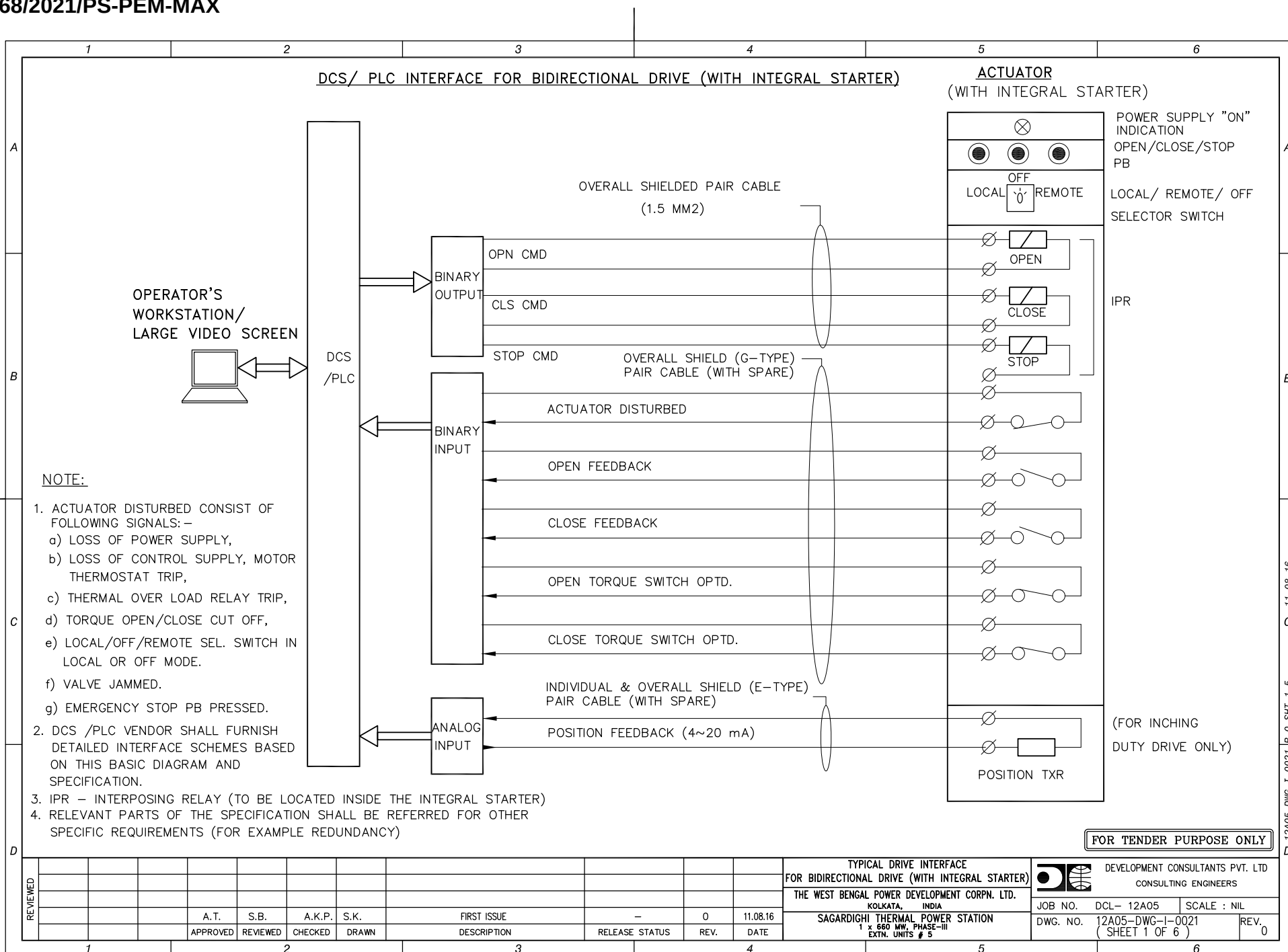






SECTION – III

ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 CODES & STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian standards (IS), IEC, ANSI & NEMA. Standards except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case the seller shall provide details of how his standards comply with the Buyer's requirement and duly certified copies of the English version of the standard adopted shall be submitted.

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or minimum S2-15 minutes as per IEC-60034-1, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operations before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).



- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.
- 6.00.00 **SPECIFIC REQUIREMENT**
- 6.01.00 **Construction**
- 6.01.01 The actuator shall essentially comprise the drive motor, torque & limit switches, gear train, self locking features, clutch, hand wheel, position indicator & transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
- 6.01.05 All motorized actuators shall be Smart Type and shall be furnished with Integral Starter mounted on the actuator and compatible with DCS/PLC. The Integral Starter shall be complete with:
1. One (1) triple pole breaker
 2. One (1) no. reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC aux. contacts for each contactor.
 3. One (1) no. Remote- Local selector switch
 4. CLOSE-STOP-OPEN oil tight push buttons with indication lights. STOP push button shall be latchable type.
 5. 415 / 240 V control transformer with primary and secondary fuses.
- These actuators shall have diagnostic feature with valve checking facility from remote.
- 6.02.00 **Motor**
- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class F insulation and weatherproof IPW-55 enclosure, designed for high torque and reversing service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 Open / Close command termination logic with position and torque limit switch positioner circuitry shall be suitably built in a PCB inside the actuator.

a) For binary drive, open/close/stop command and status thereof and disturbance monitoring signal (common contact for overload, thermostat, control supply failure, L/R selector switch at local, other protections operated) shall be provided.

Interface with the control system shall be through hardwired signal only. Interposing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

b) For modulating drive, the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided

c) Open/close command termination logic shall be suitably built inside actuator.

6.03.04 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.05 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 **Position Indicator/Transmitter (applicable for inching services only)**

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.



- 6.05.02 One (1) no. transducer (4-20 ma) for remote position indicator for 0-100 % travel
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2X2.5 Sq.mm copper conductors.
- 7.00.00 **TEST**
- The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.
- 8.00.00 **DRAWINGS, DATA & MANUALS**
- 8.01.01 To be Submitted with Bid
- Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.
- 8.01.02 To be Submitted after Award of Contract
- Actuator Data Sheet
 - Internal wiring diagram and suggested control schematic
 - Torque switch and limit switch contact development
 - Manufacturer's Catalogue
 - Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.
- 8.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.



ANNEXURE-A

DESIGN DATA

1.0

AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3 ϕ , 3W, 50 Hz Non-effectively earthed	Motors above 1500 KW and also LT Transformer (11kV / 433 V)
	3300 V, 3 ϕ , 3W, 50 Hz Non-effectively earthed	Motors above 160 KW and upto 1500 KW
	Fault level 40 KA sym. for 3 second.	
L.T. Supply	415V, 3 ϕ , 4W, 50 Hz Effectively earthed	Motors above 200W to 160 KW
	Fault level 50 KA sym. for 1 seconds.	
	240V, 1 ϕ , 2W, 50 Hz effectively earthed	Motors up to 200W, Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed & protective devices Unearthed system	D.C. alarm, control
	Fault level 25* KA for 1 second (Min.)	

* However actual value to be substantiated by the bidder through calculation.

2.0

RANGE OF VARIATION

A.C. Supply

Voltage	:	±10%
Frequency	:	±5%

Combined Volt & frequency : 10 % (absolute sum)

D.C. Supply

Voltage : 198 to 240 Volt



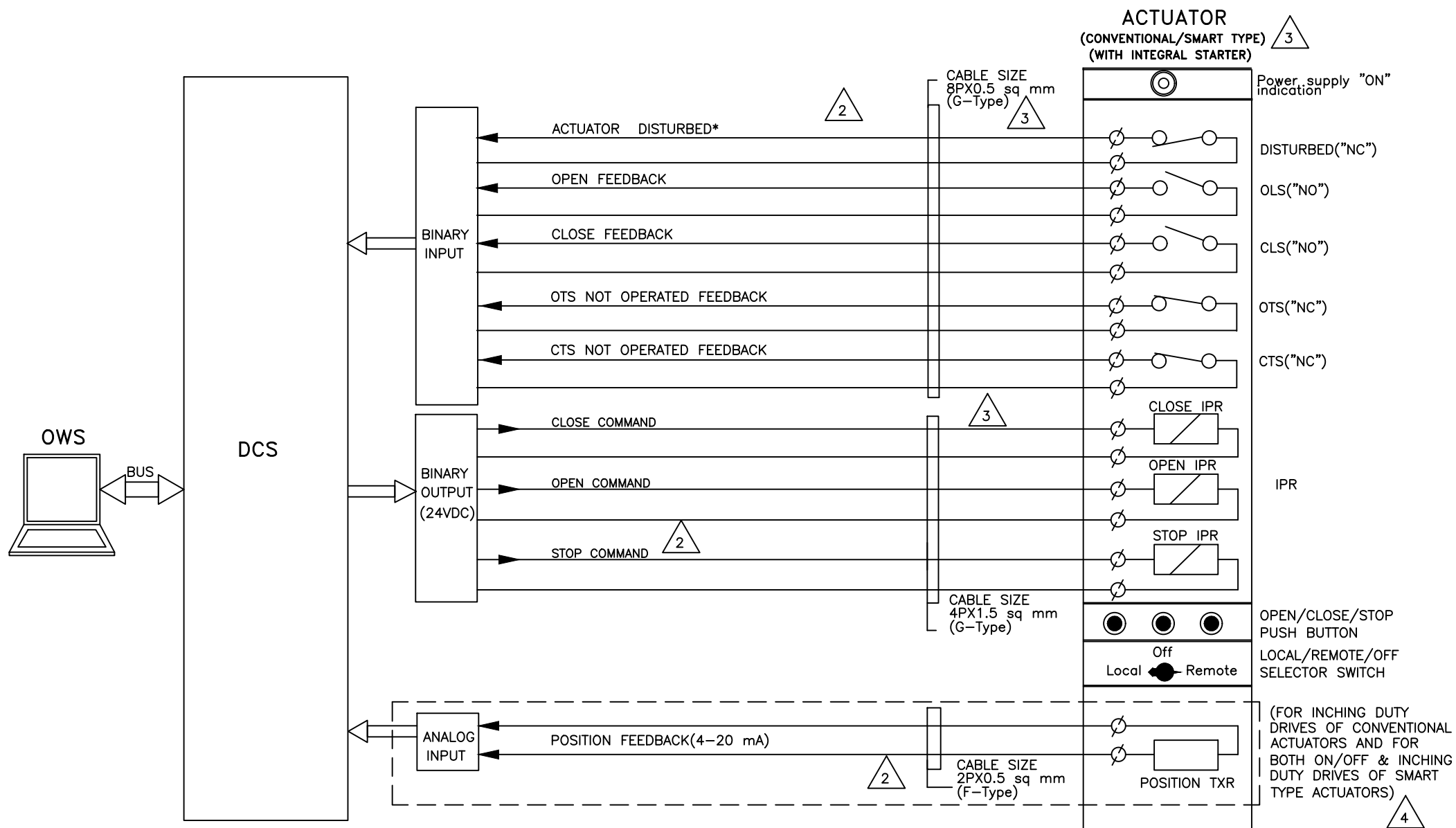
**C&I SPECIFICATION FOR
COMPRESSED AIR SYSTEM**

SECTION: C
SUB SECTION: C&I

**SIGNL EXCHANGE BETWEEN DRIVES &
DCS**

|

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



PROJECT: 1X660MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)

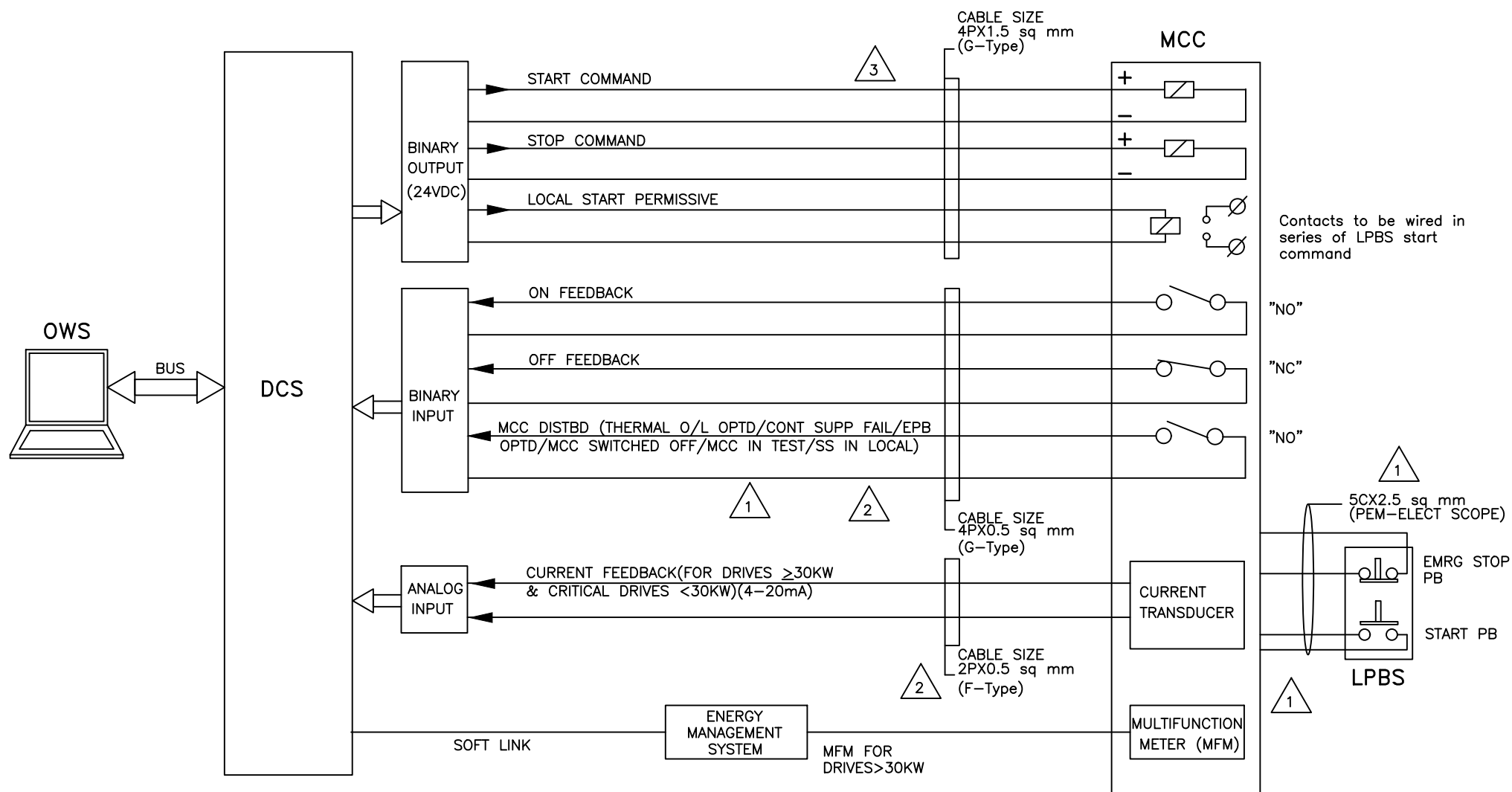
TITLE DDCMIS INTERFACE FOR
BIDIRECTIONAL DRIVE

DRG.NO. PE-DM-445-145-I002

DATE 15.03.2021

REV.NO. 04

SHT 7 Page 3 of 3

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED) 1

NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL CRITICAL LT DRIVES



PROJECT: 1X660MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)

