NO.	
				DATE:	
SHEET 1 OF 2		TAG No. Qty.		Data Sheet No.: PES-145A-DS1-0	
Data Sheet C					
DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)					

GENERAL	MANUFACTURER				NAME SIGNATURE DATE COMPANY SEAL
	CONSTRUCTION				
	TECHNICAL				
	INPUT POWER SUPPLY				
	NO. OF FEEDERS				
	CONTROL SUPPLY				
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)				
	PAINT TYPE				
	PANEL COLOUR (EXTERNAL)				
	FINISH				
	PANEL COLOUR (INTERNAL)				
	FINISH				
	CLASS OF PROTECTION				
	CONTROL HARDWARE				
	FOUNDATION ARRANGEMENT				
	WEIGHT OF PANEL (kg.)				
	PANEL TYPE				
	CABLE GLAND				
	PREPARED BY	CHECKED BY	APPROVED BY		

DOCUMENT TITLE		PROJECT : STANDARD	
GUIDELINE FOR SELECTION OF INSTRUMENTATION CABLE FOR MAUX PACKAGES		SHEET 1 OF 1	
DOCUMENT NUMBER	REVISION NUMBER	DATE	1
PE-GL-999-145-1003A	00	29-05-2008	

- The sizes of cable (in term of no. of pairs) has been rationalized in order to achieve greater standardization and better management of quantities, therefore selection shall be generally done in accordance with the following table , based on the requirement for a given application.

- For PLC based LCP, 0.5mm² screened cables (Type-F, G) to be used. The cable type shall be selected as 0.5mm² type-F (individual and overall screened) for analog signals and 0.5mm² type-G (Overall screened) for Binary signals.

- However analog signals like, current and position feedback, 2P type-G cable shall be used, wherein one pair shall remain spare.

- For selection of cable between instrument to JB/LCP, refer the enclosed interconnection diagram.

- For drive's cable between PLC and MCC/ actuator , refer project specific drive control philosophy

- The cables related to Relay based local control panels (Between field, LCP and MCC) to be selected as 1.5mm² control cable from the sizes rationalized by Pem-Elect (3C,5C,7C,12C,19C,24C), after confirming the availability for the given project



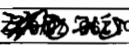
- 3C, 2.5mm² cable shall be used between interposing relays and sol valve.

Size	Purpose	Remark
4P	Control valve's demand and feedback, Field I/O	
8P	Field I/O	
12P	HT motor brg, winding, Field I/O	(when 3 pt. Of motor winding are monitored)
20P	HT motor brg, winding, Field I/O	(when 6 pt. Of motor winding are monitored)

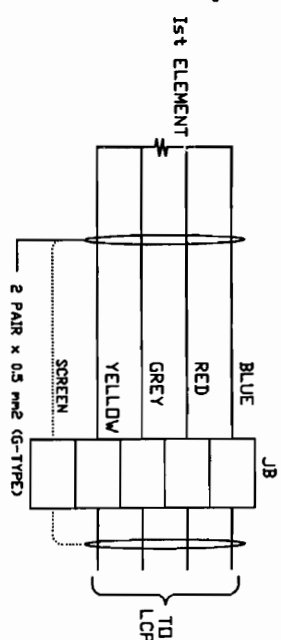
Type-F (0.5mm², Individual and overall screened)

Size	Purpose	Remark
2P	Motor Current , Position feedback signals, Field sensors	
4P	BID, LT drives, sol vlv fb, field I/O	
8P	BID, LT, HT drives, field I/O	
12P	HT drives, field I/O	
16P	LCPs , field I/O	

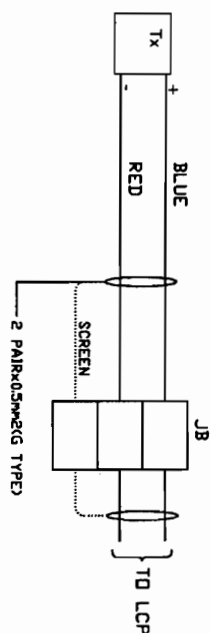
Type-G (0.5mm²,Overall screened)

PARTICULARS	PREPARED BY	REVIEWED BY	APPROVED BY
NAME	MA MANSOORI	PANKAJ JAIN	S.K. DATTA
DESIGNATION	Manager	DGM	Sr. DGM
SIGNATURE			
DATE	29-05-2008	29-05-2008	29-05-2008

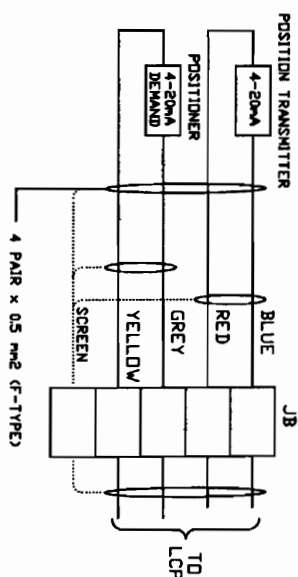
PRESS SWITCH, VALVE LIMIT SWITCH, SOLENOID VALVE LIMIT SWITCH ETC. BINARY SENSOR CONTACT TO JBS (TYPICAL)



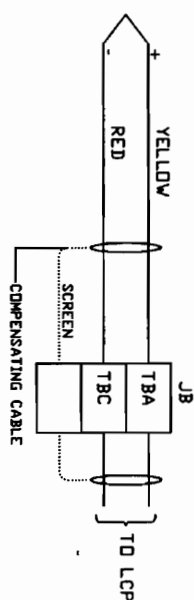
RTD WIRING (TYPICAL)



CONTROL VALVES WIRING (TYPICAL)




THEMOCOUPLE WIRING (TYPICAL)



1. FROM JB TO LCP MULTIPAIR CABLE SHALL BE SELECTED BASED ON EXTENT OF GROUPING.
2. CABLE SCREENS TO BE EARTHED AT ONE END (PANEL END) ONLY.

[illegible]

 RPCL/MTPS	RAICHUR POWER CORPORATION LIMITED YERMARUS STPS – 2 X 800 MW TITLE SPECIFICATIONS FOR INSTRUMENTS / LOCAL PANELS / JUNCTION BOXES / PLC	SHEET 1 OF 10
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1.00.00 T

Technical Specifications for Field instruments:

All instruments offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven as mentioned in design criteria. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications.

The Contractor shall furnish all Instrumentation/ Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/ erection of these transmitters shall be furnished, even if not specifically asked for, on as required basis. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.

2.00.00

Smart Electronic Transmitters for Measurement of Pressure, Differential Pressure(DP) & Flow/Level(DP Type):


Micro-processor based indicating type (LCD display), rack mounted with accuracy of $\pm 0.1\%$ of span, Repeatability: $\pm 0.05\%$ of FSR or better, Linearity: $\pm 0.1\%$ of FSR or better. Hysteresis: $\pm 0.1\%$ of FSR or better. external zero and span adjustment, self diagnostics, temperature sensor for compensation. Power supply 24 V DC; output signal of 4-20 mA DC. IP 65 or equivalent degree of protection with epoxy coating, 316 SS/ Hastelloy/ other suitable sensing element. Accessories like snubbers for pump discharge applications and chemical diaphragm with 15 m PVC covered SS armoured capillary for corrosive and oil services, etc. Material for accessories will be SS. HART protocol output shall be available in each transmitter. In case it becomes necessary to use a DP transmitter for pressure measurement then a 3-valve manifold should be used in place of 2-valve manifold. LVDI type is not acceptable.

2.00.02

Wherever, the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2.00.03

In Detail Technical Specification:
1) Type of Transmitter: Microprocessor based 2 wire type HART protocol compatible,

 RPCL/YTPS	RAICHUR POWER CORPORATION LIMITED YERMARUS STPS – 2 X 800 MW TITLE SPECIFICATIONS FOR INSTRUMENTS / LOCAL PANELS / JUNCTION BOXES / PLC	SHEET 2 OF 10
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- 2) Accuracy : - +/- 0.1 % of span
- 3) Output Signal Range: 4-20 mA DC(Analog) *Superimposed digital on HART protocol*
- 4) Turn Down Ratio : 10:1 for vacuum/very low pressure applications
30:1/100:1 for other applications
- 5) Stability: +/-0.1% of calibrated span for 6 months up to 70 KSC &
- 6) Zero and Span Drift: +/-0.015% per Deg.C at max. span and 0.11% per Deg.C at Minimum Span
- 7) Load Impedance: 500 ohm (Min)
- 8) Housing: Weather proof as per IP-65 with durable corrosion resistant coating
- 9) Over Pressure - 150 % of Max. operating pressure
- 10) Connection(Electrical)- Plug and socket type
- 11) Process Connection - 1/2 inch NPT (F)
- 12) Span and Zero: Continuous, tamper proof, Remote Adjustability as well as manual from instrument with zero suppression and elevation facility.
- 13) Accessories a) Diaphragm seal, pulsation dampeners syphon etc. as required by service and operating condition.
b) 2/3/5 Valve manifold as applicable
- 14 Diagnostics: Self Indicating Feature
- 15) Power Supply: 24 V DC +/- 10%
- 16) Adjustment : Calibration facility via Centralized PC based HART management system.

3.00.00

Displacement Type Level Transmitters:

Displacement/DP Type Smart Electronic Level Transmitters shall be provided for level measurement of condenser hotwell level, LP Heaters, HP Heaters and other vacuum services, shall be considered by the Contractor. If any more transmitters over and above the quantity indicated are required for the safe and efficient operation and maintenance the same shall be included. The type/ranges/make of transmitters and services for which these transmitters are required shall be as decided and approved by the owner during detailed engineering.

Microprocessor based smart type, displacement type level transmitters of float length of 14 inches or 32 inches with an accuracy of +/-0.5% of span, 4-20 mA DC output (2 wire system), +24 V DC supply, isolated and ungrounded electrical circuits, zero adjustment (100% of sensing element) for control application and measurement purposes for all services of condensate and drains, particularly where two phases of steam and water are present. IP 65 or equivalent degree of protection for enclosure. Displacer/float material of 316SS. The material of accessories will be SS.

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4.00.00 T


Thermocouple Assembly with Thermowell

Duplex type with accuracy of $\pm 0.5\%$ of span (as per IEC-584 class-I for turbine applications) response time of 2 to 6 sec, Spring loaded mineral insulated thermocouple assembly with 316 SS thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread or 150 RF flanged. Material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly ungrounded. Thermowell material shall be solid tungsten carbide for mill outlet temperature measurement. For Air & Flue Gas measurements, thermowells shall be made of Inconel. For metal temperature measurement, thermocouple pads weldable to M.S pipes shall be provided with 15 m thermocouple extension wires. Element size shall be 18 AWG. Insulation resistance at 540°C shall not be less than 5 M ohms. For Turbine applications process connection shall be welded as per DIN 43763.