TITLE DDCMIS INTERFACE FOR
UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)

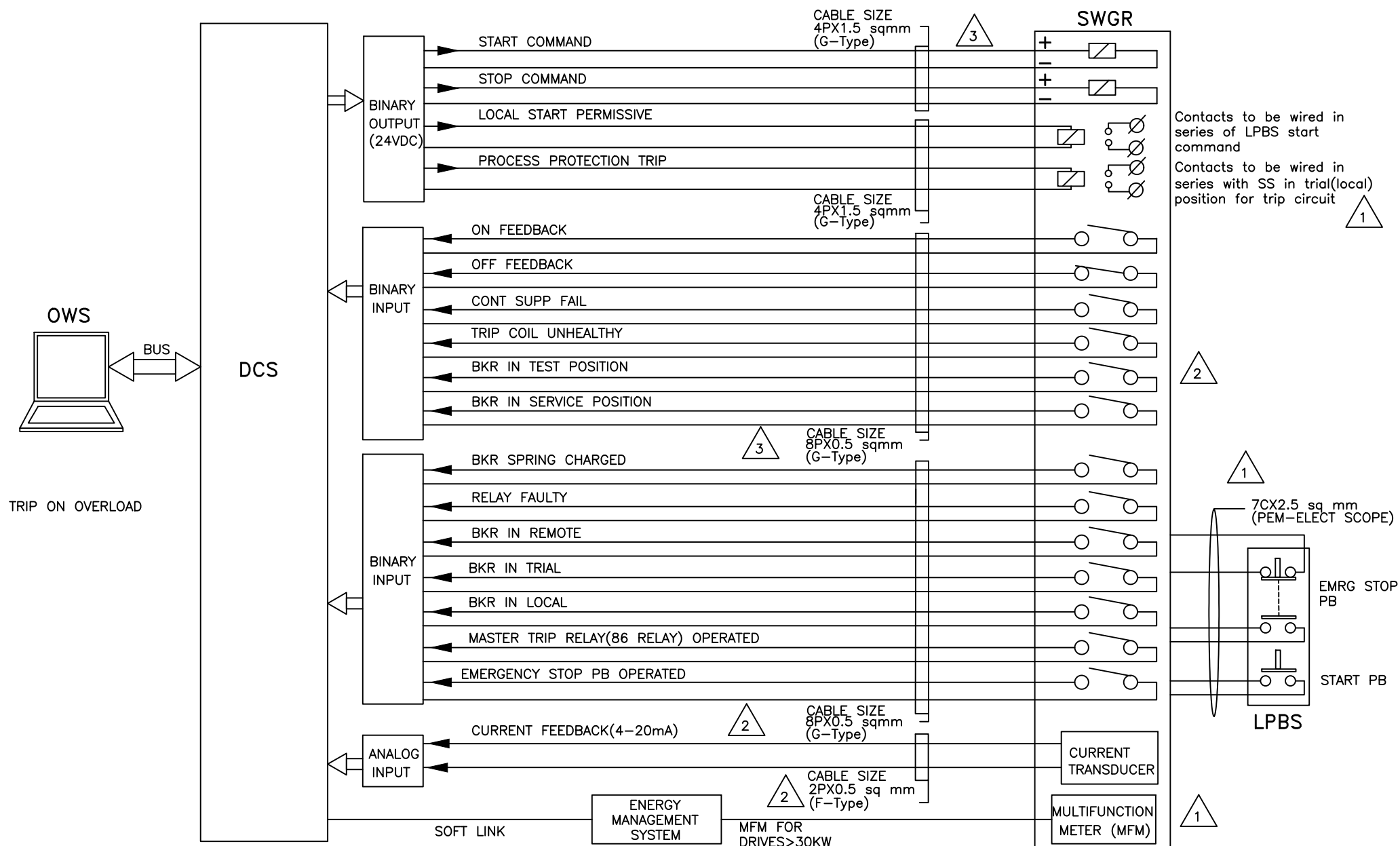
DRG.NO. PE-DM-445-145-I002

DATE 15.03.2021

REV.NO. 04

SHT 8 Page 3 of 57

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL HT AND CRITICAL LT DRIVES



PROJECT: 1X660MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)

TITLE DDCMIS INTERFACE FOR
UNIDIRECTIONAL HT DRIVE

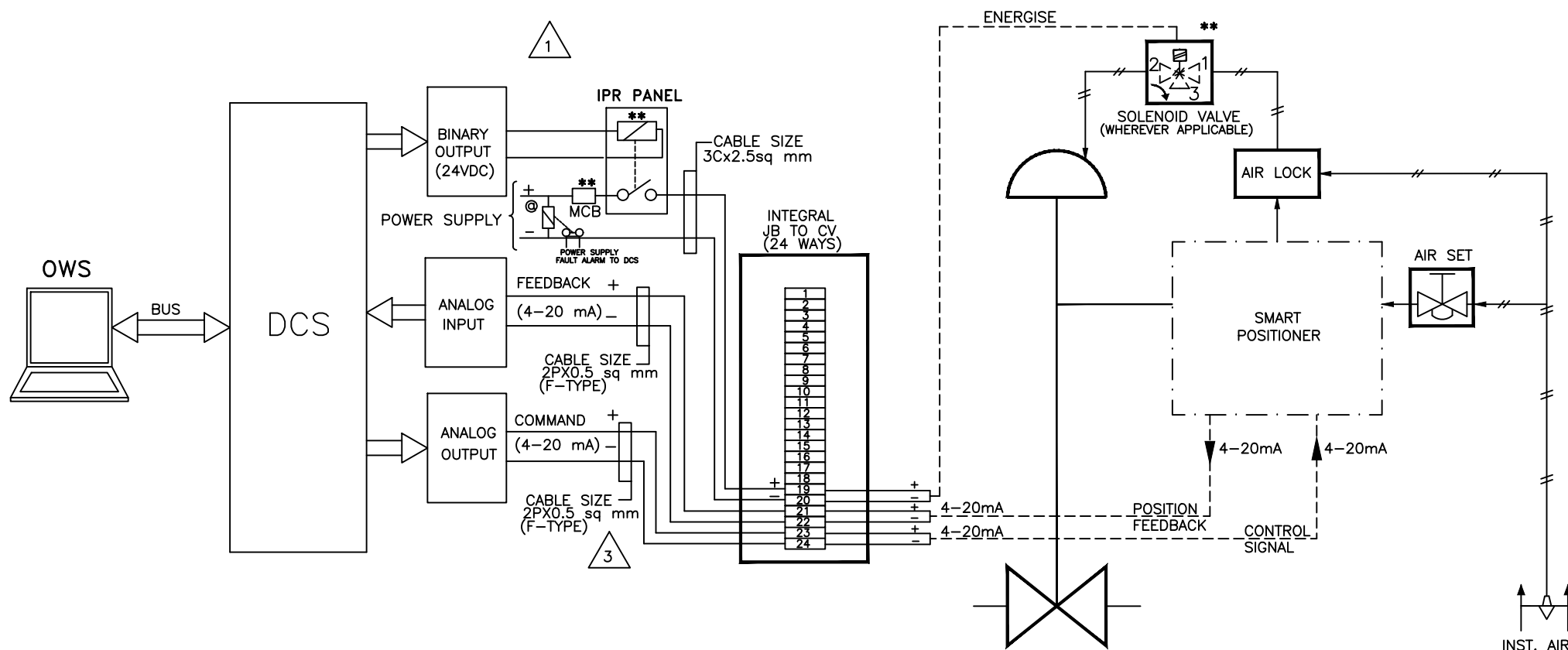
DRG.NO. PE-DM-445-145-I002

DATE 15.03.2021

REV.NO. 04

SHT 10 Page 359

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

⊗ COMMON FOR ALL SOLENOID VALVES PER PANEL.



REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL MODULATING DRIVES



PROJECT: 1X660MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)

TITLE TYPICAL HOOK-UP DIAGRAM
ANALOG DRIVE (WITH SMART POSITIONER)

DRG.NO. PE-DM-445-145-I002

DATE 15.03.2021

REV.NO. 04

SHT 11 Page 3 of 50



C&I SPECIFICATION FOR
COMPRESSED AIR SYSTEM

SECTION: C
SUB SECTION: C&I

QUALITY ASSURANCE

|



SECTION-VIII

QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Successful Bidder's works or at his Sub-Vendor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Successful Bidder shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Successful Bidder and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Successful Bidder shall generally cover the following :

- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-Vendor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.





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- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-A to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.

2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owners Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.

2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of





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all previous tests/inspections by Owner's Owner's Engineer/Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.

2.07.00 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

2.08.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.

2.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Bidder's/Sub-Vendor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

Under no circumstances any repair or welding of castings be carried out without the consent of the Owner. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner.

All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

2.10.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-1A (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for acceptance.

All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid





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penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

2.11.00 All the Sub-Vendors proposed by the Bidder for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Bidder and finalised with the Owner shall be subject to Owner's review. Quality Plans of the successful Sub-Vendors shall be discussed, finalised and accepted by the Owner/Authorised representative and form part of the Purchase Order between the Bidder and the Sub-Vendor.

2.12.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Bidder and finalised with the Owner shall be furnished to the Owner for comments and subsequent acceptance before orders are placed.

Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their Sub-Vendor's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

Quality audit/acceptance of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Bidder in earning satisfactory performance of equipment as per specification.

2.13.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.14.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the acceptance of the Owner.

2.15.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 **QUALITY ASSURANCE DOCUMENTS**

3.01.00 The Bidder shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:

- a) Material mill test reports on components as specified by the specification.





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- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Bidder for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Successful Bidder shall give the Owner's Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Successful Bidder's account except for the expenses of the Inspector. The Owner's Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Successful Bidder may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

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





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- 4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.





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EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company / Successful Bidder	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____			QP No. : _____ Date _____						
	Contractor : _____			Rev.No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks



Development Consultants Pvt. Ltd.

Page 7 of 8

Volume : II-A
Section : VIII
Quality Assurance Requirements



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EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

FIELD WELDING SCHEDULE

PROJECT : FWS NO. :

CONTRACTOR : REV NO. :

PACKAGE : FIELD WELDING CODE :

SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method	NDT Specification Number	Acceptance Norm Ref.	Remarks
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The Field Welding Schedule should be submitted for :

- o Pressure Parts
- o Tanks/Vessels
- o Piping
- o Heavy/Important Structural Steel
- o Heat Exchangers
- o Bus Ducts



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Page 8 of 8

Volume : II-A
Section : VIII
Quality Assurance Requirements

**C&I SPECIFICATION FOR
COMPRESSED AIR SYSTEM**SECTION: C
SUB SECTION: C&I**TYPE TEST REQUIREMENT**

13.03.00 Type Test Requirement for C&I Systems

Sl. No.	ITEM		TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
01.	THERMOCOUPLES		DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
02.	RTD		AS PER STANDARD	IEC-751	NO	NO	
03.	C.J.C. Box		DEGREE OF PROTECTION TEST AMBIENT TEMP. EFFECT	IS-2147	NO	YES	
				APPROVED PROCEDURE	NO	YES	
04.	ELECTRONIC TRANSMITTER		AS PER STANDARD	BS-6447 / IEC-770	NO	YES	
05.	E/P CONVERTER		AS PER STANDARD	MFR. STANDARD	NO	YES	
06.	DUST EMISSION MONITOR		DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
07.	INSTRUMENTATION CABLES TWISTED & SHIELDED				YES	YES	
	A)	CONDUCTOR	• RESISTANCE TEST	VDE-0815			
			• DIAMETER TEST	IS-10810			
			• TIN COATING TEST (DRAIN WIRE)				
	B)	INSULATION	• LOSS OF MASS	VDE-0472			
			• AGING IN AIR OVENS	VDE 0472 **			** AS PER VDE 0207 FOR TEFLON INSULATED CABLES
			• TENSILE STRENGTH AND ELONGATION	VDE 0472 **			
			• HEAT SHOCK	VDE 0472 **			
			• HOT DEFORMATION	VDE 0472			
			• SHRINKAGE	VDE 0472			
			• BLEEDING & BLOOMING	IS-5831			
	C)	INNER SHEATH	• LOSS OF MASS	VDE-0472			
			• HEAT SHOCK	VDE 0472 **			
			• COLD BEND / COLD IMPACT TEST	IS-5831			
			• HOT DEFORMATION	VDE 0472			

SL. No.	ITEM		TEST REQUIREMENT		STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
			•	SHRINKAGE	VDE 0472			
	D)	OUTER SHEATH	•	LOSS OF MASS	VDE-0472			
			•	AGING IN AIR OVENS	VDE 0472 **			
			•	TENSILE STRENGTH AND ELONGATION TEST BEFORE AND AFTER AGEING	VDE 0472 **			
			•	HEAT SHOCK	VDE 0472 **			
			•	HOT DEFORMATION	VDE 0472			
			•	SHRINKAGE	VDE 0472			
			•	BLEEDING & BLOOMING	IS-5831			
			•	COLOUR FASTNESS TO WATER	IS-5831			
			•	COLD BEND / COLD IMPACT TEST	IS-5831			
			•	OXYGEN INDEX TEST	ASTMD-2863			
			•	SMOKE DENSITY TEST	ASTMD-2843			
			•	ACID GAS GENERATION TEST	IEC-754-I			
	E)	FILERS	•	OXYGEN INDEX TEST	ASTMD-2863			
			•	SMOKE DENSITY TEST	ASTMD-2843			
			•	ACID GAS GENERATION TEST	IEC-754-I			
	F)	AL-MYLAR SHIELD	•	CONTINUITY TEST				
			•	SHIELD THICKNESS				
			•	OVERLAP TEST				
			•	NOISE INTERFERENCE	IEEE TRANSACTIONS			
	G)	OVERALL CABLE	•	FLAMMABILITY	IEEE 383			
			•	NOISE INTERFERENCE				