Temperature devices provided with thermowell shall be calibrated with the associated thermowell as an assembly. The thermowell construction shall meet the ANSI 19.3-1994 (latest) requirements. Thermocouple termination head shall be 300 mm above the pipe insulation to avoid cable damage in hot zones.

Thermowells shall be provided along with Temperature elements of RTD & Thermocouples except for metal/bearing/winding temperature measurements.

1. For measurement of flue gas temperature, Inconel coated with tungsten carbide or suitable abrasion resistant thermowells shall be provided.
2. For measurement of pulveriser outlet temperature tungsten carbide block thermowells abrasion resistant not tungsten carbide coated thermowell shall be used. Also the terminals of Thermocouple shall not be at the top of Mills itself. The thermocouple wires are to be laid up to JB through SS tubing of required diameter and the head shall be placed nearer to the JB. Compensating cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of Mill.
3. For measurement of water & steam temperature SS thermowells or better, shall be used

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5,00.00 R

istance Temperature Detectors (RTD) with Thermowell:

Duplex type with accuracy of +/-0.5% of span, response time 1-2 seconds; Spring loaded mineral insulated three (3) wire RTD assembly with 316 SS Thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread or 150 RF flanged. IP 65 or equivalent degree of protection for enclosure. Material of accessories will be SS. Thermowell with hex head with screwed cover & SS chain, barstock assembly. Element lead size will be 18 AWG. The insulation resistance at 540° shall not be less than 5M ohms. Repeatability over full range shall be better than 0.02%. RTDs shall be ungrounded. RTD shall be supplied as an assembly complete with thermowell meeting ANSI 19.3-1994 (latest) requirements.

6,00.00 T

est Thermowells:

Pipe/equipment mounted temperature test wells of 316 SS with a process connection of M33x2 thread, except for Turbine applications process connection shall be welded as per DIN 43763. Material of accessories will be SS. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. The thermowell construction shall meet the ANSI 19.3-1994 (latest) requirements. The thermowells shall be hardfaced/sterilited to avoid erosion for boiler area applications

7,00.00 P


ressure Indicators:

Direct reading, pipe mounted Pressure gauges of aluminium casing with six (6) inch phenolic dial (white dial with black numerals), 316 SS Bourdon tube, AISI304 /nylon movements and micrometer type adjustable pointer with an accuracy of +/-0.5% of span including accessories like syphons for steam services, snubbers for pump discharge applications and oil services and name plate. Material of accessories will be SS. IP65 or equivalent degree of protection for enclosure. Over range protection will be 50% above maximum pressure.

8,00.00 P

ressure Switches:

Non indicating type, field mounted Pressure Switches of aluminium casing (epoxy coated), and 316 SS element and accuracy of +/-1% of span, including accessories like syphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate. Material of accessories will be SS. Auto reset micro switch with internal adjustment for set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection for enclosure. Over range protection 50% above maximum pressure. Scale for setting shall be provided.

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9.00.00

Differential Pressure Indicators:

Direct reading type, pipe mounted, bellows or diaphragm operated differential pressure indicators; aluminium casing (epoxy coated) with six (6) inch dial (white dial with black numerals), with micrometer type pointer, 316 SS pressure element; an accuracy of $\pm 0.5\%$ of span including accessories like snubbers for pump discharge application, chemical diaphragm with 15 m PVC covered SS armoured capillary for each limb for corrosive and oil services and 5 way manifold. Material of accessories will be SS. IP 65 or equivalent degree of protection. Over range protection will be 50% above maximum pressure.

10.00.00 D

Differential Pressure Switches:

Bellows or diaphragm operated non-indicating field mounted type; aluminium casing (epoxy coated); 316 SS pressure element nylon movement; an accuracy of $\pm 1\%$ of span with an adjustable contact including accessories like snubbers for pump discharge applications, chemical diaphragm with 15 m capillary for each limb for all corrosive and oil services and 5 way manifold. Material of accessories will be SS. Auto reset micro switch with adjustable set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 or equivalent degree of protection over range protection 50% above maximum pressure. Repeatability shall be $+ 0.5\%$ FSR.

11.00.00 T


thermometers:

Indicating type, field mounted, filled system with 5 metre capillary and six (6) inch dial housed in aluminium casing (epoxy coated) with an accuracy of $\pm 1\%$ of span, response time of 2-4 seconds, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33 x 2 thread. Material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure. Thermowell with Hex head of fabricated assembly for air and flue gas system for rest of the services bar stock assembly. The thermowell construction shall meet the ANSI 19.3-1994 (latest) requirements.

12.00.00 T

emperature Switch:

Non Indicating type, field mounted, filled system with 5 metre capillary housed in Aluminium casing (epoxy coated) with an accuracy of $\pm 1\%$ span, auto temperature calibration, linear calibration over the range and 316 SS thermowell having a process connection of M33x2 thread. Micro switch with reset type with adjustable set values with 2 SPDT contacts rated for 0.2 A, 220 DC. IP 65 or equivalent degree of protection for enclosure. Thermowell with hex head of fabricated assembly for air and flue gas system, for rest of the services bar stock assembly. Material of accessories will be SS. The thermowell construction shall

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meet the ANSI 19.3-1994 (latest) requirements.

13.00.00 L level gauges:

Tubular type level gauges for low pressure upto 7 kg/cm² & reflex type for high pressure water & steam services & vacuum services with automatic ball check valves, illuminator (240 AC), pyrex / borosilicate glass, mica shield, brass guard rods & brass holders. Material of accessories (name plate, etc.) will be SS. Tubular glass OD will be 5/8". Vent & drain valves shall be provided. Connection shall be screwed or flanged (ANSI class 150 RF). Enclosure shall be IP 65.

14.00.00 L level switches:

External float operated level switches for tanks and vessels and top mounted level switches and underground tanks. The top mounted level switches shall be supplied with steel tubes to suit Purchaser's requirement. Micro switch with 2 SPDT contacts rated for 0.2 A, 220 V DC. Material of float & float chord will be 316 SS & cage material shall be fabricated steel and the material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure.


Accessories like name plate, drain valve for external case type level switches, mating flange, gaskets (asbestos), fasteners, bolts & nuts, etc. shall be supplied.

15.00.00 FI ow Glasses:

Online flow glasses for pipe size up to 4" with a rotary wheel (not a flapper type) suitable for installation on vertical or horizontal pipe lines, material pyrex tempered glass. Body material will be carbon steel, rotor & wetted parts will be bronze. The material of accessories will be SS. IP 65 or equivalent degree of protection for enclosure. Upto 50 NB size, connection shall be screwed above 50 mm NB size it shall be flanged - ANSI, 150 RF. Accessories like name plate, mating flanges with gaskets (neoprene), bolts & nuts, etc. shall be supplied. Enclosure shall be IP65.

16.00.00 FI ow Elements:

SS 316 flow nozzles for all steam and feed water services with D and D/2 pressure tapplings; 316SS flow orifice plate assembly for all water services with flange tap connections; B ratio of 0.5 & 0.7. Element material of SS 316. The material of accessories will be SS. All the flow elements shall have 3 pairs of differential pressure tapplings complete with root valves. Orifice plate shall not be less than 3 mm thick for nominal pipe diameter upto

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300 mm & not less than 6 mm thick for pipe diameter > 300 mm. The flow elements shall be supplied as assemblies with High/low pressure tapings, root valves as required. Performance Guarantee flow elements shall be provided separately. Butt welded edges shall be prepared as per ANSI 16.25 & flanged connections shall be as per ANSI 16.5 standards. Orifice assembly complete with nipples & valves to be supplied by Bidder shall be one metre long with ANSI class 150 RF SS flanges at the ends including gaskets, bolts & nuts. Isolating valves shall have SW end connection. Accessories like name plate, gaskets, bolts & nuts, reservoirs (condensing chambers), 6 nos. shut off valves per assembly, nipple, welding adapters, etc. shall supplied. Bidder shall submitted certified flow calculation and differential pressure Vs. flow curves for each element for OWNER's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for OWNER's approval. Bidder shall provide three Tappings per flow elements.

17.00.00 FI ow Switches:

Indicating, Differential pressure, flapper type on line flow switches for line sizes up to 80 mm with an accuracy of +/-2% of span and dial size of min. 50 mm having 316 SS flapper housed in die cast aluminium. Micro switch with adjustable range with 2 SPDT contacts rated for 0.2 A, 220 V DC. IP 65 or equivalent degree of protection for enclosure. The material of accessories will be SS.


18.00.00 S olenoid Valves:

Direct operated single/dual coil solenoid valves with shut off class (leakage) IV or better, body material of bronze, plunger material of 316 SS rated for continuous duty. IP 65 or equivalent protection class for enclosure. Insulation class of 'F' for the solenoid. Body ratings shall suit the pressure and temperature conditions. The operating voltage shall be for 24VDC/ 220VAC/110VAC depending on the service.

19.00.00 Local Instrument Enclosure & Racks/CJCBs:

Transmitters mounted in the field shall be suitably grouped together and mounted in Local Instrument Racks (LIR). These local instrument racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular instrument rack shall be as finalised during detailed engineering stage subject to Employer's approval.

The internal layout shall be such that the impulse piping/ blowdown lines are accessible from backside of the rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads especially

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designed to provide isolation from process line vibration shall be installed on instrument racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each rack.

The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalised during detailed engineering stage. The junction box for racks also shall conform to IP 65 protection class.

Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.


Each transmitter rack housing instruments requiring purge air for continuous air purging, shall be provided with common purge air header, redundant air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubings and individual purge meters for each purge line etc. as required.

A 15 mm NB service air header shall be furnished in each rack housing air & flue gas and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge, and valve quick disconnect connections. A hose for connecting each header to the draft instrument line four-way valves shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure of 15 kg/sq.cm. The size of the hose shall be 1/2" minimum. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.

The contractor shall prepare the piping drawings and the general arrangement layout drawings for each of the racks. Special attention shall be given in the piping layout to avoid air traps in liquid piping or water pockets in piping intended to be dry. Drawings shall indicate the arrangement of all equipment, piping, valves and fittings within the racks and shall be subject to Employer's approval.