SL. No.	ITEM		TEST REQUIREMENT		STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
			•	DIMENSIONAL CHECKS	IS 10810			
			•	CROSS TALK				
			•	MUTUAL CAPACITANCE	VDE 0472			
			•	HV TEST	VDE 0472			
			•	DRAIN WIRE CONTINUITY				
08.	PRESSURE GAUGE		•	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
			•	TEMPERATURE INTERFERENCE TEST	IS-3624	NO	NO	
09.	TEMPERATURE GAUGE		DEGREE OF PROTECTION TEST		IS-2147	NO	NO	
10.	PRESSURE & DIFFERENTIAL PRESSURE SWITCH		•	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
			•	AS PER STANDARD	BS 6134	NO	NO	
11.	LEVEL SWITCH		DEGREE OF PROTECTION TEST		IS-2147	NO	NO	
12.	CONDUCTIVITY LEVEL SWITCH		DEGREE OF PROTECTION TEST		IS-2147	NO	YES	
13.	CONTROL VALVES		CV TEST		ISA 75.02	YES	NO	
14.	FLOW NOZZLES & ORIFICE PLATE		CALIBRATION		ASME PTC, BS-1042	YES	NO	
15.	PLCs		ALL TESTS AS PER IEC-1131		IEC-1131			
16.	DCS							
	a)	I/O MODULES	CMRR & NMRR VERIFICATION		Mfr. standard	NO	YES	
	b)	OTHER MODULES	CMRR & NMRR VERIFICATION		Mfr. standard	NO	YES	
	c)	CLCS SYSTEMS	MODEL TEST		Approved Procedure	YES	YES	
17.	LIE / LIR / JUNCTION BOX		DEGREE OF PROTECTION TEST		IS-2147	YES	YES	
18.	FLUE GAS O ₂ ANALYZER		DEGREE OF PROTECTION TEST		IS-2147	NO	YES	
19.	FLUE GAS CO ₂ ANALYZER		DEGREE OF PROTECTION TEST		IS-2147	NO	YES	

266568/2021/PS-PEM-MAX

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
20.	FLUE GAS SO ₂ ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
21.	FLUE GAS NO _x ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	

FORM NO. PEM-666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)		SPECIFICATION NO.: VOLUME SECTION REV. NO. DATE: SHEET I OF I	
	Data Sheet No.: PE-CL-999-145-1026-0			

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

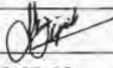
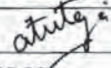
LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

1. QUANTUM OF CHECK SHALL BE AS BELOW
100 % - BY MANUFACTURER
RANDOM FOR EACH TYPE - BY BHEL & CUSTOMER
2. MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3. IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	SACHIN SRIVASTAVA	DILIP JEJURIKAR	ALKA TUTEJA
SIGNATURE			
DATE	30.09.08	30.09.08	30.09.08

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BH&N

CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (Mechanical Auxiliary Packages)

SPECIFICATION NO.:

VOLUME

SECTION

REV. NO.

DATE:

SHEET 2 OF 2

2

Data Sheet No.: PE-CL-999-145-I031-0

LEGEND:
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS. V: VERIFICATION.

NOTE:

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND
SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (Mechanical Auxiliary Packages)	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF 2	
Data Sheet No.: PE-CL-999-145-1026-0			

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGEN CY			REMARKS
				P	W	V	
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
	1.1 DIAL SIZE	100%		M	C	C	
	1.2 MODEL NO/TAG NO	100%		M	C	C	
	1.3 RANGE/SCALE	100%		M	C	C	
	1.4 END CONNECTION	100%		M	C	C	
	1.5 SWITCH CONTACT RATING & NOS	100% M			C	C	
2.0	CALIBRATION						
	2.1 ACCURACY	100%		M	C	B	
	2.2 REPEATABILITY (FOR SWITCH)	100% M			C	B	
	2.3 SET POINT ADJUSTMENT FOR SWITCH	100% M			C	C	
3.0	OVER PRESSURE & LEAK TEST	100% M			C	C	
4.0	OPERATION OF PR. RELEIF DEVICE	ONE PER TYPE		M	C	C	
5.0	REVIEW OF T.C. FOR MATERIAL OF--						
	5.1 SENSOR	FOR LOT		--		B	
	5.2 MOVEMENT			-	-	B	
	5.3 PROCESS CONNECTION			-	-	B	
	5.4 HOUSING			-	-	B	
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B	
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE	--		B		
8.0	ACCESSORIE S AS APPLICABLE	100% M		C	C		

LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

 PEM :: C&I		STANDARD QUALITY PLAN FOR SIGHT FLOW INDICATOR						QUALITY PLAN NO.: PE-QP-999-145-I029				
								VOLUME I IB				
								SECTION D				
								REV. NO. 00 DATE: 08.11.2000				
								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	Material / Components											
1.1	Body, Cover, Interns, Flanges, Gaskets	1. Physical, Chemical Properties	MA Physical	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	Visual, Measurement	100% Manufacturing standards / drgs.	Manufacturing standards / drgs.	Manufacturing standards / drgs.	Inspection Report / Log Book	3/2 ---		2,1#	
1.2	Window Glass	Strength, Transparency, dimensions	MA Thermal	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	Visual	100%	- do -	- do -	Inspection Report	2	1	---	
		2. Workmanship	MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	
		3. Direction of flow stamping	MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	
		4. Dimensions and end connections	MA Measurement	Measurement	100%	- do -	- do -	- do -	2	1	---	
3.0	Routine Test											
		1. Operation, Calibration [⊕]	CR	Measurement	100%	- do -	- do -	- do -	2	1**	1	⊕ For flapper type
		2. Hydro Test	CR	Measurement	100%	- do -	No Leakage	- do -	2	1**	1	**10% quantity with minimum of 1 piece / type & size

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 SIGHT FLOW INDICATOR							QUALITY PLAN NO.: PE-QP-999-145-I029				
								VOLUME I IB				
								SECTION D				
								REV. NO. 00		DATE: 08.11.2000		
								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	Painting	Shade & Finish	MA	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Inspection Report	2	1**	1	
5.0	Packing	Soundness MA		Visual	100%	- do -	- do -	- do -	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 LEVEL GAUGES						QUALITY PLAN NO.: PE-QP-999-145-I028				
								VOLUME I IB				
								SECTION D				
								REV. NO. 00 DATE: 01.11.2000				
								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	Material / Components											
1.1	Body, Cover, Interns, Flanges, Gaskets	1. Physical, Chemical Properties	MA Physical	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	Visual, Measurement	100% Manufacturing standards / drgs.	Manufacturing standards / drgs.	Manufacturing standards / drgs.	Inspection Report / Log Book	3/2 ---		2,1#	
1.2	Glass Tube	Strength, Transparency, dimensions	MA Thermal	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	Visual	100%	- do -	- do -	Inspection Report	2	1	---	For Reflex type
		2. Workmanship	MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	
		3. Scale graduation	MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	
		4. Glass Opaque painting	MA Visual	Visual	100%	- do -	- do -	- do -	2	1	---	
		5. Dimensions and end connections	MA Measurement	Measurement	100%	- do -	- do -	- do -	2	1	---	
3.0	Routine Test	1. Calibration	CR Measurement	Measurement	100%	- do -	- do -	- do -	2	1**	1	**10% quantity with minimum of 1 piece / type & size
		2. Hydro Test	CR Measurement	Measurement	100%	- do -	No Leakage	- 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 LEVEL GAUGES						QUALITY PLAN NO.: PE-QP-999-145-I028				
								VOLUME I IB				
								SECTION D				
								REV. NO. 00 DATE: 01.11.2000				
								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	Painting	Shade & Finish	MA Visual	Visual	100%	Approved drg. / data sheet / BHEL Spec.	Approved drg. / data sheet / BHEL Spec.	Inspection Report	2	1**	1	
5.0	Packing	Soundness MA		Visual	100%	- do -	- do -	- do -	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

 PEM :: C&I		STANDARD QUALITY PLAN FOR RESISTANCE TEMPERATURE DETECTOR WITH THERMOWELL							QUALITY PLAN NO.: PE-QP-999-145-I025					
									VOLUME		IIB			
									SECTION		D			
									REV. NO.		01		DATE: 21.03.2012	
									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	One Sample from each lot	Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ▲	▲Relevant compliance certificate to be verified.		
1.2	Protective Sheath	Material composition	MA	Chemical testing		Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ▲			
1.3	Terminal Head	Material composition	MA	Chemical testing		Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ▲			
1.4	Thermowell⊕	1. Chemical properties	CR	Chemical composition	One Sample from each lot	Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1	♦BHEL to witness 25% Samples ⊕IBR certificate wherever specified to be verified. **10% of total quantity with minimum of 2 random piece/type & size		
		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			
		3. Threading	MA	Thread matching	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection Report	2	2,1♦	1			
		4. Leak Test (Hyd. test at 1.5 times design press)	CR	Visual	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection Report	3,2	1**	2/1			

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics; Mfd std - Manufacturers' standard

^{\$} 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 RESISTANCE TEMPERATURE DETECTOR WITH THERMOWELL							QUALITY PLAN NO.: PE-QP-999-145-I025					
									VOLUME		IIB			
									SECTION		D			
									REV. NO.		01		DATE: 21.03.2012	
									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			
2.0	Final Inspection													
2.1	RTD Assembly	1. Workmanship	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Inspection Report	2	----	1▲			
		2. Marking	MA	Visual	100%				2	----	1▲			
		3. Dimensions	MA	Measurement	100%				2	----	1▲			
2.2	Routine Tests	1. Calibration (Resis Vs. Temp.)	CR	Measurement	100%	IS:2848	IS:2848	Test Report	2	2	1			
		2. Insulation Resistance	MA	Electrical	100%	IS:2848	IS:2848	Test Report	2	1	---			
		3. Thermal Response time	CR	Measurement	One Sample from each type	IS:2848	IS:2848	Test Certificate	2	1	---			
2.3	Type Test	Enclosure protection test	CR	Verification	Each type	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	3/2	----	1*			
3.0	Packing	Soundness of packing	MA	Visual	100%	Mfd std.	Mfd std.	Inspection Report	3/2	2	---			

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics; Mfd std - Manufacturers' standard

^{\$} 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		QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY							QUALITY PLAN NO.: PE-QP-445-145-I005			
									VOLUME	IIB		
									SECTION	D		
									REV. NO.	00	DATE: 24.05.19	
									SHEET	2	OF	6
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 Flow Nozzle, pipe, adapter	Physical, Chemical properties	MA	Physical, Chemical tests	One / Heat	AP / DS / SP	AP / DS / SP	TC	3/2	---	2,1	Refer Note-1
		Ultrasonic testing (nozzle only)	MA	Ultrasonic test	100%	ASTMA388 & ANSI B 16.34	ASTMA388 & ANSI B 16.34	TC	3	2	1	
2.0	IN PROCESS											
2.1	Welding procedure specification (WPS)	Correctness	MA	Scrutiny	100%	IS:7307 / ASME IX	IS:7307 / ASME IX	Format of IS / ASME	3/2	---	2,1	IBR certification to be verified by BHEL, if applicable
2.2	Procedure Qualification Record(PQR) & Welders qualification	Weld soundness	MA	Physical test / Radiographic Test	IS:7307/ IS:7310/ ASME IX	IS:7307/ IS:7310/ ASME IX	IS:7307/ IS:7310/ ASME IX	Format of IS / ASME	3/2	2	1	Welding to be done by qualified welders. Refer Note-4
2.3	Weld FIT-UPS	Dimension, Alignment, Orientation.	MA	Measurement & Visual	100%	WPS/Approved drg.	WPS/Approved drg.	IR / Log Book	3/2	---	2	
2.4	Weldments final run	1. Surface defects	MA	Penetrant Test	100%	IS:3658 / ASTM 165/ ASME VIII Div. I	ASTM. / 165ASME VIII Div I	IR / Log Book	3/2	2	1	100% by Vendor, 10 % by BHEL
		2. Sub Surface defects(After PWHT)	MA	Radiographic Test	100%	ASME SEC. V	ASME SEC. VIII	IR	3/2	2	1	Films to be reviewed by BHEL.

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

IR - Inspection Reports
TC - Test Certificates
AP - Approved Drawings/doc

DS - Data Sheet
SP - Tech. Spec.
MS- Manufacturer standards

MR- Manufacturer records
MS- Manufacturer standards
\$ 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		QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY							QUALITY PLAN NO.: PE-QP-445-145-I005			
									VOLUME	IIB		
									SECTION	D		
									REV. NO.	00	DATE: 24.05.19	
									SHEET	3	OF	6
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 Heat Treatment	MA	Review of HT Chart	100%	ASME SEC. VIII	ASME SEC. VIII	HT Chart	3/2	2	1	100% by Vendor, 10% by BHEL
2.5	Machining											
	1. Flow Nozzle (machined)	1. Dimensions	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		2. Profile	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Surface finish	MA	Visual	100%	-----	Mirror finish.	IR / Mfd Records	3/2	2	1	
	2. Pipe, Adapter	1. Machining of pipe ID	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		2. Dimensions	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Surface flaw on weld edge preparation (for shop welding)	MA	Penetrant Test	100%	ASTM 165/ IS-3658	ASTM 165/ IS-3658	IR / TC	3/2	2	1	
		4. IBR Clearance	MA	Review	100%	IBR Compliance	IBR Compliance	Form III C	3/2		1	
3.0	ROUTINE TEST	1. Leak tightness	CR	Hydraulic test (1.5 times Design pressure)	100%	AP / DS	No Leakage	Test Certificate	3/2	2,1	---	Minimum time duration of test shall be ½ hours.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL
 MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics AP – Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor

 PEM :: C&I		QUALITY PLAN FOR FLOW NOZZLE ASSEMBLY							QUALITY PLAN NO.: PE-QP-445-145-I005			
									VOLUME IIB			
									SECTION D			
									REV. NO. 00		DATE: 24.05.19	
									SHEET 4		OF 6	
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. Calibration	CR	Measurement	1 per type per size	----	Tech Spec.	TC	2	---	1	Refer note-5
4.0	FINAL ASSEMBLY	1. Marking – Tag No., direction of flow	MI	Visual	100%	AP / DS	AP / DS	IR	2	---	1	Refer Note-3 before dispatch
		2. Workmanship, surface flaw on weld edge preparation on end of pipe (for site welding)	MA	Visual, Penetrant test	100%	ASTM165 / IS: 3658	No Surface Flaw	TC /IR	3/2	2	1	
		3. Overall Dimensions and end connection	MA	Measurement	100%	AP / DS	AP / DS	IR	3/2	2/1	---	
5.0	PACKING & DISPATCH	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP /MS		2	---	---	Refer Note-6

NOTE:

1. Test Certificates to be verified by BHEL at final inspection stage.
2. Positive Material Identification (PMI) testing shall be performed by vendor in accordance with ASTM-E1916 and API practice 578 on the finished nozzle element, nipples & root valve. Same shall be witnessed (if required) by BHEL.
3. Minimum 2 coats of primer paint to be applied before dispatch.
4. In case of NTPC / LLOYDS / BHEL qualified welders available, then prequalification and WPS, PQR not required, only TC to be verified.
5. CALIBRATION Test to be carried out at IIT-DELHI / FCRI or BHEL approved laboratory.
6. Sea worthy packing shall be provided, if called for in the Data sheets.
7. Qualification records of the Vendors can be verified.
8. For P91 & P22 material welding should be continuously done. No interruptions shall be allowed.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL
 MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics AP – Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor

 PEM :: C&I		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY							QUALITY PLAN NO.: PE-QP-445-145-I005			
									VOLUME	IIB		
									SECTION	D		
									REV. NO.	00	DATE: 24.05.19	
								SHEET		5	OF	6
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											
1.1	Orifice Plate	1. Physical, Chemical properties	MA	Physical, Chemical Tests	One / Plate OR One/ Heat	AP / DS / SP	AP / DS / SP	Lab Report	3/2	---	2,1	IBR certification (if applicable) to be verified by BHEL
		2. Dimensions	MA	Measurement	100%	AP	AP	IR	3/2		1	
1.2	Flanges											
	A. Forgings	Chemical, Mech Properties, UT & Heat Treatment	MA	Chem & Mech UT test	Sample	Material Spec as per ASTM A 388 for UT	ANSI B 16.34	MTC, UT cert, HT cert	3/2	---	1	
	B. Machining	Dimensions	MA	Measurement	100 %	AP / DS	AP / DS	IR	3/2	----	1	
2.0	IN PROCESS											
	Machine	1. Dimension	MA	Measurement	100%	AP	AP	IR	3/2	2	2	
		2. Surface finish	MA	Visual	100%	-----	Mirror Finish	-----	3/2	2	---	
		3. Surface flaw on machined surface	MA	Penetrant test	100%	ASTM 165 / IS:3658	No surface flaw	IR / TC	3/2	2	1	
3.0	ASSEMBLY and FINAL INSPECTION											
		1. Overall dimensions	MA	Measurement	100%	AP	AP	IR	3/2	2,1	----	
		2. Marking, Tag no. Direction of flow	MA	Visual	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Calibration	MA	Performance Test	One per type	-----	SP	TC	3/2	----	1	
		4. Painting	MA	Visual	100%	SP / MS	SP / MS	IR / MR	3/2	----	1	
		5. Root valve BOQ	MA	Measurement	100%	AP / DS	AP / DS	IR	2	----	1	
LEGEND: * CR - Critical characteristics IR - Inspection Reports DS - Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL MA - Major characteristics TC - Test Certificates SP - Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics AP - Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor												

 PEM :: C&I		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY						QUALITY PLAN NO.: PE-QP-445-145-I005					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		00	DATE:		24.05.19
								SHEET		6	OF		6
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
4.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP / MS	----	3/2	----	----	Refer Note 4	

NOTE:

1. All test reports & dimension reports shall be verified by BHEL wherever verification is by BHEL at the time of Final Inspection. Positive material identification testing shall be performed by vendor and the same shall be witnessed by BHEL.
2. Minimum 2 coats of primer paint to be applied before dispatch.
3. CALIBRATION Test to be carried out at IIT-DELHI / FCRI or BHEL approved laboratory.
4. Sea worthy packing shall be provided, if called for in the Data sheets.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet
 MA - Major characteristics TC - Test Certificates SP – Tech. Spec.
 MI - Minor characteristics AP – Approved Drawings/doc

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 MS- Manufacturer standards

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1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME	IIB			
								SECTION	D			
								REV. NO.	00		DATE: 24.05.2019	
								SHEET	2		OF	6
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	
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2	---	2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Mfr. standard	Record	3	---	2	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Relevant Standards	Relevant Standards	Test Certificate	3	---	2	
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	

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

RT- Radiographic Test
UT - Ultrasonic Test

PT - Dye penetrant Test
MT- Magnetic Test

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V - Agency Verifying the Test.

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 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 00 DATE: 24.05.2019				
								SHEET 3 OF 6				
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	
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2	
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2	
2.0	IN PROCESS INSPECTION											
2.1	After machining, i. Body ii. Bonnet iii. Plug iv. Valve Stem v. seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
3.0	TESTS ON COMPLETED VALVE											
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19/ ASME B16.34	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1	Refer Note-4
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4

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 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 00		DATE: 24.05.2019		
								SHEET 4		OF 6		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		4. Repeatability	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦ Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	--	1	♦ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	Approved drg. / data sheet	Records	2	1	1	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	1	1	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional, paint thickness	100%	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	1	1	
		13. Surface Quality	MA	Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	--	2,1	

LEGEND: * CR - Critical characteristics
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 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		00		DATE: 24.05.2019	
								SHEET		5		OF 6	
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		
5.0	AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)												
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	Certificate of Conformance (C.O.C)	
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)	
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)	
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)	
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	---	(C.O.C)	
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)	
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)	

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 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 00		DATE: 24.05.2019		
								SHEET 6		OF 6		
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	
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Mfr. Standard	Mfr. Standard	Test Certificate	2	---	---	(C.O.C)
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3

NOTES:

1. In case valid CV test certificate for a similar control valve(same size, same CV, same trim characteristics) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if called for in the Data sheets.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation), C.O.C's(Certificates of Conformance) shall be submitted to BHEL for verification and acceptance.

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

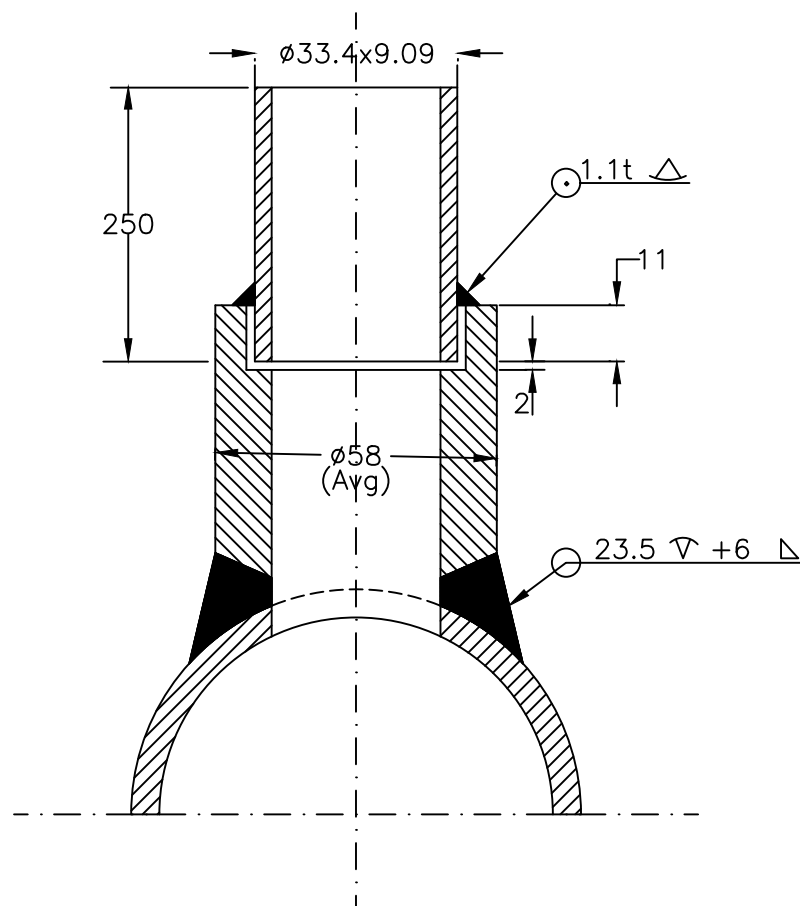
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V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor

**C&I SPECIFICATION FOR
COMPRESSED AIR SYSTEM**SECTION: C
SUB SECTION: C&I**INSTRUMENT STUB DETAILS**



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHOULD BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO



TITLE :
**INSTRUMENT STUB DETAILS
 FOR PRESSURE MEASUREMENT**

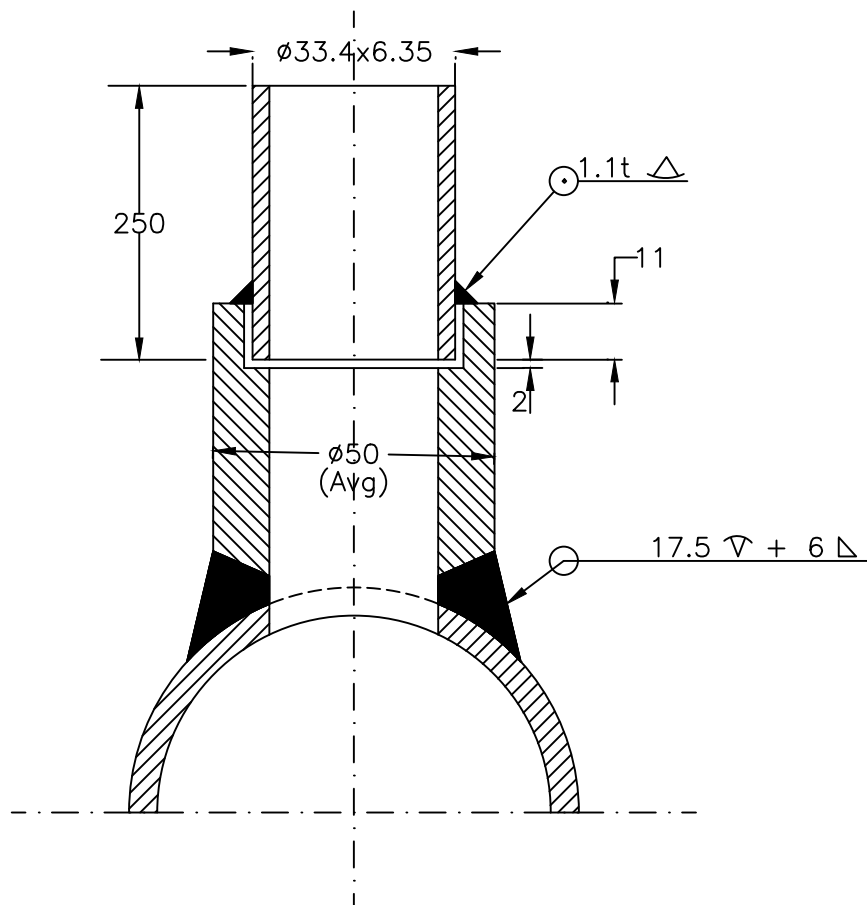
(TEMP > 500 DegC AND Nb25, CLASS 9000 #)
 OR (PRESS > 455 Kg/Cm2 AND Nb25, CLASS 9000 #)

DRG. NO.

PE-DG-445-145-I101

REV. 01

SH. 2 OF 8 SHS.



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO 



TITLE :

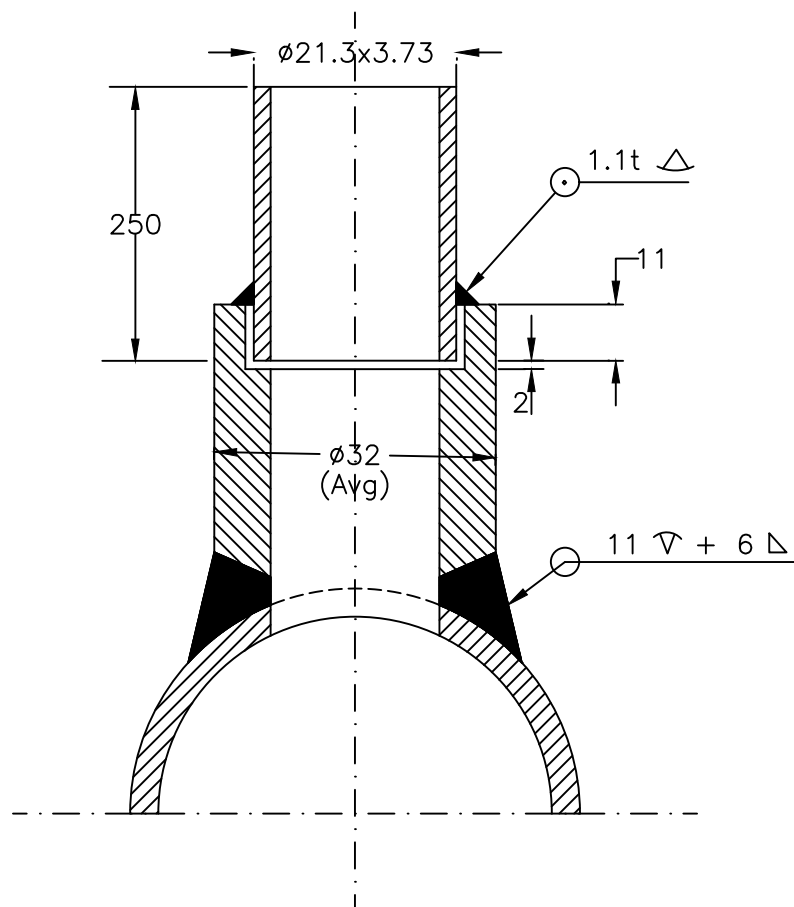
INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

DRG. NO.

PE-DG-445-145-I101

REV. 01

(60Kg/Cm² < PRESS ≤ 455Kg/Cm², TEMP ≤ 425 DegC & Nb25, CLASS 6000#) SH. 3 OF 8 SHS.
OR (PRESS ≤ 455Kg/Cm², 425DegC < TEMP ≤ 500 DegC & Nb25, CLASS 6000#)



NOTE :

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO 

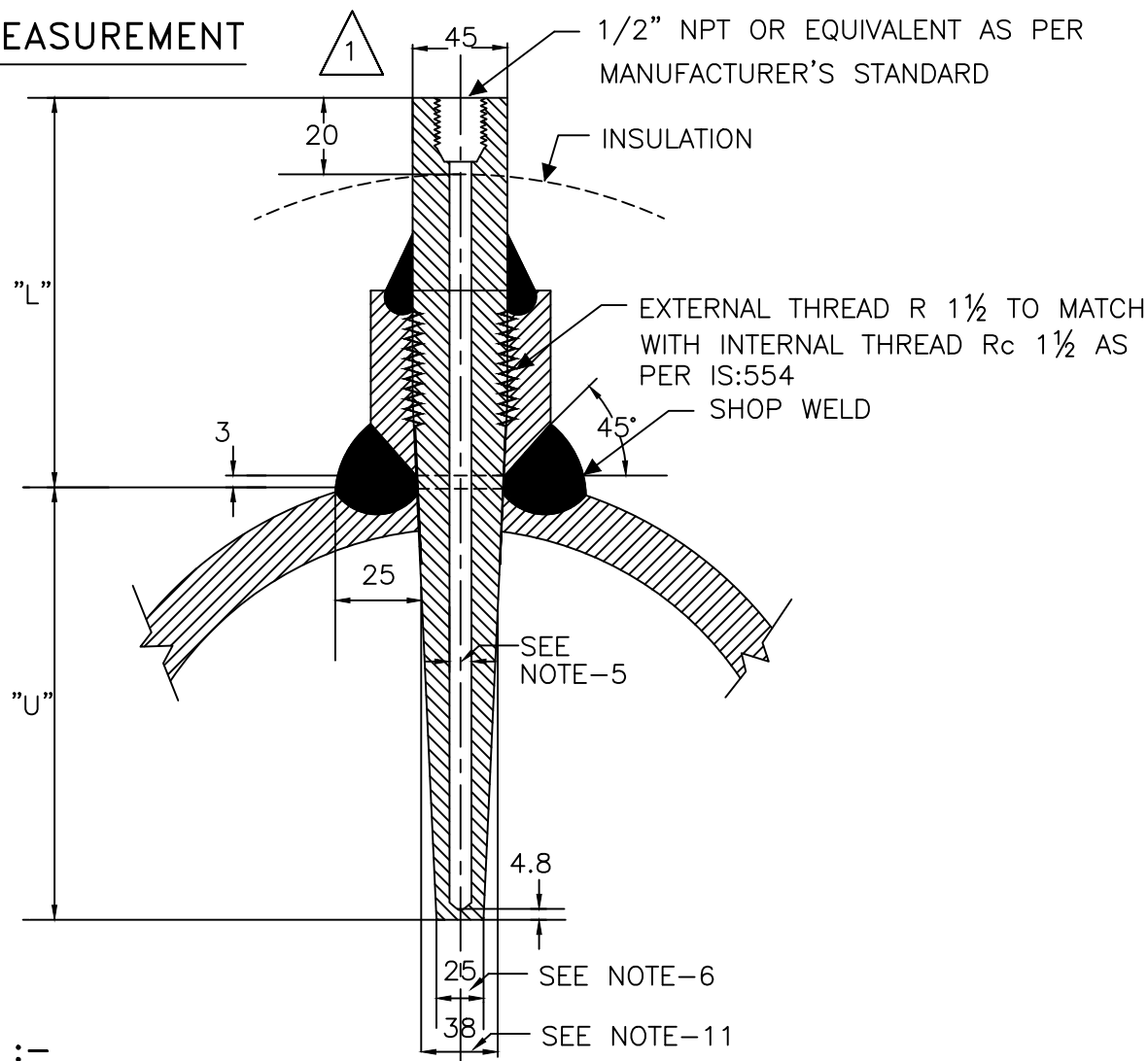


TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT

(PRESS < 60Kg/Cm², TEMP < 425DegC & Nb15, CLASS 3000#)

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 4 OF 8 SHS.