All liquid filled blow down lines, except those measuring vacuum shall be connected to a two inch header which is extended through one end of the enclosure and turned downward for directing the blowdown into a drain. The material of the blow down header shall be carbon steel as per ASTM A

106 Gr C.

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20.00.00


Junction Boxes:

Wall/column mounted junction boxes having 12/24/36/48 terminals and cable entry only at the bottom and sealed with fire proof compound; Cage clamp terminals suitable for cable terminations up to 2.5 sqmm; IP 65 or equivalent degree of protection for enclosure. Separate terminal blocks shall be used for analog and digital signal signals. Separate JBs for different voltage levels shall be supplied. Removable gland plate shall be supplied. JB shall have single lockable door with gasket, able to open side ways, with common keys. Painting inside will be glossy white & outside - IS-5 shade 631. Shield bus for screw connection shall be provided. Terminal size shall be suitable for 0.5 mm2 to 2.5 mm2 wire. Terminal blocks shall be vertical. JB shall have provision to add 20% additional terminals. Accessories like metal tag (SS), clamps, fixtures, bolts (SS), nuts (SS), gaskets (neoprene), lock & key, fire proof compound for sealing, etc. shall be supplied. The grouping of instruments in JBs is subject to Purchaser's approval. All the field junction boxes shall have double doors. All JBs shall be provided with individual canopies to avoid ingress of water. The case, cover/door constructed from cold rolled sheet steel of 3 mm thick and shall have gland plate of 3 mm CRCA at the bottom.

21.00.00

Inter Posing Relays (IPR):

Electro magnetic type IPRs with plug-in type connections, suitable for channel/rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.2A 220 V DC. Free wheeling diode across relay coil(copper) and self reset type status indicator flag (electronic) shall be provided. Neon/LED indicating lamps shall be provided to indicate energise condition of relay. All commands to the Drives viz., Unidirectional drives, Bi-Directional drives, Solenoids and critical output contacts between systems for interlock and protection shall be through IPR. All relays shall be mounted on relay base (silver plated) internally wired to the external cabling termination block in cabinet. Wiring connection shall be screwed & termination shall be suitable for 0.5 mm2 to 2.5 mm2 size wiring. Facility to simulate relay operation manually shall be provided. Relays of different contact interrogation voltages shall be separated by a barrier in IPR cabinet. Accessories like name plate (SS) with tag & service inscription, relay base mounting rail/channel, nuts & bolts, etc. shall be supplied. Three nos. change over contacts shall be wired to external TB with screwed terminations only. Status lamps shall be provided.

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22.00.00 L

Local Panels:

Indoor/Outdoor located, free standing vertical type local panels with 3 mm thick sheet material of cold rolled steel; anti-vibration pads of 15 mm thick; fluorescent lighting; Double doors with neoprene gaskets at every 1.5 m; blower & louvers in each section with brass mesh; fire proof compound (50 mm thick) for sealing cable entry (bottom); fire detector for each section; space heater with thermostat control for each section (strip type). IP 65 degree of protection for enclosure. Removable cover plates with locking facility shall be provided along the bottom of the front desk continuously to facilitate maintenance work. The length of each cover plate shall not exceed 1 m. CFL of 40 W shall be provided from one end of the panel to the other end at continuous length and shall be operated by the door switches as well as by manual switches. Name plates shall be provided for all instruments/inserts with Tag. No. & short description of service engraved. These shall be phenolic overlays (1.6mm thick), black background with white lettering & shall be fixed to the panel by stainless steel screws (counter sunk). Each section of the panels shall be provided with one each 3 pin receptacles for 240V, IP 50 c/s & 110 V, IP, 50 c/s. Panel shall be delivered totally wired. All instruments, inserts and annunciation windows shall be mounted & wiring connections at these hardwares shall be terminated at site by vendor. Quantity shall be as required.


23.00.00 P


Programmable Logic Controllers (PLC):


The microprocessor shall be based on 32 bit processing. The programme memory shall be non-volatile memory. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, maths functions, boolean functions & timer functions. PLC shall complete with processor, I/O cards, memory modules, racks, mounting accessories. The scan time for digital inputs shall not be more than 60msec and execution 120msec. The system shall be loaded to maximum 60% under worst loading conditions. The redundant processors, redundant communication cards, redundant bus, redundant Power Supply cards for PLC system shall be considered. Further, I/O cards shall be redundant for critical inputs and outputs used for protection, interlock & commands for critical services.


The system shall have self diagnosis features. The operation, monitoring and programming shall be performed from the MMI Monitor station. The system shall be connected to DCS using hot redundant bi-directional OPC communication link and shall have time synchronisation with master clock system. The required hardware for this connectivity shall be included.

Independent redundant UPS with 1 hour Battery backup shall be provided for each of local PLC systems. PLC system with MMI, laser printer shall be included. For PLC system without MMI OWS, a hand held programmer shall be provided.

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	<p>Input/Output Modules as required in the control system for all type of field input (4-20 mA, RTD, T/C, Digital contacts etc.) and output from the control system are to be provided as per requirement. Electrical isolation for 1.5 KV with optical coupler between the plant put/output and surge protection as per IEEE 472. The hardware design shall be such that it is able to withstand power line disturbance. The system shall conform to ANSI/IEEE C 62.4 (Immunity to power supply line disturbance).</p> <p>Contractor shall provide at least 20% wired spare capacity of input/output modules over and above the system requirement. Contractor shall provide built in diagnostic for easy fault detection.</p> <p>System shall be able to operate in non air conditioned area. However where PLC panels/ I-O racks are located at local areas in dusty and hot zone, PLC panels/I-O racks shall be provided with air condition with suitable protection class. Contractor may provide Annunciation System as integral part of PLC. Field contacts shall be acquired through PLC only. The Annunciation sequence logic shall be implemented as a part of PLC controllers. The No. of Annunciation facia windows and provision of original input will be on as required basis.</p> <p>Contractor shall provide electronic grounding for PLC which shall be separate from Electrical grounding as per IS or IEEE Standard.</p> <p>The Factory Acceptance Test for PLC system shall consist of a) Hardware & Software as per BOM b) Spare capacity in cabinet for new module c) Current & Power Consumption d) Power Failure Test e) Healthiness of Hardware/all module f) On line removal of I/O card g) Accuracy Test h) Diagnostic Test i) Functional Test j) Verification of Software k) Redundancy Test of Controller l) Redundancy Test of power supply m) CPU loading duty cycle n) Power failure auto restart. Any other Test as per QAP. The Type test reports also shall be submitted for review.</p>	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-ID-362-145-1902	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 07.12.10
			SHEET 1	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL *4	* PROJECT	2X800 MW YERMARAS STPS		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	<input type="checkbox"/> ON / OFF <input type="checkbox"/> INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
	CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:55	
MECHANICAL POSITION INDICATOR		TO BE PROVIDED FOR 0-100% TRAVEL		
BEARINGS		DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION		METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
SIZING		OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING(REGULATING) SERVICE 150 STARTS/HR MINIMUM		
HANDWHEEL	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED		
	TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT.		
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11		
	COLOUR SHADE	<input type="checkbox"/> BLUE (RAL 5012) ENAMEL <input type="checkbox"/>		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V		
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 65 <input type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF <input type="checkbox"/> IP 55, TOTALLY ENCL, SELF VENTILATED.		
	@ INSULATION CLASS	<input type="checkbox"/> CLASS-B <input type="checkbox"/> CLASS-F		
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/>		

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			VOLUME II B		
			SECTION D		
			REV. NO.	00	DATE: 07.12.10
			SHEET	2	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
INTEGRAL STARTER	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION		REQUIRED		
	INTEGRAL STARTER		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	TYPE OF SWITCHING DEVICE		<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS		
	TYPE		<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)		
	IF SMART				
	a) SERIAL LINK INTERFACE		<input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED		
	b) SERIAL LINK PROTOCOL		<input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> TCP/IP <input type="checkbox"/>		
	c) SERIAL LINK MEDIA		<input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC		
	d) HAND HELD PROGRAMMER		<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	e) MASTER STATION		<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	f) MASTER STN INTRFACE WITH DCS		<input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP		
	g) DETAILS OF SPECIAL CABLE		<input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED		
	STEP DOWN CONT. TRANSFORMER		<input checked="" type="checkbox"/> REQUIRED		
	OPEN / CLOSE PB		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	STOP PB		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	INDICATING LAMPS		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	LOCAL REMOTE S/S		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
INTEGRAL STARTER DISTURBED SIGNAL		REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
INTERPOSING RELAY (Applicable for integral Starter)	INTERPOSING RELAYS		REQUIRED		
	INTERPOSING RELAY (QUANTITY)		<input type="checkbox"/> 2 NOs. <input checked="" type="checkbox"/> 3 NOs.		
	DRIVING VOLTAGE		<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC		
	DRIVING CURRENT		<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX		
	LOAD RESISTANCE		<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator)	MFR & MODEL NO.		BIDDER TO SPECIFY		
	OPEN / CLOSE		<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos		
	CONTACT TYPE		2 NO + 2 NC		
	RATING		5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)		REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY		+3% OF SET VALUE		
LIMIT SWITCH (Not Applicable for Smart Actuator)	MFR & MODEL NO.		BIDDER TO SPECIFY		
	OPEN : INT : CLOSE		<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2 Nos. (ADJ.) <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.		
	CONTACT TYPE		2 NO + 2 NC		
	RATING (AC / DC)		5A 240V AC AND 0.5A 220V DC		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.: PE-ID-362-145-1902		
		VOLUME	II B	
		SECTION	D	
		REV. NO.	00	DATE: 07.12.10
		SHEET	3	OF 3
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty)	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	<input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/>		
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA		
	ACCURACY	$\pm 1\%$ FS		
SPACE HEATER	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY			
	@ RATING			
TERMINAL BOX	MOTOR TERMINAL BOX	REQUIRED		
	ACTUATOR TERMINAL BOX	REQUIRED		
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	<input type="checkbox"/> IP 65 @ <input type="checkbox"/> <input type="checkbox"/> IP65 <input type="checkbox"/>		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET (9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/>		
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:		
	@ SPACE HEATER CABLE GLAND	SIZE:		
	OTHER CONTROL CABLE GLANDS-1	<input type="checkbox"/> 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2)		
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.

NOTES:

- SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
- CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
- THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
- THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE $\pm 10\%$ SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO $+3\%$ VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.

NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
	VENKAT AGRAWAL	RAVINDER RAINA	M A MANSOORI	NAME
				SIGNATURE
				DATE

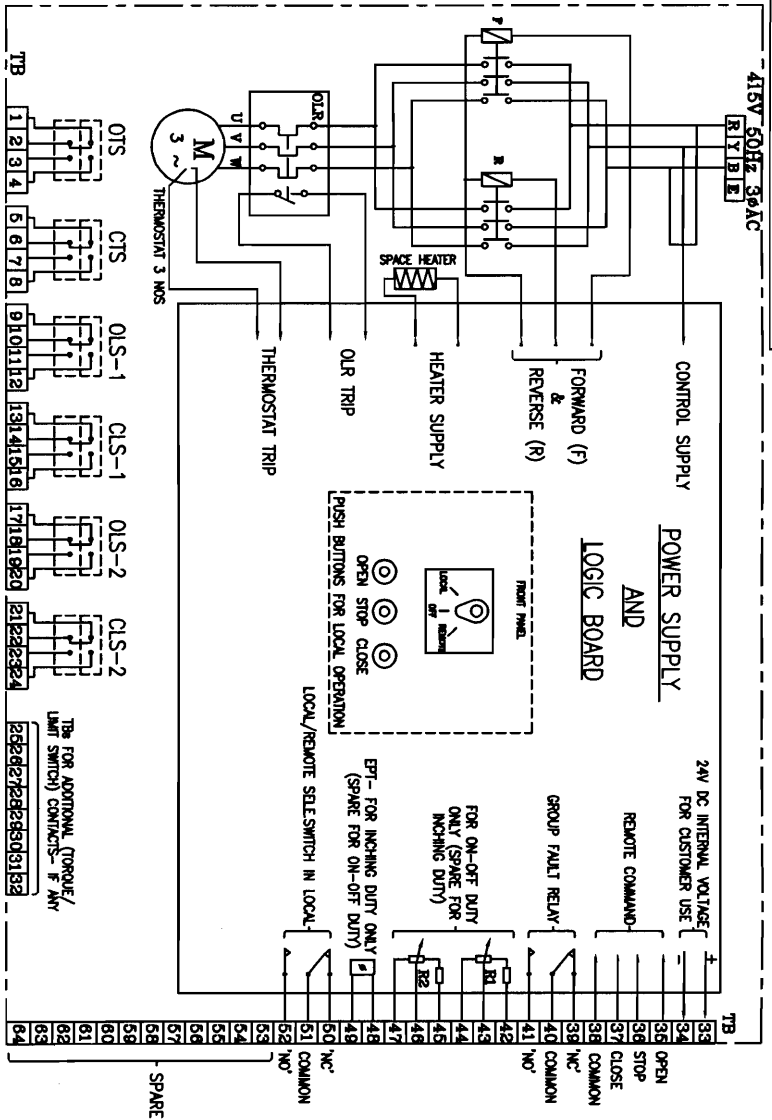
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY).

@= TO BE FILLED BY ES

L27242-CSIW-A-C

ON DIMENSIONS

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.



SWITCH TERMINALS FOR CUSTOMER USE

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS, CTS, OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
2. CTS - TORQUE SWITCHES WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
3. OTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
4. OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
6. EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M - MOTOR 3φ 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CRD & APPD

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT		ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS	
OR NAME OF CUSTOMER/PROJECT		(DRAWN FOR INTERMEDIATE POSITION OF VALVES)	
BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE PISTON PLANT, THERUGHERAPALLY-680014.		DRAWING NO. 3-V-MISC-24227	
DEPT VL	SCALE	WEIGHT (KG.)	NO. OF
CODE			VAR.
TITLE	WIRING DIAGRAM (TERMINAL PLAN)		REV
FOR ACTUATOR WITH INTEGRAL STARTER	U 01		0

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH					
VALVES	OPEN		CLOSE		#
	MAIN	BACK UP	MAIN	BACK UP	
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS	
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CLS	CTS	

* - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

CONTACT DEVELOPMENT DIAGRAM				
CONTACT	1-2	3-4	5-6	7-8
OTS	OPEN AT OVER TORQUE DURING OPENING TRAVEL	CLOSE AT OVER TORQUE DURING OPENING TRAVEL	OPEN AT OVER TORQUE DURING OPENING TRAVEL	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	OPEN AT OVER TORQUE DURING OPENING TRAVEL	CLOSE AT OVER TORQUE DURING OPENING TRAVEL	OPEN AT OVER TORQUE DURING OPENING TRAVEL	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
OLS-1	9-10	11-12	13-14	15-16
OLS-2	17-18	19-20	21-22	23-24
CLS-1	25-26	27-28	29-30	31-32
CLS-2	33-34	35-36	37-38	39-40
CLS-3	41-42	43-44	45-46	47-48
CLS-4	49-50	51-52	53-54	55-56
CLS-5	57-58	59-60	61-62	63-64
CLS-6	65-66	67-68	69-70	71-72
CLS-7	73-74	75-76	77-78	79-80
CLS-8	81-82	83-84	85-86	87-88
CLS-9	89-90	91-92	93-94	95-96
CLS-10	97-98	99-100	101-102	103-104
CLS-11	105-106	107-108	109-110	111-112
CLS-12	113-114	115-116	117-118	119-120
CLS-13	121-122	123-124	125-126	127-128
CLS-14	129-130	131-132	133-134	135-136
CLS-15	137-138	139-140	141-142	143-144
CLS-16	145-146	147-148	149-150	151-152
CLS-17	153-154	155-156	157-158	159-160
CLS-18	161-162	163-164	165-166	167-168
CLS-19	169-170	171-172	173-174	175-176
CLS-20	177-178	179-180	181-182	183-184
CLS-21	185-186	187-188	189-190	191-192
CLS-22	193-194	195-196	197-198	199-200
CLS-23	201-202	203-204	205-206	207-208
CLS-24	209-210	211-212	213-214	215-216
CLS-25	217-218	219-220	221-222	223-224
CLS-26	225-226	227-228	229-230	231-232
CLS-27	233-234	235-236	237-238	239-240
CLS-28	241-242	243-244	245-246	247-248
CLS-29	249-250	251-252	253-254	255-256
CLS-30	257-258	259-260	261-262	263-264
CLS-31	265-266	267-268	269-270	271-272
CLS-32	273-274	275-276	277-278	279-280
CLS-33	281-282	283-284	285-286	287-288
CLS-34	289-290	291-292	293-294	295-296
CLS-35	297-298	299-300	301-302	303-304
CLS-36	305-306	307-308	309-310	311-312
CLS-37	313-314	315-316	317-318	319-320
CLS-38	321-322	323-324	325-326	327-328
CLS-39	329-330	331-332	333-334	335-336
CLS-40	337-338	339-340	341-342	343-344
CLS-41	345-346	347-348	349-350	351-352
CLS-42	353-354	355-356	357-358	359-360
CLS-43	361-362	363-364	365-366	367-368
CLS-44	369-370	371-372	373-374	375-376
CLS-45	377-378	379-380	381-382	383-384
CLS-46	385-386	387-388	389-390	391-392
CLS-47	393-394	395-396	397-398	399-400
CLS-48	401-402	403-404	405-406	407-408
CLS-49	409-410	411-412	413-414	415-416
CLS-50	417-418	419-420	421-422	423-424
CLS-51	425-426	427-428	429-430	431-432
CLS-52	433-434	435-436	437-438	439-440
CLS-53	441-442	443-444	445-446	447-448
CLS-54	449-450	451-452	453-454	455-456
CLS-55	457-458	459-460	461-462	463-464
CLS-56	465-466	467-468	469-470	471-472
CLS-57	473-474	475-476	477-478	479-480
CLS-58	481-482	483-484	485-486	487-488
CLS-59	489-490	491-492	493-494	495-496
CLS-60	497-498	499-500	501-502	503-504
CLS-61	505-506	507-508	509-510	511-512
CLS-62	513-514	515-516	517-518	519-520
CLS-63	521-522	523-524	525-526	527-528
CLS-64	529-530	531-532	533-534	535-536
CLS-65	537-538	539-540	541-542	543-544
CLS-66	545-546	547-548	549-550	551-552
CLS-67	553-554	555-556	557-558	559-560
CLS-68	561-562	563-564	565-566	567-568
CLS-69	569-570	571-572	573-574	575-576
CLS-70	577-578	579-580	581-582	583-584
CLS-71	585-586	587-588	589-590	591-592
CLS-72	593-594	595-596	597-598	599-600
CLS-73	601-602	603-604	605-606	607-608
CLS-74	609-610	611-612	613-614	615-616
CLS-75	617-618	619-620	621-622	623-624
CLS-76	625-626	627-628	629-630	631-632
CLS-77	633-634	635-636	637-638	639-640
CLS-78	641-642	643-644	645-646	647-648
CLS-79	649-650	651-652	653-654	655-656
CLS-80	657-658	659-660	661-662	663-664
CLS-81	665-666	667-668	669-670	671-672
CLS-82	673-674	675-676	677-678	679-680
CLS-83	681-682	683-684	685-686	687-688
CLS-84	689-690	691-692	693-694	695-696
CLS-85	697-698	699-700	701-702	703-704
CLS-86	705-706	707-708	709-710	711-712
CLS-87	713-714	715-716	717-718	719-720
CLS-88	721-722	723-724	725-726	727-728
CLS-89	729-730	731-732	733-734	735-736
CLS-90	737-738	739-740	741-742	743-744
CLS-91	745-746	747-748	749-750	751-752
CLS-92	753-754	755-756	757-758	759-760
CLS-93	761-762	763-764	765-766	767-768
CLS-94	769-770	771-772	773-774	775-776
CLS-95	777-778	779-780	781-782	783-784
CLS-96	785-786	787-788	789-790	791-792
CLS-97	793-794	795-796	797-798	799-800
CLS-98	801-802	803-804	805-806	807-808
CLS-99	809-810	811-812	813-814	815-816
CLS-100	817-818	819-820	821-822	823-824
CLS-101	825-826	827-828	829-830	831-832
CLS-102	833-834	835-836	837-838	839-840
CLS-103	841-842	843-844	845-846	847-848
CLS-104	849-850	851-852	853-854	855-856
CLS-105	857-858	859-860	861-862	863-864
CLS-106	865-866	867-868	869-870	871-872
CLS-107	873-874	875-876	877-878	879-880
CLS-108	881-882	883-884	885-886	887-888
CLS-109	889-890	891-892	893-894	895-896
CLS-110	897-898	899-900	901-902	903-904
CLS-111	905-906	907-908	909-910	911-912
CLS-112	913-914	915-916	917-918	919-920
CLS-113	921-922	923-924	925-926	927-928
CLS-114	929-930	931-932	933-934	935-936
CLS-115	937-938	939-940	941-942	943-944
CLS-116	945-946	947-948	949-950	951-952
CLS-117	953-954	955-956	957-958	959-960
CLS-118	961-962	963-964	965-966	967-968
CLS-119	969-970	971-972	973-974	975-976
CLS-120	977-978	979-980	981-982	983-984
CLS-121	985-986	987-988	989-990	991-992
CLS-122	993-994	995-996	997-998	999-1000
CLS-123	1001-1002	1003-1004	1005-1006	1007-1008
CLS-124	1009-1010	1011-1012	1013-1014	1015-1016
CLS-125	1017-1018	1019-1020	1021-1022	1023-1024
CLS-126	1025-1026	1027-1028	1029-1030	1031-1032
CLS-127	1033-1034	1035-1036	1037-1038	1039-1040
CLS-128	1041-1042	1043-1044	1045-1046	1047-1048
CLS-129	1049-1050	1051-1052	1053-1054	1055-1056
CLS-130	1057-1058	1059-1060	1061-1062	1063-1064
CLS-131	1065-1066	1067-1068	1069-1070	1071-1072
CLS-132	1073-1074	1075-1076	1077-1078	1079-1080
CLS-133	1081-1082	1083-1084	1085-1086	1087-1088
CLS-134	1089-1090	1091-1092	1093-1094	1095-1096
CLS-135	1097-1098	1099-1100	1101-1102	1103-1104
CLS-136	1105-1106	1107-1108	1109-1110	1111-1112
CLS-137	1113-1114	1115-1116	1117-1118	1119-1120
CLS-138	1121-1122	1123-1124	1125-1126	1127-1128
CLS-139	1129-1130	1131-1132	1133-1134	1135-1136
CLS-140	1137-1138	1139-1140	1141-1142	1143-1144
CLS-141	1145-1146	1147-1148	1149-1150	1151-1152
CLS-142	1153-1154	1155-1156	1157-1158	1159-1160
CLS-143	1161-1162	1163-1164	1165-1166	1167-1168
CLS-144	1169-1170	1171-1172	1173-1174	1175-1176
CLS-145	1177-1178	1179-1180	1181-1182	1183-1184
CLS-146	1185-1186	1187-1188	1189-1190	1191-1192
CLS-147	1193-1194	1195-1196	1197-1198	1199-1200
CLS-148	1201-1202	1203-1204	1205-1206	1207-1208
CLS-149	1209-1210	1211-1212	1213-1214	1215-1216
CLS-150	1217-1218	1219-1220	1221-1222	1223-1224
CLS-151	1225-1226	1227-1228	1229-1230	1231-1232
CLS-152	1233-1234	1235-1236	1237-1238	1239-1240
CLS-153	1241-1242	1243-1244	1245-1246	1247-1248
CLS-154	1249-1250	1251-1252	1253-1254	1255-1256
CLS-155	1257-1258	1259-1260	1261-1262	1263-1264
CLS-156	1265-1266	1267-1268	1269-1270	1271-1272
CLS-157	1273-1274	1275-1276	1277-1278	1279-1280
CLS-158	1281-1282	1283-1284	1285-1286	1287-1288
CLS-159	1289-1290	1291-1292	1293-1294	1295-1296
CLS-160	1297-1298	1299-1300	1301-1302	1303-1304
CLS-161	1305-1306	1307-1308	1309-1310	1311-1312
CLS-162	1313-1314	1315-1316	1317-1318	1319-1320
CLS-163	1321-1322	1323-1324	1325-1326	1327-1328
CLS-164	1329-1330	1331-1332	1333-1334	1335-1336
CLS-165	1337-1338	1339-1340	1341-1342	1343-1344
CLS-166	1345-1346	1347-1348	1349-1350	1351-1352
CLS-167	1353-1354	1355-1356	1357-1358	1359-1360
CLS-168	1361-1362	1363-1364	1365-1366	1367-1368
CLS-169	1369-1370	1371-1372	1373-1374	1375-1376
CLS-170	1377-1378	1379-1380	1381-1382	1383-1384
CLS-171	1385-1386	1387-1388	1389-1390	1391-1392
CLS-172	1393-1394	1395-1396	1397-1398	1399-1400
CLS-173	1401-1402	1403-1404	1405-1406	1407-1408
CLS-174	1409-1410	1411-1412	1413-1414	1415-1416
CLS-175	1417-1418	1419-1420	1421-1422	1423-1424
CLS-176	1425-1426	1427-1428	1429-1430	1431-1432
CLS-177	1433-1434	1435-1436	1437-1438	1439-1440
CLS-178	1441-1442	1443-1444	1445-1446	1447-1448
CLS-179	1449-1450	1451-1452	1453-1454	1455-1456
CLS-180	1457-1458	1459-1460	1461-1462	1463-1464
CLS-181	1465-1466	1467-1468	1469-1470	1471-1472
CLS-182	1473-1474	1475-1476	1477-1478	1479-1480
CLS-183	1481-1482	1483-1484	1485-1486	1487-1488
CLS-184	1489-1490	1491-1492	1493-1494	1495-1496
CLS-185	1497-1498	1499-1500	1501-1502	1503-1504
CLS-186	1505-1506	1507-1508	1509-1510	1511-1512
CLS-187	1513-1514	1515-1516	1517-1518	1519-1520
CLS-188	1521-1522	1523-1524	1525-1526	1527-1528
CLS-189	1529-1530	1531-1532	1533-1534	1535-1