TEMP. MEASUREMENT



NOTES :-

1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE DESIGN PRESS EQUAL/ ABOVE 40 KG/CM²(g) AND FOR DESIGN TEMP EQUAL/ABOVE 400 DegC EVEN IF THE DESIGN PRESSURE IS LESS THAN 40 Kg/Cm²(g)
2. THE MATERIAL OF THE BOSS SHALL BE SIMILAR TO PIPING MATERIAL.
3. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
4. THERMOWELL SHALL BE DRILLED BAR STOCK TYPE.
5. INTERNAL BORE OF THE THERMOWELL SHOULD BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME PTC-19.3.
6. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS AND TEMP AS PER ASME PTC-19.3.
7. THE 'U' & 'L' DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION.
8. ORIENTATION OF STUB ON VERTICAL/ HORIZONTAL PIPES SHALL BE 90° TO THE CENTRE LINE OF THE PIPES, FOR PIPE SIZE LARGER THAN 4". HEIGHT OF STUB SHALL BE 64mm FOR PIPE OD < 200Nb AND 45mm FOR PIPE OD ≥ 200Nb.
9. STUB SHALL HAVE IBR CERTIFICATION, AS APPLICABLE, ACCORDING TO PROCESS DATA.
10. BOSS OD SHALL BE DEPENDENT ON PROCESS PRESS, TEMP & PIPE DIAMETER.
11. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1 1/2.
12. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.



TITLE :
**INSTRUMENT STUB DETAILS
 FOR TEMPERATURE MEASUREMENT**

(APPLICABLE FOR PIPE SIZE ABOVE 4")
 [(i) DESIGN PRESS = /> 40 Kg/Cm²(g) OR
 (ii) DESIGN TEMP = /> 400 DegC]

DRG. NO.

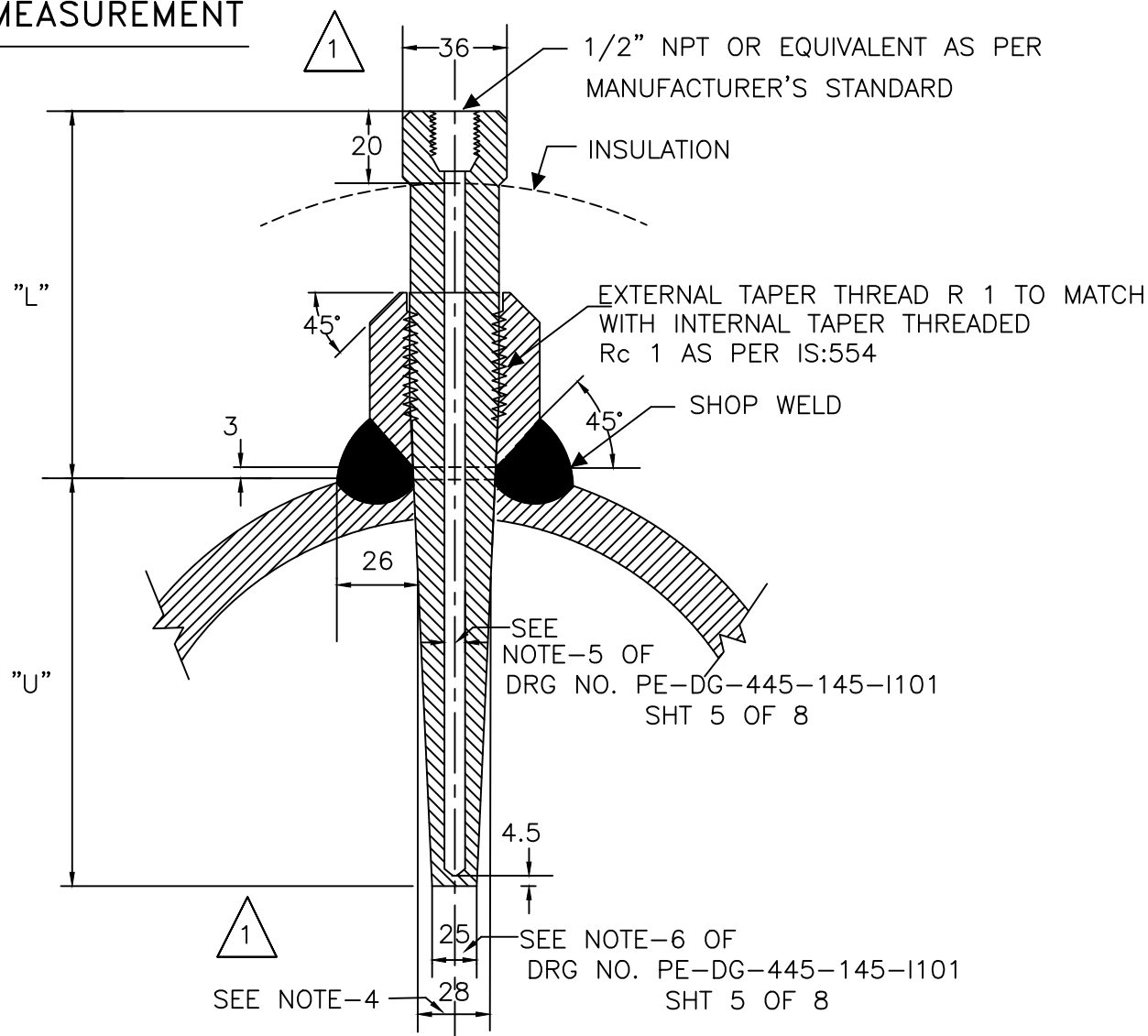
PE-DG-445-145-I101

REV. 01

SH. 5 OF 8 SHS.

Page 5 of 9

TEMP. MEASUREMENT



NOTES :-

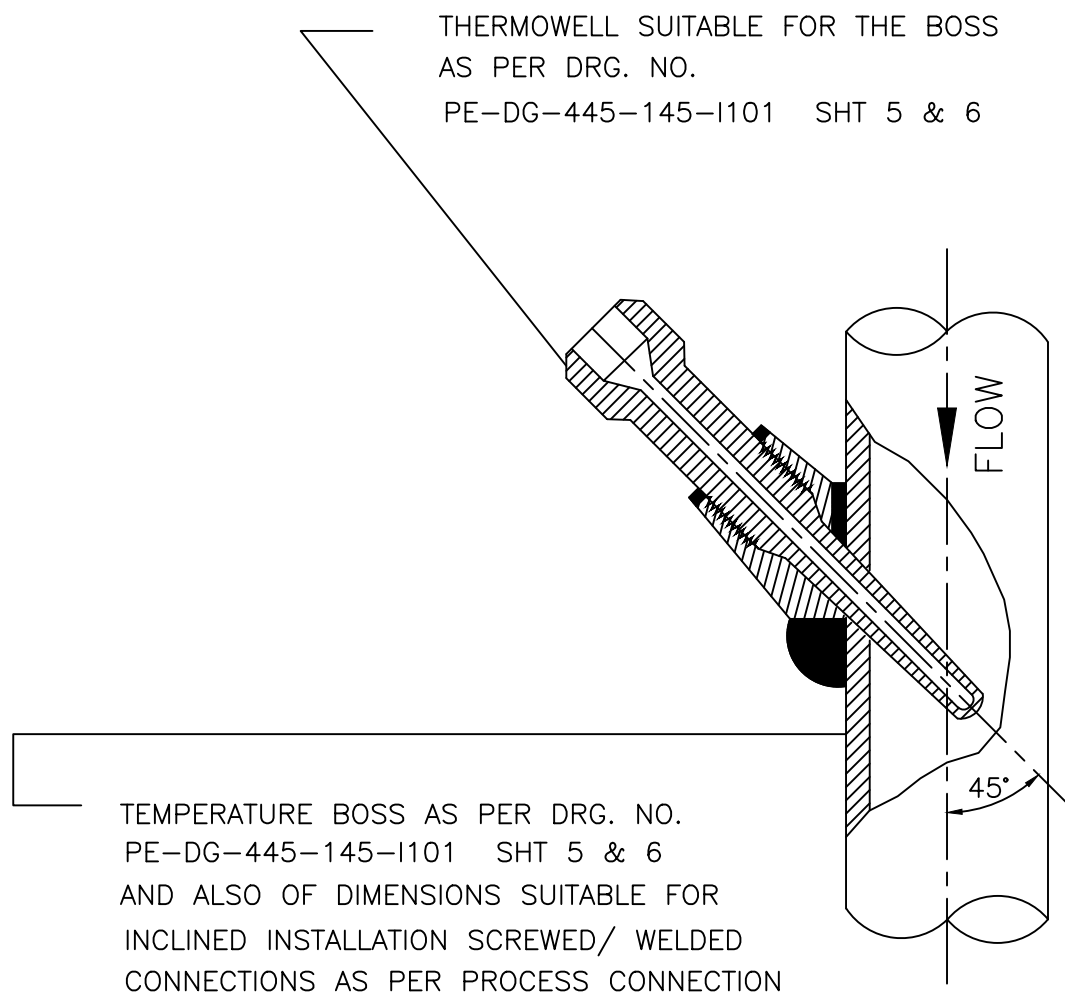
1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE DESIGN PRESS/ TEMP BELOW 40 KG/CM²(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES-2 TO 10 IN SHT. 5 OF 8 OF THIS DRG. 
4. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1.
5. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.



TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
(APPLICABLE FOR PIPE SIZE ABOVE 4")

[DESIGN PRESS < 40 Kg/Cm² (g) & DESIGN TEMP < 400 C]

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 6 OF 8 SHS.



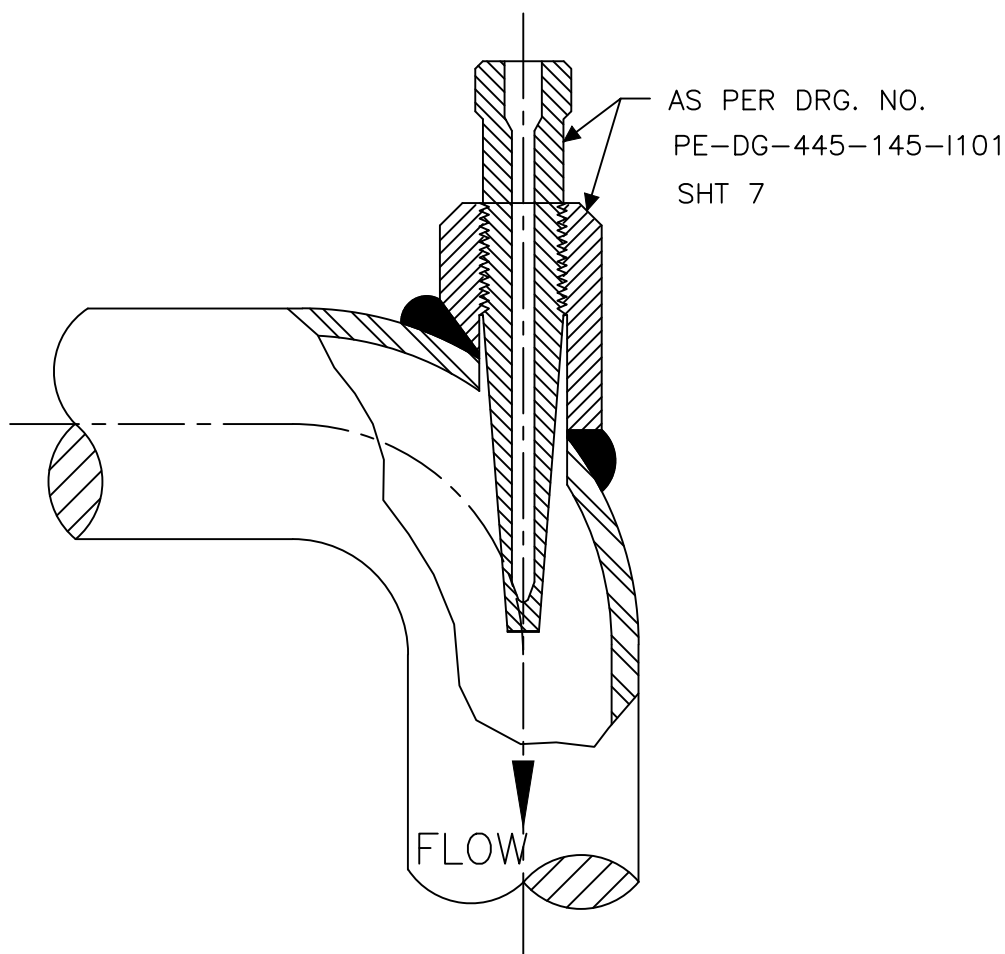
NOTES :-

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION TO BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (AT LEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDES OF THE INSTALLED THERMOWELL).



TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
THERMOWELL INSTALLATION

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 7 OF 8 SHS.



NOTES :-

1. THIS INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE. THIS DETAIL IS APPLICABLE FOR THERMOWELL INSTALLATION IN BEND PIPES. △
1
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.



TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
THERMOWELL INSTALLATION

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 8 OF 8 SHS.