VOLUME – III

VOLUME – III
ANNEXURE- I
LIST OF APPROVED SUB-VENDORS

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

S.NO.	DESCRIPTION OF EQUIPMENTS	APPROVED SUB-VENDORS
1.	OIL FREE SCREW COMPRESSOR	ATLAS COPCO - PUNE KOBELCO (KPC) – PUNE ELGI – COIMBTORE Ingersoll Rand - Ahmadabad
	Centrifugal COMPRESSOR	ATLAS COPCO - PUNE KOBELCO (KPC) – PUNE ELGI – COIMBTORE Ingersoll Rand - Ahmadabad
2.	AIR DRYING PLANT (HOC TYPE -ROTARY DRUM)	ATLAS COPCO – PUNE KOBELCO – JAPAN
3.	AIR DRYING PLANT (HOC TYPE – CONVENTIONAL TWIN TOWER)	MELLCON – DELHI DELAIR – GURGAON SUMMITS – COIMBTORE AIROX-NIGEN - AHMEDABAD
4.	AIR DRYING PLANT (REFRIGERANT TYPE)	ATLAS COPCO – PUNE SUMMITS – COIMBTORE DELAIR - GURGAON SAVROE – GERMANY MTA – ITALY DOMNIC HUNTER - UK
5.	AIR RECEIVER	PARKAIRE – DELHI ARC WELD – BARODA HEAT TRANSFER – PUNE UNITED ENGG. WORKS – NASIK AIROX-NIGEN - AHMEDABAD. TEMASME VESSELEX – NOIDA.
6.	AIR FILTERS	IAEC - FINE FILTERS -
7.	INSULATION MATERIAL	FGP - LLOYDS - BASF - METTUR BEARDSHELL - U.P.TWIGA -
8.	PIPES (MS/GI)	TATA TUBE - JAMSHEDPUR JINDAL - GHAZIABAB SAIL - ROURKELA SURYA ROSHNI – BAHADUR GARH
9.	PIPES (STAINLESS STEEL)	REMI - MUMBAI RATNAMANI - AHMEDABAD CHOKSI - AHMEDABAD
10.	PIPE FITTINGS	MS FITTINGS – KOLKATTA METAL LLOYDS – MUMBAI BHARAT FORGE – PUNE TUBE PRODUCTS – BARODA NITIN PROFILE - BARODA
11.	BEARINGS	SKF -

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

		NORMA - FAG - NBC -
12.	AUTO DRAN TRAPS (INVERTED BUCKET/ BALL FLOAT TYPES)	DRAYTON - GREAVES - JN MARSHALL (SPIRAX) - PUNE
13.	ELECTRONIC DEW POINT METER	SHAW - GE SENSING -
14.	CAST STEEL GATE/GLOBE/NON-RETURN VALVES	FLUIDLINE VALVES - MUMBAI CRESCENT – NAVI MUMBAI LEADER – JALANDHAR AV VALVES – AGRA FOURESS VALVES – MUMBAI KBL – PUNE NITON INDUSTRIES – MUMBAI STEEL STRONG – NAVI MUMBAI VENUS – KOLKATTA BDK ENGG. – HUBLI (KARNATAKA)
15.	GUN METAL GATE/GLOBE/NON RETURN VALVES	LEADER – JALANDHAR AV VALVES – AGRA SANT VALVES - JALANDHAR
16.	BALL VALVES	CRESCENT – NAVI MUMBAI BDK – HUBLI (KARNATAKA) MICROFINISH – HUBLI (KARNATAKA) FISHER SANMAR – CHENNAI- CLASS 150/300, SIZE 15-200 NB, CCS, SH A216 Gr. WCB & CSS AV VALVES – AGRAKBL – PUNE FOR CARBON STEEL BALL VALVES ONLY. FLUIDLINE VALVES - MUMBAI FLOW CHEM - AHMEDABAD M/S AKAY INDUSTRIES PVT.LTD M/S BELGAUM AQUA VALVES PVT.LTD. M/S ASIAN INDUSTRIAL VALVES & INSTRUMENTS, CHENNAI M/S CHEMTECH INDUSTRIAL VALVES PVT. LTD. M/S DEMBLA VALVES LTD. M/S LEADER VALVES LTD.
17.	SAFETY RELIEF VALVES	BLISS ANAND – LEADER – JALANDHAR JN Marshall (SPIRAX) – PUNE KEYTONE - BARODA
18.	PLC	M/S ABB LIMITED M/S FORBES MARSHALL PVT. LTD. M/S GE Intelligent Platforms Private Limited M/S LARSEN & TOUBRO LTD. M/S ROCKWELL AUTOMATION INDIA LTD. (ALLENBRADLEY) M/S SIEMENS LTD M/S SCHNEIDER ELECTRIC INDIA PVT.LTD., NEW DELHI
19.	Pressure Gauge & DPS	M/S DRESSER INDUSTRIES INC., USA M/S GENERAL INSTRUMENTS CONSORTIUM