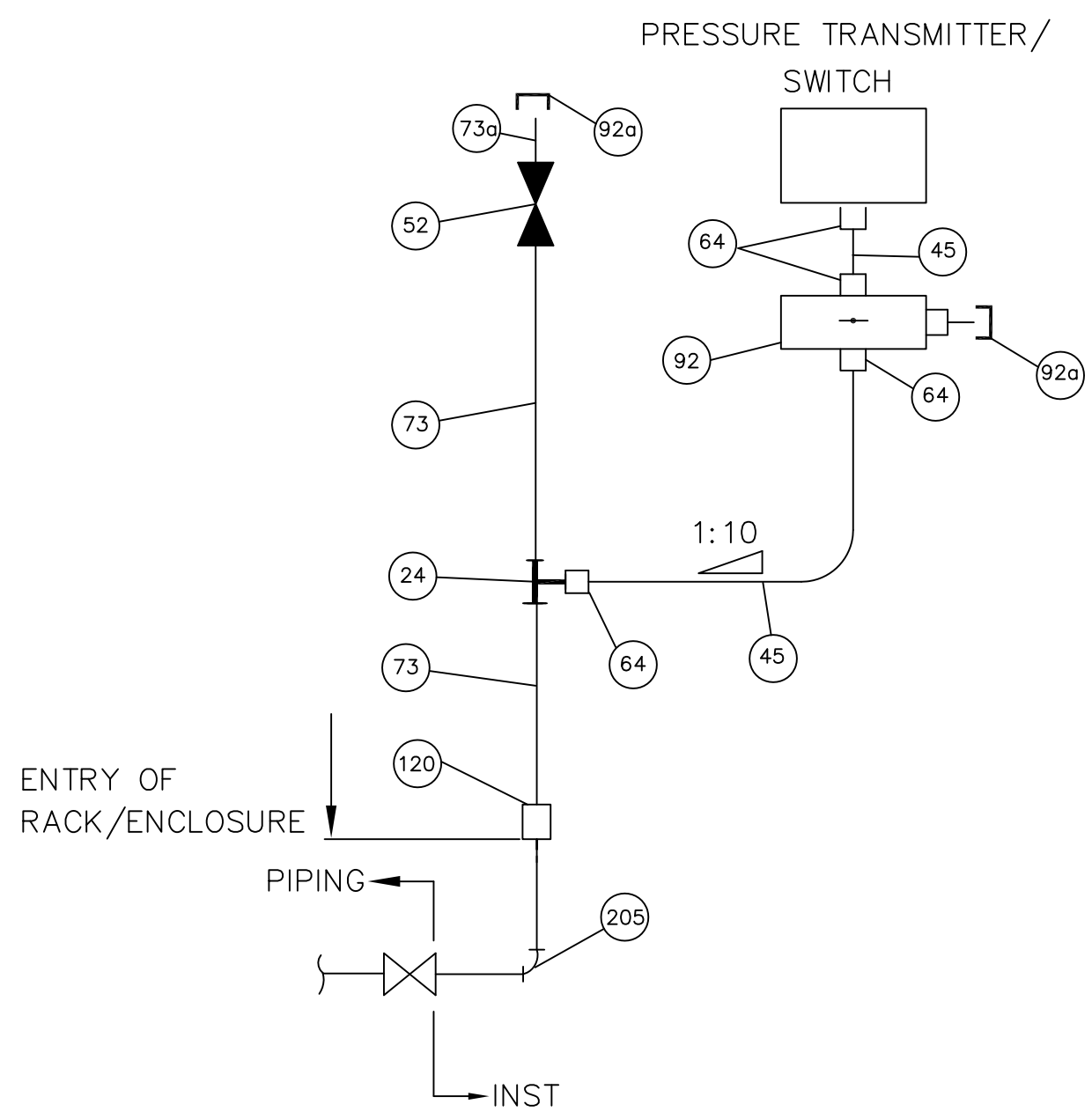
**C&I SPECIFICATION FOR
COMPRESSED AIR SYSTEM**

SECTION: C
SUB SECTION: C&I

INSTRUMENT INSTALLATION DRAWING

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT

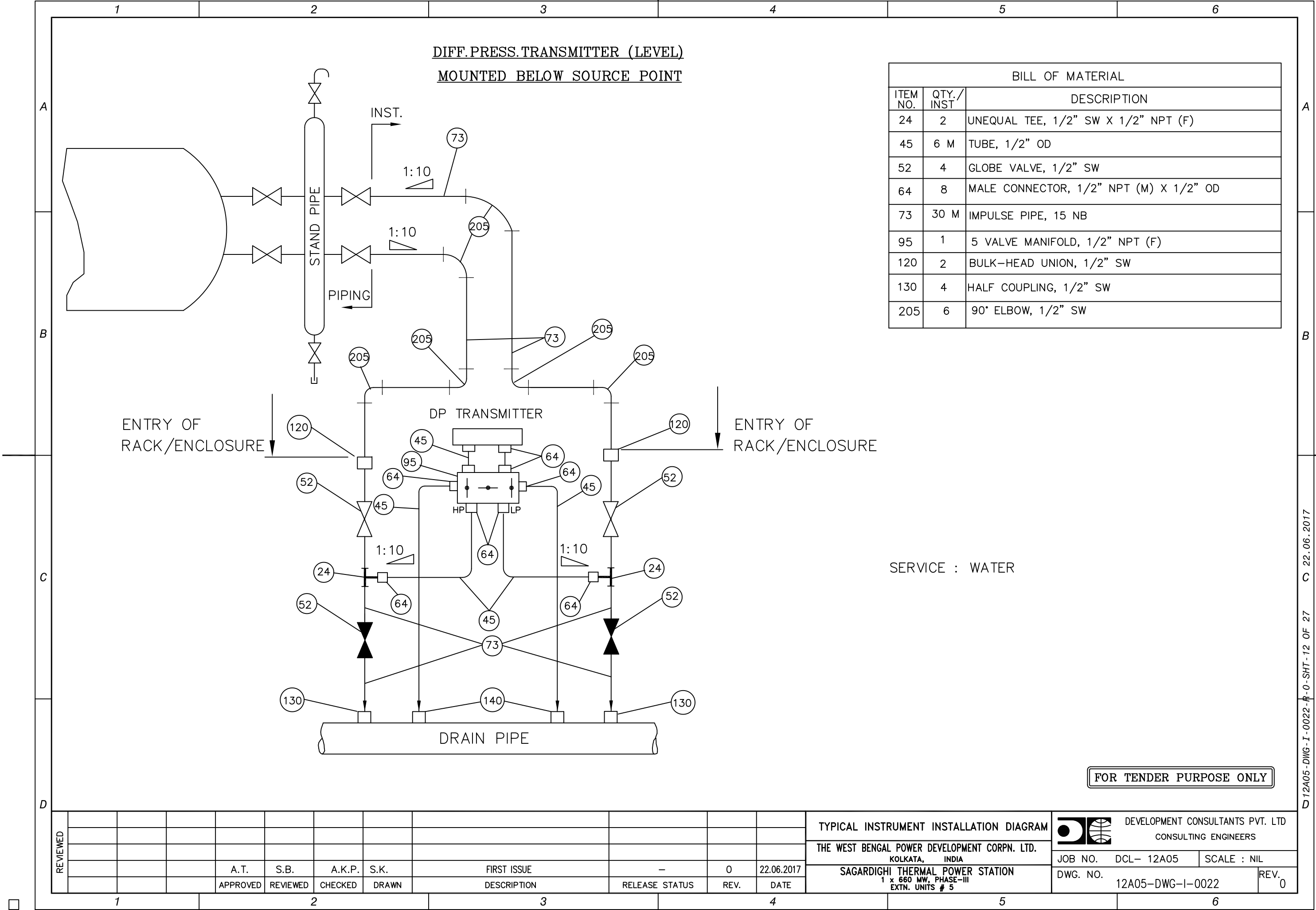
BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	1	GLOBE VALVE, 1/2" SW
64	4	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
92	1	2- VALVE MANIFOLD, 1/2" NPT (F)
92a	2	VENT PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW



SERVICE : INSTRUMENT AIR

FOR TENDER PURPOSE ONLY

REVIEWED												TYPICAL INSTRUMENT INSTALLATION DIAGRAM		DEVELOPMENT CONSULTANTS PVT. LTD.		
														CONSULTING ENGINEERS		
												THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.				
												KOLKATA, INDIA				
				A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	—	0	22.06.2017	SAGARDIGHI THERMAL POWER STATION				
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE	1 x 660 MW, PHASE-III EXTN. UNITS # 5			JOB NO.	DCL- 12A05	SCALE : NIL
												DWG. NO.	12A05-DWG-I-0022		REV.	0



A3 (9-96) [420x297]

D 12A05-DWG-I-0022-I-0-SHT-12 OF 27 22.06.2017

1	2	3	4	5	6
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PRESSURE TRANSMITTER/PRESSURE SWITCH

WITH REMOTE DIAPHRAGM SEAL

INST.

(73)

(100)

(33)

PIPING

PRESSURE TRANSMITTER/
SWITCH/ GAUGE

BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
33	A/R	SS ARMoured CAPILLARY TUBE
73	1 M	IMPULSE PIPE, 15 NB
100	1	FLANGE ASSEMBLY TO SUIT 1/2" PIPE

SERVICE: CORROSIVE/ VISCOUS/SOLID BEARING OR SLURRY SERVICE

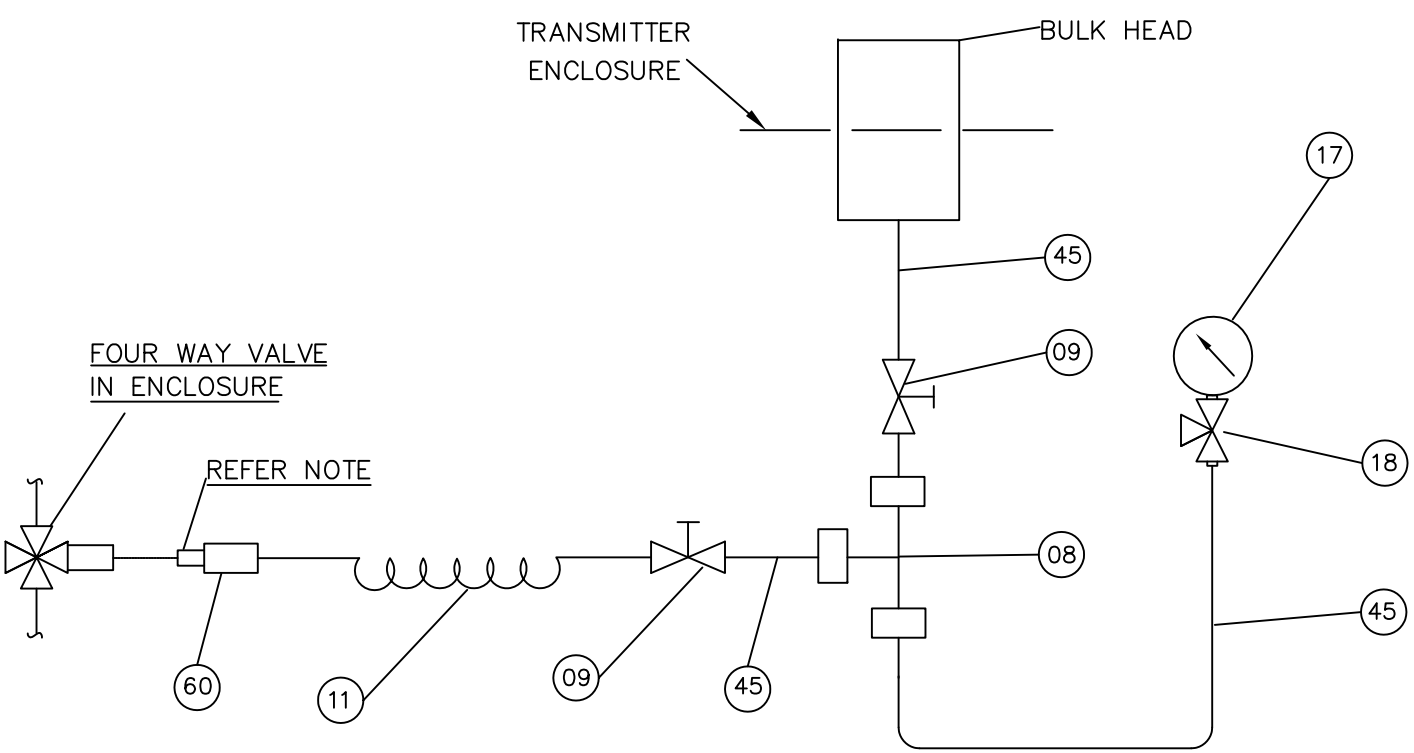
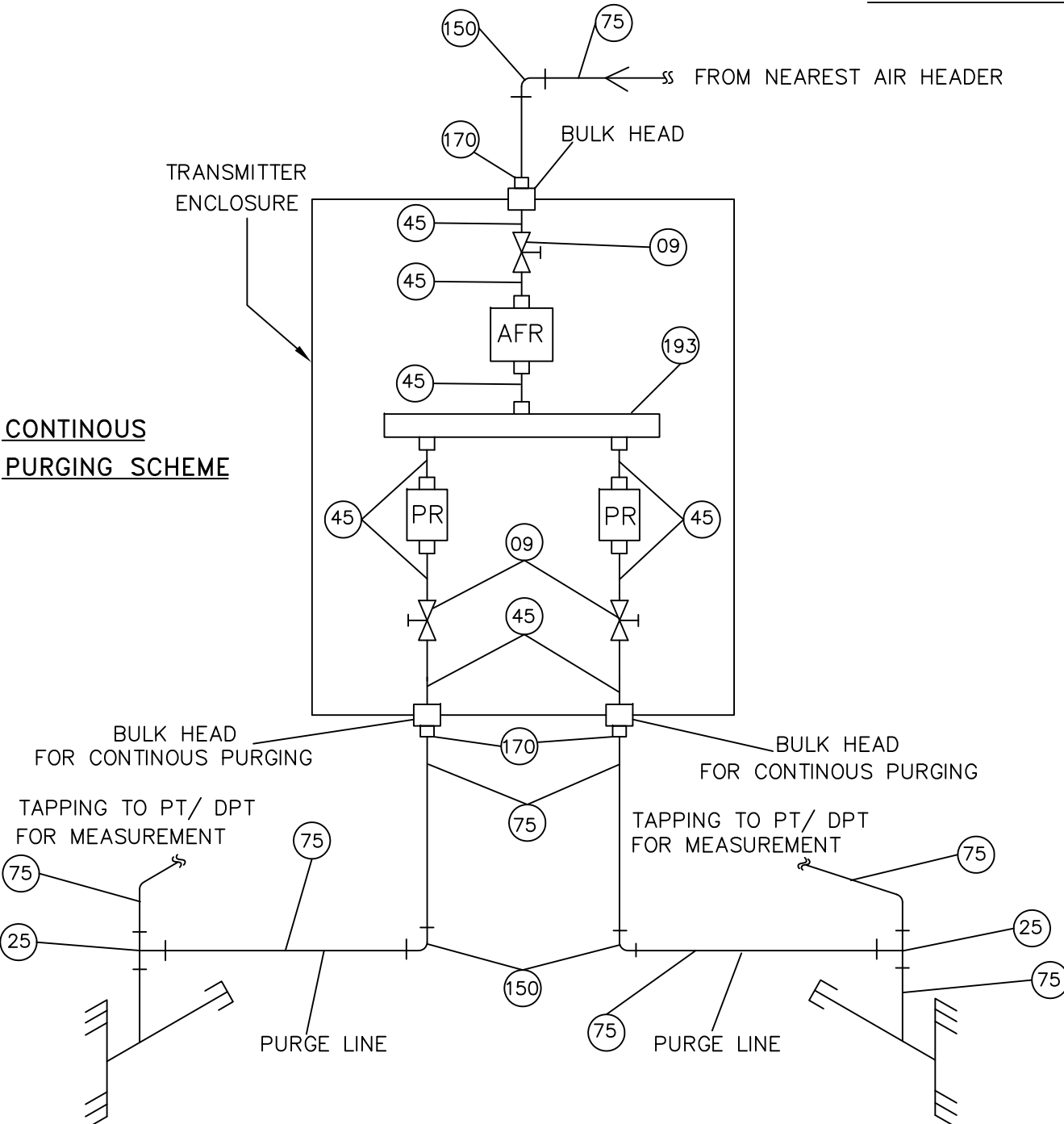
FOR TENDER PURPOSE ONLY