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

		M/S INFOS INDUSTRIES LIMITED,GHAZIABAD M/S SWITZER INSTRUMENT LTD. M/S SOR INC., USA M/S VASU TECH LIMITED
20	Transmitters	M/S BRISTOL BABCOCK LTD.,U.K M/S BIRLA KENT-TAYLOR LTD. M/S BLISS ANAND PVT.LTD. M/S EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD. M/S SIEMENS LTD M/S SBEM PVT.LTD.,PUNE M/S SMART INSTRUMENTS LTD, BRAZIL M/S TATA HONEYWELL LTD M/S V. AUTOMAT & INSTRUMENTS (P) LTD.
21	Temperature gauge	M/S A.N.INSTRUMENTS PVT.LTD M/S BUDENBERG GAUGE CO.LTD, UK M/S DRESSER INDUSTRIES INC., USA M/S FORBES MARSHALL (HYD) LTD. M/S GOA INSTRUMENTS INDUSTRIES PVT.LTD M/S GOA THERMOSTATIC INSTRUMENTS PVT.LTD.,GOA M/S H. GURU INSTRUMENTS (N. I.) PVT. LTD. M/S WAAREE INSTRUMENTS LIMITED,MUMBAI
22	Temperature Switch	M/S INFOSS (INDIA) LTD. M/S DRESSER INDUSTRIES INC., USA M/S SWITZER INSTRUMENT LTD. M/S SOR INC., USA M/S TOSHNIWAL BROTHERS (P) LTD. M/S VASU TECH LIMITED
23	Control valve	M/S DeZURIK - COPES VULCAN LTD., U.K M/S CONTINENTAL VALVES LTD. M/S CONTROL COMPONENT INC., USA M/S DRESSER VALVE INDIA PVT.LTD M/S FOURESS ENGG.INDIA LTD. M/S FISHER SANMAR LIMITED M/S FORBES MARSHALL ARCA PVT.LTD. ,PUNE - ENLISTED FOR CONTROL VLAVES UPTO 12" SIZE AND ANSI RATING UPTO CLASS 1500 ONLY. M/S WEIR VALVES & CONTROLS M.E M/S INSTRUMENTATION LTD M/S KOSO FLUID CONTROLS (PVT.) LTD. M/S LESLIE CONTROLS, INC. M/S MIL CONTROLS LTD. M/S R.K.CONTROL INSTRUMENTS PVT.LTD
24	220V DC Ni-Cd BATTERIES	M/S HOPPECKE BATTERIEN GMBH & CO .KG , GERMANY M/S AMCO SAFT INDIA LTD M/S HBL POWER SYSTEMS LTD
25	220V DC LEAD ACID BATTERIES (TUBULAR AND PLANTE	M/S HOPPECKE BATTERIEN GMBH & CO .KG , GERMANY M/S EXIDE INDUSTRIES LTD M/S HBL POWER SYSTEMS LTD
26	Battery & Battery Charger	M/S AFCO INDUSTRIAL AND CHEMICALS LTD. M/S AMCO SAFT INDIA LTD M/S AMARA RAJA POWER SYSTEMS PVT. LTD- 220V/ 24V & UPTO 1000Amps M/S BCH ELECTRIC LIMITED. UPTO 250A HOUR CAPACITY ONLY M/S EXIDE INDUSTRIES LTD- LEAD ACID BATTERIES ONLY.

BHEL APPROVED SUB-VENDOR LIST FOR COMPRESSED AIR SYSTEM

		M/S HBL POWER SYSTEMS LTD
27	LOCAL CONTROL PANELS	M/S CONTROL & SWITCHGEAR CO. LTD. M/S INDUSTRIAL CONTROLS & APPLIANCES P.LTD M/S PYROTECH ELECTRONICS PVT.LTD M/S PROCON INSTRUMENTATION PVT LTD
28	JUNCTION BOX	M/S AJMERA INDUSTRIAL & ENGINEERING WORKS- APPROVED FOR GALVANIZED AND FRP JUNCTION BOXES M/S BALIGA LIGHTING EQUIPMENTS PRIVATE LIMITED , CHENNAI M/S DEVI POLYMERS,CHENNAI M/S ELECTROMAC INDUSTRIES,MUMBAI M/S K.S.INTRUMENTS PVT.LTD.,BANGALORE M/S MANISHA ENTERPRISE , PUNE M/S SHRENIK & COMPANY M/S SUCHITRA INDUSTRIES , BANGALORE
29	HT MOTORS	BHEL (INDUSTRY SECTOR) CROMPTON GREAVES KIRLOSKAR ELECTRIC CO LTD. NGEF GE-POWER MARATHON

VOLUME – III
ANNEXURE-II
PERFORMANCE REQUIREMENTS



**RAICHUR POWER CORPORATION LIMITED
YERAMARUS TPS - 2x800 MW**

SECTION: C5
VOLUME-II

**PERFORMANCE GUARANTEE AND LIQUIDATED
DAMAGES FOR PERFORMANCE**

Page 19 of 20

ELEVATORS

Passenger lift for service building as well as ~~passenger lifts & goods lifts for~~
steam generator area: over load test, travel & hoist speed checks.

COMPRESSED AIR SYSTEM:

At shop: 1. Capacity and discharge pressure of each air compressor.
2. Power consumption of each air compressor at its rated duty
Point with its own motor.

At site: 1. Parallel operations of air compressors.
2. Capacity & dew point of air at the outlet of air drying plants of
instrument air compressors.
3. Pressure drop across the air drying plants of air compressors.
4. Vibration & noise level of air compressors, blowers of air
drying plant (if applicable)

ACW & ACW BOOSTER PUMP SYSTEM

Capacity, head & power consumption of all the pumps at the rated duty point.
Vibration, noise level & parallel operations of the pump at rated duty point.

EQUIPMENT COOLING WATER SYSTEM (Under BTG scope)

1. Design heat load, inlet and outlet temperatures of plate type heat exchangers on the primary & secondary side to be demonstrated at site.
2. Capacity, head & power consumption, vibration, noise level & parallel operation of all the pumps.
3. Pressure drop across head exchangers on primary , secondary water circuit.

RODM PLANT

The contractor shall guarantee the following Effluent guarantee:

UF Outlet: Turbidity – less than 1 NTU and SDI₁₅ less than 3
Mixed bed unit –silica shall not exceed 0.015 ppm as Si O₂.
Conductivity at the outlet - not greater than 0.1 micro MHO/CM at 25 Deg C.
PH Organic matter – about 7 (6.8 to 7.2) should be practically free (less
than 0.2 mg of KMNO₄-Ltr).

MISCELLANIOUS PUMPS

Rated speed, rated capacity, power consumption at motor terminals,
vibrations & noise levels & parallel operations.

DG SET

Shall be capable of starting from cold condition and reach full synchronise
speed & rated voltage within 15 Seconds & shall take full rated load within 30
seconds without undue vibration & over heating of engine, suitable for parallel





050




78/0/12

VOLUME – III
ANNEXURE-III
PAINTING SCHEDULE

	TITLE	DOCUMENT NO. PE-DC-362-100-A999																																					
	PAINTING SCHEDULE RPCL YERAMARUS TPS (2X800 MW)																																						
		REV.NO. 00	DATE 06/07/2012																																				
		SHEET 1 OF 3																																					
<p>1.0 <u>GENERAL PAINTING REQUIREMENTS</u></p> <p>1.1 Painting of equipment shall be carried out as per the specifications indicated below and attached annexure and shall conform to the relevant IS specification/ international standards for the material and workmanship.</p> <p>1.2 The following Indian Standards may be referred to for carrying out the painting job :</p> <table border="0"> <tr> <td>IS:5</td> <td>:</td> <td>Colours for ready mixed paints and enamels</td> </tr> <tr> <td>IS:1303</td> <td>:</td> <td>Glossary of terms relating to paints</td> </tr> <tr> <td>IS:2379</td> <td>:</td> <td>Colour code for identification of pipelines</td> </tr> <tr> <td>IS:1477</td> <td>:</td> <td>Code of practice for painting of ferrous metals in buildings (Parts I & II)</td> </tr> <tr> <td>IS:2524</td> <td>:</td> <td>Code of practice for painting of non-ferrous metals in buildings (Parts I & II)</td> </tr> <tr> <td>IS:2395</td> <td>:</td> <td>Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)</td> </tr> <tr> <td>IS:2338</td> <td>:</td> <td>Code of practice for finishing of wood and wood based materials (Parts I & II)</td> </tr> <tr> <td>IS:6278</td> <td>:</td> <td>Code of practice for white washing and colour Washing</td> </tr> <tr> <td>IS:158</td> <td>:</td> <td>Ready mixed paint, brushing, bituminous, black, leadfree, acid, alkali, water and heat resisting</td> </tr> <tr> <td>IS:2074</td> <td>:</td> <td>Ready mixed paint, air drying, red Oxide Zinc Chrome, priming</td> </tr> <tr> <td>IS:104</td> <td>:</td> <td>Ready mixed paint, brushing, Zinc Chrome, priming</td> </tr> <tr> <td>IS: 2932</td> <td>:</td> <td>Enamel , synthetic, exterior (a) undercoating (b) Finishing</td> </tr> </table>				IS:5	:	Colours for ready mixed paints and enamels	IS:1303	:	Glossary of terms relating to paints	IS:2379	:	Colour code for identification of pipelines	IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)	IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)	IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)	IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)	IS:6278	:	Code of practice for white washing and colour Washing	IS:158	:	Ready mixed paint, brushing, bituminous, black, leadfree, acid, alkali, water and heat resisting	IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming	IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming	IS: 2932	:	Enamel , synthetic, exterior (a) undercoating (b) Finishing
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	TITLE	DOCUMENT NO. PE-DC-362-100-A999	
	PAINTING SCHEDULE RPCL YERAMARUS TPS (2X800 MW)		
		REV.NO. 00	DATE 06/07/2012
		SHEET 2 OF 3	
<p>1.3 Preparation of Surfaces</p> <p>All surfaces to be painted shall be thoroughly cleaned of all grease , oil, loose mill scale , dust , rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out sand scrapping may be permitted with steel wire brushes and /or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER/OWNER REPRESENTATIVE. The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphating and rinsing. However, in case mechanical cleaning is also required the Contractor shall carry out the same to get a smooth finish.</p> <p>1.4 Primer Paint</p> <p>After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied. After this first coat is dried up completely, second coat of primer shall be applied. Primer shall be applied by brushing, spray, roller as per manufacture recommendation to ensure a continuous film. The dry film thickness of each coat shall be as indicated in Ann-I & II enclosed. Insulated surfaces will have only primer coating and no finish painting.</p> <p>1.5 Finish Paint</p> <p>Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade for various items is listed in annexure III. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.</p> <p>1.6 Painting and Corrosion Protection for Pipes & Fittings</p> <p>1.6.1 All uninsulated piping systems, hangers and supports shall have two coats of Zinc Phosphate Primer (conforming to IS 2074) and finish paint using synthetic enamel paint to give a finish coat. Shades shall be as per IS 5 or as indicated by PURCHASER/OWNER. Service of the pipeline designations shall be painted on all pipes at visible locations.</p> <p>1.6.2 Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.,</p>			