REVIEWED												TYPICAL INSTRUMENT INSTALLATION DIAGRAM THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD. KOLKATA, INDIA SAGARDIGHI THERMAL POWER STATION 1 x 660 MW, PHASE-III EXTN. UNITS # 5	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS	JOB NO. DCL- 12A05		SCALE : NIL	
														DWG. NO. 12A05-DWG-I-0022		REV. 0	
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	—	0	22.06.2017							
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE							
1			2				3		4			5			6		



JOB NO.	DCL- 12A05	SCALE : NIL
DWG. NO.	12A05-DWG-I-0022	REV. 0

TYPICAL AIR PURGING SCHEMES



NOTE:
QUICK DISCONNECTING FITTING IS CONNECTED TO FOUR WAY VALVE WHERE INTERMITTENT PURGING IS CALLED IN SCHEME.

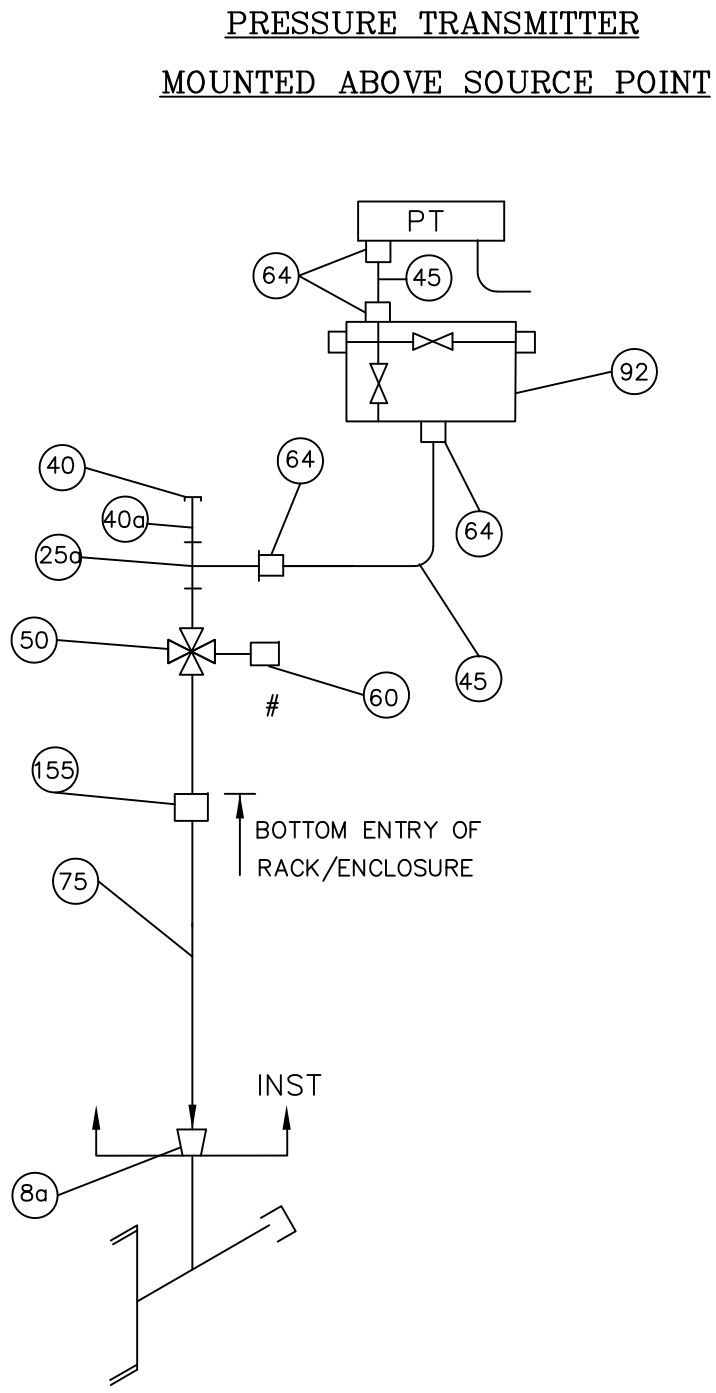
ABBREVIATION:
AFR: AIR FILTER REGULATOR
PR: PURGE ROTAMETER

CONTINUE TO SHT. NO. 22/27

FOR TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM									
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.									
KOLKATA, INDIA									
SAGARDIGHI THERMAL POWER STATION									
1 x 660 MW, PHASE-III									
EXTN. UNITS # 5									
DEVELOPMENT CONSULTANTS PVT. LTD									
CONSULTING ENGINEERS									
JOB NO. DCL- 12A05									
SCALE : NIL									
DWG. NO. 12A05-DWG-I-0022									
REV. 0									

12A05-DWG-I-0022-R-0-SHT-22 OF 27 22.06.2017



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8a	1	REDUCER 1" NB X 3/4" NB-SW
25	1	EQUAL TEE, 3/4" SW
25a	1	UNEQUAL TEE, 3/4" SW (2) X 1/2" NPT (F)
40	1	PLUG, 3/4" NPT (M)
40a	1	NIPPLE, 3/4" SW X 3/4" NPT (F), 150 MM
45	3 M	TUBE, 1/2" OD
50	1	FOUR WAY VALVE SIZE : (2 X 3/4" NB-SW)X(2 X 1/2"NPTF)
60	1	QUICK DISCONNECTING FITTING SIZE: 1/2"NPT(M)
64	4	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
75	A/R	IMPULSE PIPE, 15 NB
93	1	3 VALVE MANIFOLD, 1/2" NPT(F)
155	1	BULK HEAD UNION, 3/4" SW

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

FOR INTERMITTENT PURGING PLEASE REFER SHEET NO. 21 OF 27.

FOR TENDER PURPOSE ONLY

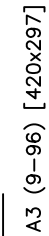
TYPICAL INSTRUMENT INSTALLATION DIAGRAM
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.
KOLKATA, INDIA
SAGARDIGHI THERMAL POWER STATION
1 x 660 MW, PHASE-III
EXTN. UNITS # 5

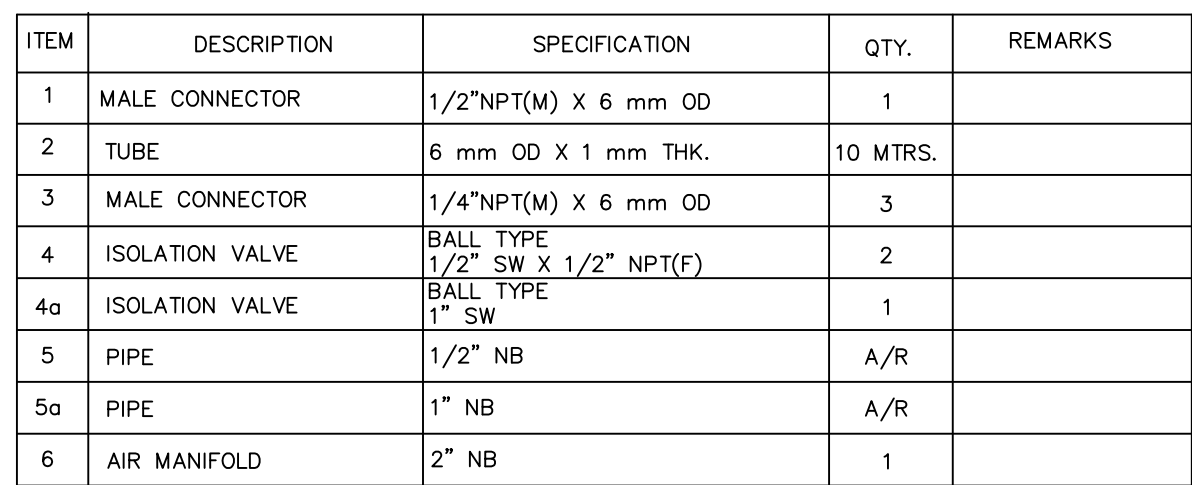


DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO. DCL- 12A05 SCALE : NIL
DWG. NO. 12A05-DWG-I-0022 REV. 0

REVIEWED												
				A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	-	0	22.06.2017	
				APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE	





	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-I	
		REV 00	DATE: Mar,21
		SHEET: 1 OF 1	

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS



**1 X 660MW SAGARDIGHI TPS EXTN.
UNIT#5**

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-445-555-A001

VOLUME : II B

SECTION : E / ANNEXURE-I

REV 00

DATE: Mar.21

SHEET: 1 OF 1

Sl.No	Item Description	Model No./Capacity/rating	Make
1	Air Compressor	ZR 275, Cap.: 36 Nm ³ /min @ 8.0 Kg/cm ² (g)	Atlas Copco India Limited
2	Air Dryer	MD 600W, Rotary Drum Type, Cap: 36 Nm ³ /min	Atlas Copco India Limited
3	Air Receivers	5 nos. 10 M3 (3 nos. IA and 2 nos. SA) & 2 M3 (1 no. IA) (for details refer P&ID for compressed air system- VOLUME-III, SECTION-5)	As per WBPDCCL approved sub-vendor list
4	Valves	Ball/ Gate/Butterfly, Various Sizes	As per WBPDCCL approved sub-vendor list
5	Pipes & Fittings	ASTM-A312 Gr. 304 & CONFORM AS PER ANSI B36.19, SCH 40S FOR SIZE UPTO 50 NB & SCH. 10S FOR 65 NB & ABOVE.	As per WBPDCCL approved sub-vendor list
6	Instruments	Pressure Guage/ Temperature Guage/ Pressure transmitters/ Flow Indicators/Vortex Flow Meters etc.	As per WBPDCCL approved sub-vendor list

FOR THE MAKES OF THE INDIVIDUAL COMPONENTS OF THE COMPRESSED AIR SYSTEM PLEASE REFER VOLUME-IIB, SECTION C-2B

NOTE: ACCEPTANCE OF ADDITIONAL SUB-VENDOR IS SUBJECT TO APPROVAL BY CUSTOMER/BHEL. SUCCESSFUL BIDDER SHALL PROPOSE HIS SUB-VENDOR LIST ALONG WITH BACK UP DOCUMENTS (EXPERIENCE LIST, END USER CERTIFICATE ETC.) WHICH WILL BE SUBJECT TO CUSTOMER AND BHEL APPROVAL DURING DETAIL ENGINEERING STAGE WITHOUT ANY TECHNICAL, COMMERCIAL & DELIVERY IMPLICATION TO BHEL/CUSTOMER.

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-II	
		REV 00	DATE: Mar.21
		SHEET: 1 OF 1	

ANNEXURE-II

PAINTING SPECIFICATION

266568/2021/PS-PEM-MAX



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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

SECTION-XI

PROTECTIVE COATING AND PAINTING



Development Consultants Pvt. Ltd.

Volume : II-A
Section : XI
Protective Coating and Painting



CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTENT OF SPECIFICATION	1
2.00.00	CODES AND STANDARDS	1
3.00.00	GENERAL REQUIREMENTS	2
4.00.00	EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER	3
5.00.00	COATING PROCEDURE AND APPLICATION	5
6.00.00	TEST REQUIREMENTS	6
7.00.00	INFORMATION/DATA REQUIRED	10





SECTION-XI

PROTECTIVE COATING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

- | | | | |
|----|----------------------------|---|--|
| a) | SSPC SP 10 / NACE 2 / Sa2½ | : | Near White Blast Cleaning |
| b) | SSPC PA 2 | : | Measurement of dry film coating thickness with magnetic gauges. |
| c) | ASTM D 45 | : | Method for pull off strength using portable Adhesion Tester. |
| d) | NACE RP 0274 – 2004 | : | High-Voltage Electrical Inspection of Pipeline Coatings. |
| e) | NACE SP 0188 – 2006 | : | Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates. |
| f) | NACE RP 0169 – 2002 | : | Control of External Corrosion of Underground or Submerged Metallic Piping Systems. |
| g) | AWWA C 210 – 2007 | : | Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines. |
| h) | IS 3589:2001 Annexure-B | : | Steel Pipes for Water and Sewage Specification. |
| i) | AWWA C222-2000 | : | Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings. |



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1x660 MW Unit No. 5, Phase – III

- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)
- k) ISC HD 20 (11902) : Polyurethane coating for Interior and Exterior of steel pipe and fittings.
- l) ISC HD 20 (11055) : Solvent less Liquid epoxy system by application of Interior and Exterior surface of steel pipeline.

3.00.00 GENERAL REQUIREMENTS

- 3.01.00 The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00 The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00 The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00 The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.
- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.





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1x660 MW Unit No. 5, Phase – III

- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti-corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.
- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 **EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER**

- 4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be





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1x660 MW Unit No. 5, Phase – III

applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 **Surface Preparation**

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting up to SSPC SP10/NACE2/Sa2½ level to get “near white metal” surface before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.03.00 **Painting**

4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves shall be as follows :

- a) Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SP10/NACE 2/Sa2½ Standard.
- b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
- c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
- d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
- e) Total DFT of paint system shall not be less than 300 microns.

4.03.02 Specification for application of paints for external surfaces protection of steel pipes and fittings which are buried underground / laid inside a Hume Pipe & or submerged Under Water and laid under Pipe Trenches (in road/rail/pipe or trench crossings) shall be as follows :

- a) Surface preparation by means of sand blasting and shall conforms to SSPC SP10/NACE2/ Sa2½.
- b) External surface of the pipe, fittings, specialties etc. handling raw water/ clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 1500 micron including primer coat.