	TITLE	DOCUMENT NO. PE-DC-362-100-A999															
	PAINTING SCHEDULE RPCL YERAMARUS TPS (2X800 MW)																
		REV.NO. 00	DATE 06/07/2012														
		SHEET 3 OF 3															
1.6.3	All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.																
1.6.4	Shop fabricated equipment/items shall be dispatched with final paint. Necessary touch up shall be done at site. Site fabricated equipment/items shall be dispatched with primer painting only and final painting shall be applied at site.																
1.7	Painting and Corrosion Protection for Valves & Specialties Two coats of primer of thickness as indicated in Ann-It shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited. Bores of all vales shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.																
1.8	Suggested Colour Codes for Painting Suggested colour codes for major items shall be as per annexure III. Colour codes for piping shall be as per IS 2379 with necessary modifications. Where band colour is specified for piping, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.																
1.9	Approved Paint Makes <table border="0"><tr><td>i) Asian Paints (I) Ltd.</td><td>vi) Shalimar Paints Ltd.</td></tr><tr><td>ii) Berger Paints India Ltd</td><td>vii) Addison Paints Ltd.</td></tr><tr><td>iii) Goodlass Nerolac</td><td>viii) Grand Polycoat</td></tr><tr><td>iv) Jenson & Nicholson (I) Ltd</td><td>ix) Bombay Paints</td></tr><tr><td>v) CDC carboline (I) Ltd.</td><td>x) Hemple Paints (Singapore)</td></tr><tr><td></td><td>xi) Jotun Paints</td></tr><tr><td></td><td>xii) Akzonobel coatings</td></tr></table>			i) Asian Paints (I) Ltd.	vi) Shalimar Paints Ltd.	ii) Berger Paints India Ltd	vii) Addison Paints Ltd.	iii) Goodlass Nerolac	viii) Grand Polycoat	iv) Jenson & Nicholson (I) Ltd	ix) Bombay Paints	v) CDC carboline (I) Ltd.	x) Hemple Paints (Singapore)		xi) Jotun Paints		xii) Akzonobel coatings
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2.0	<u>PAINTING SCHEDULES</u>																
2.1	Painting schedules for various systems/ items are furnished as per enclosed Annexures-I and II . Vendors of different packages/ items will furnish detailed painting schedule for customer approval during detail engineering as per this guide specification.																



TITLE

PAINTING SCHEDULE

RPCL YERAMARUS TPS (2X800 MW)

DOCUMENT NO. PE-DC-362-100-A999

REV.NO. 00 DATE 06/07/2012

SHEET 1 OF 2

Annexure-I

Paint Reference Scheme	Surface Preparation Grade / Surface Profile	Primer Coat			Intermediate Coat			Finish Coat			Total DFT in micro ns
		Premier Paint	No. of Coats	DFT in Microns	Intermediate Paint	No. of Coats	DFT in Micro ns	Finish Paint (See Note)	No. of Coats	DFT in Microns	
Various type of equipment/v alve, etc. (Temp. upto 90°C)	Degreasing and Mech. Cleaning with wire brushing/hand tool (Sa1/St2/St3 as applicable)	HB Zinc Phosphate (alkyd Medium) as per IS:2074	2	35-45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140
LP Piping/structurals/ Vessels, etc. (Temp. upto 90°)	- do -	HB Zinc Phosphate as per IS:2074 (alkyd medium)	2	35 – 45 per coat	- NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110- 140
Equipment with (Temp. upto 250°)	- do -	Heat resistant Al – paint	2	20 per coat	- NA	-	-	NA	Insulated	NA	40
Equipment in corrosive areas like CPU (regeneration) Dosing skid, etc.	Blast clean to Sa 2 ¹ /2	HB Epoxy resin based zinc phosphate primer	1	50 per coat	Epoxy based MIO pigmented paint	1	50 per coat	Polyamide cured Epoxy finish coat	2	25 – 35 per coat	150 - 170
Elect. / Control Panels, etc.	Seven tank process	HB Zinc phosphate (alkyd Medium) as per IS:2074	2	35 – 45 per coat	-NA	-	-	Synthetic enamel (alkyd med.) as per IS:2932	2	20 – 25 per coat	110 - 140



TITLE

PAINTING SCHEDULE**RPCL YERAMARUS TPS (2X800 MW)**


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SHEET 2 OF 2

Notes:

1. Surface preparation shown is as per Swedish Standards SIS 05-5900 or equivalent Indian std. Degreasing will be as per Standard SSPC-SP1.
2. In case of insulated surfaces, only primer coats shall be applied.
3. GM/SS items with piping and G.I. pipes will not be painted. However these items carrying under Fire Fighting System shall be painted Fire Red as per TAC guidelines. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.
4. All instruments shall be painted as per manufacturer standard practice.
5. All structural steel items shall be painted at site. Piping shall go with primer coating & finish paint shall be applied at site. Equipment shall be finish painted at shop.
6. Method of painting application shall be as per paint manufacturer's recommendation.
7. **Based on above painting schedule, detailed painting schedule will be prepared by respective Package supplier and these be submitted to RPCL for their approval.**
8. **This painting schedule is applicable for bought out equipment/packages of PEM. Painting specification for various piping/ equipment in scope of various other BHEL units like Power cycle piping, CW piping, LP piping, R.E. joints, Butterfly valves, Power cycle valve etc., shall be furnished by unit separately.**

	TITLE		DOCUMENT NO. PE-DC-362-100-A999	
	PAINTING SCHEDULE RPCL YERAMARUS TPS (2X800 MW)			
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		SHEET 1 OF 2		

ANNEXURE –II

Condensate/DM Water Storage Tank			
Int	ernal	External	Underneath
Surface preparation	Blast clean to SA 2.5	Hand/Power tool cleaning/ wire brushing to ST-2	Blast clean to SA 2.5
Primer	1 coat of epoxy resin based zinc phosphate high build primer (2 pack), DFT : 50 – 70 microns	2 coats of red oxide zinc chromate primer (IS 2074) of 30 - 35 microns DFT each	1 coat of high build coal tar epoxy suitably pigmented, DFT : 80 – 100 microns
Finish	2 coats of solvent free epoxy paint, DFT – 35 microns each	2 coats of synthetic enamel (IS – 2932) paint of 20 – 25 microns DFT each	N.A
Total DFT	120 – 140 microns	100 – 120 microns	80 – 100 microns

NaOH Breather and Seal Pot			
Inter	nal	External	Underneath
Surface preparation	Blast clean to SA 2.5	Blast clean to SA 2.5	N.A.
Primer	1 coat of epoxy resin based zinc phosphate high build primer (2 pack), DFT : 50 – 70 microns	2 coats of epoxy resin based zinc phosphate primer of 35-50 microns.	N.A.
Finish	2 coats of solvent free epoxy paint, DFT – 35 microns each	2 coats of polyamide cured epoxy finish paint of 30-35 microns each	N.A.
Total DFT	120 – 140 microns	130 – 170 microns	



TITLE

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PAINTING SCHEDULE**RPCL YERAMARUS TPS (2X800 MW)**

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SHEET 2 OF 2

ANNEXURE –II

LDO/HFO Storage Tank			
Int	ernal	External	Underneath
Surface preparation	Wire bushing	ST2 (Wire Brushing/ Hand tool cleaning)	Blast clean to SA 2.5
Primer	NA	2 coats of red oxide zinc chromate primer (IS 2074) of 30 - 35 microns DFT each	1 coat of high build coal tar epoxy suitably pigmented, DFT : 80 – 100 microns
Finish	2 coats of double boiled linseed oil	2 coats of synthetic enamel (IS – 2932) paint of 20 – 25 microns (DFT) each	N.A
Total DFT		100 – 120 microns	80 – 100 microns

	TITLE	DOCUMENT NO. PE-DC-362-100-A999			
	PAINTING SCHEDULE RPCL YERAMARUS TPS (2X800 MW)				
		REV.NO. 00	DATE 06/07/2012		
		SHEET 1 OF 2			
ANNEXURE-III					
SUGGESTED COLOUR CODES FOR PAINTING					
SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.0	Fans, pumps, motors, compressors, Blowers	Light Grey	631	-	-
3.0	Tanks (without insulation and cladding)				
3.1	Outdoor, Stand pipes, vent pipes	Aluminum	-	-	-
3.2	Indoor	Aluminum	-	-	-
4.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
5.0	Switchgear	Light grey	631	-	-
6.0	Control & relay panels	Light grey	631/7078 of IS 1650	-	-
7.0	Transformers	Dark Admiralty Grey	632	-	-
8.0	Machinery guards	Signal red	537	-	-
9.0	Piping (without insulation and cladding)				
9.1	Water System				
a)	Boiler feed	Sea green	217	-	-
b)	Condensate	Sea green	217	Light brown	410
c)	D M Water	Sea Green	217	Light orange	557
d)	Soft water	Sea green	217	French blue	166
e)	Bearing cooling water	Sea green	217	French blue	166
f)	Potable & filtered water	Sea green	217	French blue	166
g)	Service & clarified water	Sea green	217	French blue	166
h)	Raw water	Sea green	217	White	-
i)	Cooling water	Sea green	217	French blue	166
9.2	Compressed Air System				
a)	Service air	Sky Blue	101	-	-
b)	Instrument air	blue	101	White	-
9.3	Oil system				
a)	Fuel oil	Light brown	410	French Blue	166
b)	Light oil	Dark Brown	412	Brilliant green	221
c)	Lubricating oil	Light brown	410	Light grey	631



TITLE

PAINTING SCHEDULE**RPCL YERAMARUS TPS (2X800 MW)**

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SHEET 2 OF 2

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
d)	Control oil	Light brown	410	Light orange	557
e)	Transformer oil	Light brown	410	Light orange	557
9.4	Gas system				
a)	Carbon dioxide	Canary yellow	309	Light grey	631
9.5	Fire services	Fire red	536	-	-
9.6	Drainage	Black	-	-	-
9.7	Stand pipes and all Vent pipes	Aluminum	-	-	-

Notes:

1. This color code basically refers to IS:2379 for piping with necessary modifications.
2. Where band color is specified, same shall be provided at 10 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.



RAICHUR POWER CORPORATION LIMITED
YERAMARUS TPS - 2x800 MW

SECTION: C9
VOLUME-II

PAINTING

Page 1 of 3

1.0 SCOPE

- 1.1 This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted.

2.0 CODES AND STANDARDS

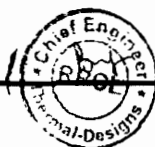
Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job :

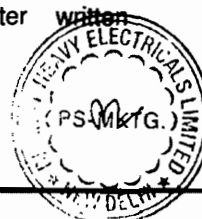
IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)
IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:6278	:	Code of practice for white washing and colour Washing
IS:3140	:	Code of practice for painting asbestos cement building products
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and heat resisting
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel, synthetic, exterior (a) undercoating (b) finishing

3.0 PREPARATION OF SURFACES

All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, sand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER / ENGINEER.



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RAICHUR POWER CORPORATION LIMITED
YERAMARUS TPS - 2x800 MW

SECTION: C9

VOLUME-II

PAINTING

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4.0 PRIMER PAINT

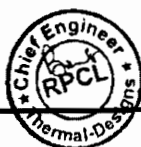
After the surface is prepared, one coat of Zinc Phosphate primer conforming to IS:2074 shall be applied. After this first coat is dried up completely, second coat of red oxide primer shall be applied. Primer shall be applied by brushing to ensure a continuous film without 'holidays'. The dry film thickness of each coat shall be minimum 30 microns.

5.0 FINISH PAINT

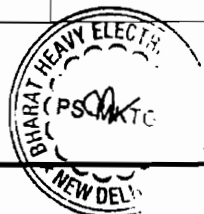
Synthetic enamel paint conforming to IS:2932 shall be used for finish coats. The colour/shade shall be as approved by the OWNER. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.

6.0 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
1.0	Structures, platforms, galleries, ladders and handrails	Dark Admiralty Grey	632	-	-
2.0	Boiler casing, ESP and ducting	Nut Brown	413	-	-
3.0	Crane				
3.1	Crane structure	Golden Yellow	356	-	-
3.2	Trolley and hook	Crimson	540	-	-
4.0	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.0	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.0	Switchgear	Light grey	631	-	-
8.0	Control & relay panels	Light grey	631/70 78 of IS 1650	-	-
9.0	Turbine	Golden Yellow	356	-	-



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RAICHUR POWER CORPORATION LIMITED
VERAMARUS TPS - 2x800 MW

SECTION: C9
VOLUME-II

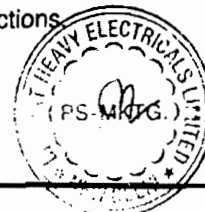
PAINTING

Page 3 of 3

SL. NO.	ITEM/SERVICE	COLOUR	IS-5 Grade	COLOUR (BAND)	IS-5
10.0	Generator & exciter	Light grey	631	--	-
11.0	Transformers	Grey	-	-	-
12.0	Machinery guards	Signal red	537	-	-
13.0	Piping (without insulation and cladding)				
13.1	Water System				
	Boiler feed	Sea green	217	-	-
	Condensate	Sea green	217	Light brown	410
	D M Water	Sea green	217	Light orange	557
	Soft water	Sea green	217	French blue	166
	Bearing cooling water	Sea green	217	French blue	166
	Potable & filtered water	Sea green	217	French blue	166
	Service & clarified water	Sea green	217	French blue	166
	Raw water	Sea green	217	White	-
	Cooling water	Sea green	217	French blue	166
13.2	Air System				
	Station air	Sky blue	101	-	-
	Control air	Sky blue	101	White	-
13.3	Oil system				
	Fuel oil	Light brown	410	French	166
	Light oil	Light Brown	410	Brilliant green	221
	Lubricating oil	Light brown	410	Light grey	631
	Transformer oil	Light brown	410	Light orange	557
13.4	Gas system				
	Carbon dioxide	Canary yellow	309	Light grey	631
	Hydrogen	Canary yellow	309	Signal red	537
13.5	Fire services	Fire red	536	-	-
13.6	Ash slurry pipes	Black	-	-	-
13.7	Vacuum pipes	Sky blue	101	Black	-
13.8	Fuel pipes (pulverised coal)	Light brown	410	-	-
13.9	Drainage	Black	-	-	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications
2. Where band colour is specified, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions



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VOLUME – III
ANNEXURE-IV
DOCUMENT DISTRIBUTION SCHEDULE



RAICHUR POWER CORPORATION LIMITED

YERAMARUS TPS - 2x800 MW

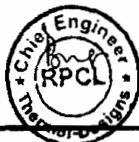
DOCUMENT DISTRIBUTION SCHEDULE

SECTION: F4

VOLUME-II

Page 1 of 2

Sl. No.	Description	RPCL			Contractor (BHEL)				
	1	Bangalore (Thermal Design)	YTPS (Site)	Consulting Engineer M/s.EESI	PS- Marketing	Units/ PEM	Site	PMG	PSSR
A	Correspondence – soft copy (email) & Hard copy as per requirement								
1	Post Contract	1	Nil	Nil	S	1*	1*	1	1*
		1	Nil	S	Nil	Nil	Nil	Nil	Nil
		1	S	Nil	Nil	1*	1	1	1
		S	1	1	Nil	1	1*	1	1*
		1*	1*	Nil	Nil	1*	1*	1	S
		1	1	Nil	1*	1*	1*	S	1*
B (a)	Contractor Drawings								
1	Preliminary/ resubmission	PDF+1 Hard copy	Nil	PDF	Nil	S	Nil	P	Nil
2	Return preliminary with comments	PDF	Nil	S	Nil	PDF	Nil	P	Nil
3	Final approved drawings for stamping (Hard copy)	Nil	Nil	4	Nil	S	Nil	P	Nil
4	Return of stamped copies by EESI (Hard copy)	1	Nil	S	Nil	2	Nil	P	Nil
5	Distribution by contractor (Hard copy)	4	4	Nil	Nil	S	4	P	Nil
6	As-Built drawings/ Erection Drawings	1CD + 1 hard copy	1CD + 4 hard copies	Nil	Nil	S	1	P	Nil
B (b)	All design calculations/design memorandum/data sheet/MQP								
1	Preliminary/ resubmission	1	Nil	1	Nil	S	Nil	P	Nil
2	Return preliminary with comments	1	Nil	S	Nil	1	Nil	P	Nil
3	Final approved documents for stamping (Hard copy)	Nil	Nil	4	Nil	S	Nil	P	Nil
4	Stamped copies	1	Nil	S	Nil	2	Nil	P	Nil
5	Distribution	2 CD	Nil	Nil	Nil	S	1*	P	1*





**RAICHUR POWER CORPORATION LIMITED
YERAMARUS TPS - 2x800 MW**

SECTION: F4
VOLUME-II

DOCUMENT DISTRIBUTION SCHEDULE

Page 2 of 2

Sl. No.	Description	RPCL			Contractor (BHEL)				
C	Progress Reports (Monthly)								
1	Contractor	3	Nil	Nil	Nil	Nil	Nil	S	Nil
2	Consultant	3	Nil	S	Nil	Nil	Nil	1	Nil
D	Manuals								
1	Erection & Commissioning	3	5	Nil	Nil	Nil	3	P	S
2	Operation & maintenance	3	5	Nil	Nil	S	3	P	P

Abbreviations:

- RPCL: Raichur Power Corporation Limited
- Consultant: M/s Evonik Energy Services (India) Pvt. Ltd., (EESI)
- S: Source
- T: Transparency
- CD: Compact Disc
- 1*: One copy case to case basis
- P: Only transmittal/covering letter
- PDF: Soft copy in pdf format



VOLUME – III
ANNEXURE- V
FORMAT FOR NO DEVIATION CERTIFICATE

FORMAT FOR NO DEVIATION CERTIFICATE
(To be submitted in the bidder's letter head)

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector – Project Engineering Management,
PPEI Building,HRD & ESI Complex,
Plot no. 25, Sec.16A
Noida – 201301(UP)

Sub	No Deviation Certificate.	
Job	Design, manufacturing, supply, erection, testing & commissioning of Compressed Air System for 2 X 800 MW YERAMRUS STPS.	
Ref	1.0	Tender document no
	2.0	BHEL's NIT vide reference no
	3.0	BHEL's Amendment vide reference no .
	4.0	All other pertinent issues till date.

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed/ modified the tender documents and in case of observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in above referred NIT and convey our unqualified acceptance to all terms and conditions as stipulated in the tender and NIT.

We hereby confirm to unqualified compliance to technical specification together with other references as enumerated in above referred NIT.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted offer strictly in accordance with above.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized
representative of the bidder)

VOLUME – III
ANNEXURE- VI
FORMAT FOR DEVIATION

VOLUME – III
ANNEXURE- VII
GUARANTEE POWER CONSUMPTION FIGURE

YERAMARUS TPS - (2X800 MW)						
Guaranteed Power Consumption For Air Compressor System Shall be as per Following :						
S.No. (1)	Description of Equipments (2)	Nos. of Equipments (3)		Total Guaranteed Power Consumption for Each Equipment at Motor Input Terminals & control Panel (4)	Duty Factor (5)	Total (KW) (6) = (3A)*(4)*(5)
		Working (3A)	Standby (3B)			
1	Serve Air Compressor (Oil free screw) 30 NM3/min at 8.5 Kg/cm2 pressure	2	1		1	
2	Instrument Air Compressor (Oil free screw) 30 NM3/min at 8.5 Kg/cm2	4	2		1	
3	Air Drying Plant Unit (Conventional Twin Tower Type / Rotary drum type as applicable)	4	2		1	
					TOTAL	

Note :

1	Estimated Power Consumption (EPC) Figure for the compressed air system (For Working Drives Only) considered is 1740 KW (For station)
2	Bidders Guaranteed power consumption at motor input terminals (Not Shaft Power) including power for control panel as furnished in guaranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.
3	The price quoted by the bidder shall be loaded @ Rs 4.75 Lakhs/- for every additional kW increase in consumption from the EPC figure indicated at Note no. 1.0 above.
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (EPC figure OR Guaranteed Power Consumption (GPC) figure, whichever is higher) on actual performance testing at the manufacturing works / site, penalty @Rs 4.75 Lakhs/- per kW increase in power consumption figure shall be levied.