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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

- 4.03.03 Specification for application of paints for internal surface protection of large diameter pipes, if any, shall be as follows :
- Surface preparation by means of sand blasting which shall conforms to SSPC SP10/NACE2/Sa2½ standard.
 - All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
 - Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
 - The minimum dry film thickness (DFT) of internal lining shall be 500 micron.
- 4.03.04 Specification for application of paints for protection of internal surfaces of DM Water Storage Tank(s) shall be as follows :
- Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
 - Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
 - Total thickness of primer and paint should not be less than 500 microns.
- 4.03.05 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.
- 4.03.06 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.07 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.
- 4.03.08 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 **COATING PROCEDURE AND APPLICATION**

5.01.00 Surface preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 /





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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be at least 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.

- b) Material preparation shall be in accordance with manufacturer's recommendations.

- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature at least 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating: Coating thickness shall be in the range of ±20% and as per SSPC PA 2.



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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

6.01.01 **Apparatus / Instrument**

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 **Procedures**

a) **Number of measurements**

For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.

Area measurement must be within specified range.

6.02.00 **Electrical Inspection (Holiday) Test**

6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.





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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.

6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

6.03.00 **Adhesion Pull off Test**

After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.

6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “Jaw” at the bottom and also dollies.

6.03.02 **Prepare the test surface**

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

6.03.03 **Prepare Dolly (Test Pull Stub)**

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 **Select an adhesive**

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 **Attach the dolly to the surface**

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.



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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

6.03.06 **Adhesion Test Procedure**

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.
- e) Read the scale and record the adhesion value.

6.04.00 **Coating Repair**

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 **Surface Preparation**

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 **Coating Application**

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 **Repair Inspection:**

Repaired portion shall be electrically inspected using a holiday detector.



**WBPDCCL**

EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase – III

6.05.00 **Welded Field Joints**

6.05.01 **Preparation**

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 **Electrical Inspection**

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 **INFORMATION/DATA REQUIRED**

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-III	
		REV 00	DATE: Mar.21
		SHEET: 1 OF 1	

ANNEXURE-III

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

MDL FOR CAS PACKAGE FOR 1 X 660 MW SAGARDIGHI TPS EXTN. UNIT#5

PROJECT	SAGARDIGHI TPS	PACKAGE-COMPRESSED AIR SYSTEM	NOA DATE		
"A" S NO	"B" VENDOR_DRG_NO.	"D" DRAWING TITLE	"E" PURPOSE	"G" NAME OF BOI	"H" SCHEDULED SUBMISSION (NO. OF WEEKS FROM LOA DATE/SCH PO DATE)(*)
1	PE-V0-445-555-A001	QUALITY PLAN OF AIR COMPRESSOR	A-CUST	CAS	2
2	PE-V0-445-555-A002	QUALITY PLAN OF AIR DRYING PLANT	A-CUST	CAS	2
3	PE-V0-445-555-A003	QUALITY PLAN OF AIR RECEIVER	A-CUST	CAS	3
4	PE-V0-445-555-A004	QUALITY PLAN OF MOTOR	A-CUST	CAS	3
5	PE-V0-445-555-A005	TDS OF AIR COMPRESSOR	A-CUST	CAS	2
6	PE-V0-445-555-A006	TDS OF AIR DRYING PLANT	A-CUST	CAS	2
7	PE-V0-445-555-A007	TDS & CHARACTERISTIC CURVES OF MOTOR	A-CUST	CAS	3
8	PE-V0-445-555-A008	TDS & GA OF VALVES	I-CUST	CAS	5
9	PE-V0-445-555-A010	TDS OF INSTRUMENTS	I-CUST	CAS	5
10	PE-V0-445-555-A011	GA DRAWING OF AIR COMPRESSOR	I-CUST	CAS	3
11	PE-V0-445-555-A012	GA DRAWING OF AIR DRYER	I-CUST	CAS	3
12	PE-V0-445-555-A013	GA DRAWING OF MOTOR	I-CUST	CAS	3
13	PE-V0-445-555-A014	GA DRAWING OF AIR RECEIVER	I-CUST	CAS	3
14	PE-V0-445-555-A015	COMPRESSOR HOUSE LAYOUT	A-CUST	CAS	4
15	PE-V0-445-555-A016	P & I DIAGRAM OF AIR COMPRESSOR	I-CUST	CAS	2
16	PE-V0-445-555-A017	P&I DIAGRAM OF AIR DRYER	I-CUST	CAS	2
17	PE-V0-445-555-A018	P&I DIAGRAM OF COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE	A-CUST	CAS	3
18	PE-V0-445-555-A019	OPERATION & CONTROL PHILOSOPHY OF COMPRESSED AIR SYSTEM	A-CUST	CAS	3
19	PE-V0-445-555-A020	ELECTRICAL & INTERNAL WIRING DIAGRAM FOR COMPRESSOR PANEL	I-CUST	CAS	2
20	PE-V0-445-555-A021	ELECTRICAL FEEDER LIST FOR COMPRESSED AIR SYSTEM	I-G-P	CAS	3
21	PE-V0-445-555-A022	CONTROL CABLE SCHEDULE FOR COMPRESSED AIR SYSTEM	I-G-P	CAS	5
22	PE-V0-445-555-A023	PG TEST PROCEDURE FOR COMPRESSED AIR SYSTEM	I-CUST	CAS	7
23	PE-V0-445-555-A024	O&M MANUAL-COMP AIR SYSTEM	I-CUST	CAS	12
24	PE-V0-445-555-A029	SUB-VENDOR LIST WITH INSPECTION CATEGORISATION PLAN FOR COMPRESSED AIR SYSTEM	A-CUST	CAS	1

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-IV	
		REV 00	DATE: Mar.21
		SHEET: 1 OF 1	

ANNEXURE-IV

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



266568/2021/PS-PEM-MAX

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

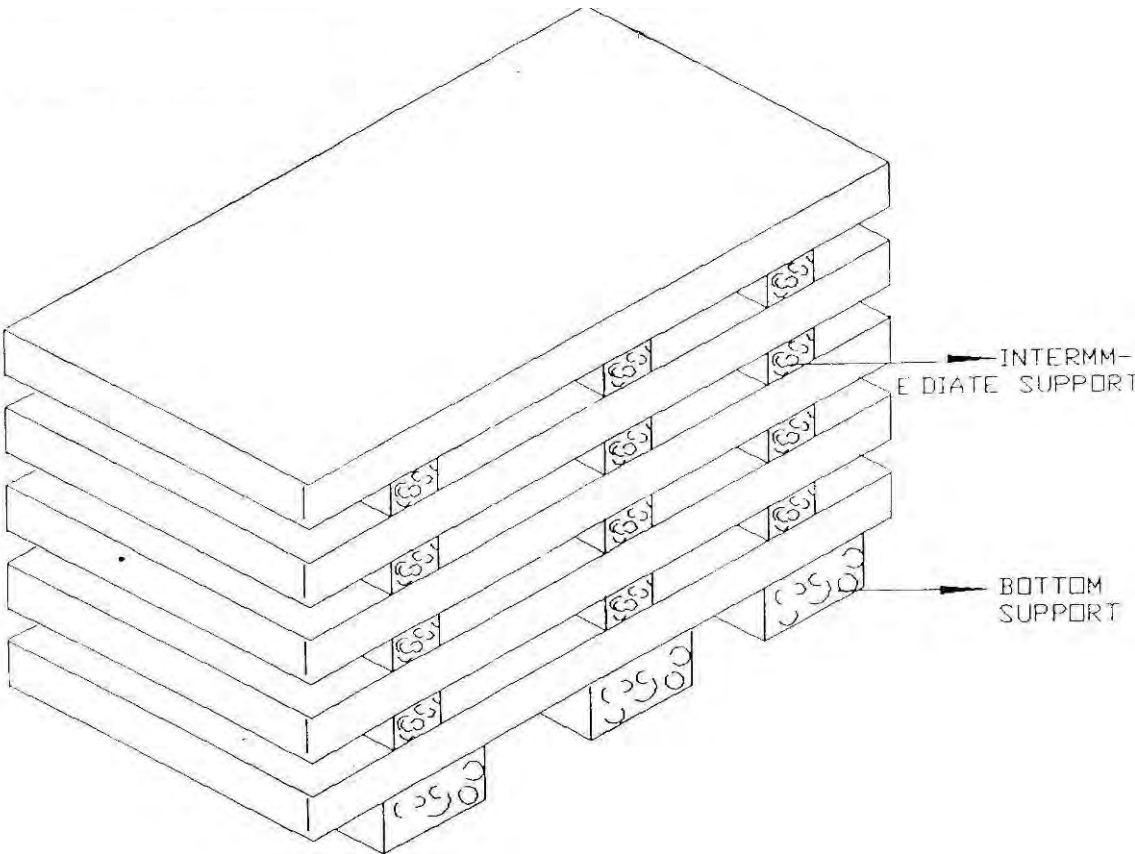


Figure – 1 – PLATE STACKING ARRANGEMENT

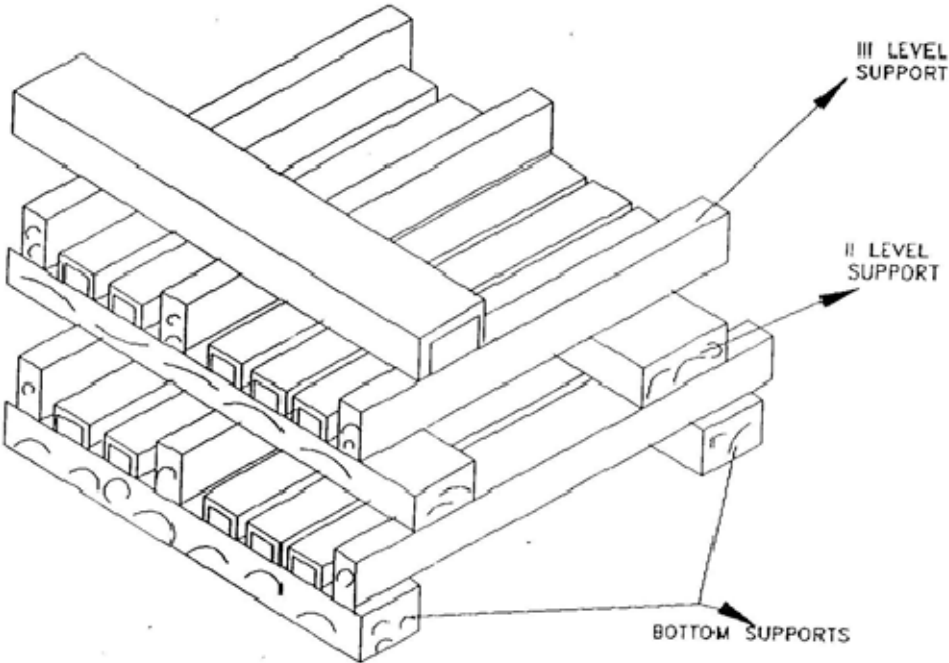


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-445-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-V	
		REV 00	DATE: Mar.21
		SHEET: 1 OF 1	

ANNEXURE-V

PACKING PROCEDURE

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 1 of 24

DOMESTIC PACKING

COMMON GUIDELINES

1 GENERAL:

This standard lays down packing instructions for domestic packing of Components/ Assemblies/ Equipment to be despatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments. For Seaworthy Packing refer standard AA0490004 wherever applicable.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. For specific applications the concerned engineering department shall issue a product standard. Reference of this product standard, must appear in the Shipping list/Packing List.

2 SCOPE:

This procedure gives minimum guidelines to be complied with for domestic packing of Components /Assemblies/ Equipment. This domestic packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.

3 WOOD SPECIFICATION

Based on availability, the wood shall conform to specification AA51401 or AA51402.

4 TYPES OF PACKING:

The following 5 types of packing have been standardized for packing of General Components/ Assemblies.

- 1) 'OP' - Open Type.
- 2) 'PP' - Partially Packed.
- 3) 'CP' – Crate/Box Packing - Components/Equipment requiring physical protection.
- 4) 'CQ' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
- 5) 'CR' - Case Packing – Electrical/Electronic Components/ Assemblies, which require special packing viz. Water Proof, Shock Proof etc...

5 DESCRIPTION OF TYPES OF PACKING:

The various types of packing, as standardized above, are described below.

5.1 'OP' - Open Type

In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.

5.2 'PP' - Partially Packed

Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene

Revisions:			APPROVED: PROCEDURAL GUIDELINES COMMITTEE – PGC (Packing)		
Rev. No. 02	Amd. No.	Reaffirmed	Prepared HPBP, Trichy	Issued Corp. R&D	Dt. of 1 st Issue 31-05-2018
Dt: 28-08-2018	Dt:	Year:			

AA0490010

Rev. No. 02

PAGE 2 of 24

CORPORATE STANDARD

Film to Specification No. AA51420. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film

5.3 'CP' - Crate Packing

Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.

5.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipment

Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel to AA55619 or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with 100GSM (Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.

For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.

5.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel to AA55619 packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM (Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420 before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel to AA55619.

Empty space in the cartons shall be filled with rubberized coir to get proper cushioning effect. The cartons shall be manufactured from corrugated Fiber Board, meeting requirements of AA51414.

6 PREPARATION OF PACKING CASES**6.1 DIMENSIONS:**

- a) Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units.
- b) Width of all planks including the tongue shall be more than 125mm and after planing it shall be minimum 100mm.
- c) Minimum number of planks shall be used for a shook.
- d) Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel).
- e) Width of binding planks shall be minimum 100mm.
- f) Distance between any 2 binding planks shall be less than 750mm.
- g) diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm
- h) Distance of the outer edges of these planks from the edge of case shall be less than 250mm.
- i) Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

6.2 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 3 of 24

6.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

6.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

6.5 OTHER MATERIALS

6.5.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

6.5.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

6.5.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust.If sufficient nailing is done for bigger boxes, strapping need not be done.

6.5.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

6.5.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

6.5.6 FASTENERS

Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by the vendor. Drilling of holes will have to be done using contractor's tools.

6.5.7 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film Specification No: AA51420 are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

6.5.8 RUBBERISED COIR:

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

6.5.9 FOAM RUBBER / 'U' FOAM:

This is used for covering the delicate items. This material is provided by the vendor.

AA0490010

Rev. No. 02

PAGE 4 of 24

CORPORATE STANDARD**6.5.10 MARKING PLATE:**

This shall be of anodized aluminium sheet. Size of the marking plate shall be maintained minimum of size as per the details specified in the Figure 4.

6.5.11 PACKING SLIP HOLDER:

This shall be of galvanized iron tinned sheet /Aluminium sheet

6.5.12 SILICA GEL:

This shall be of indicating type to conform to IS: 3401/AA55619. Silical gel shall be used for such products only where moisture needs to be avoided.

6.5.13 COTTON BAGS:

These are used for holding silica gel. The bags shall have the following matter indicated on them:

BHEL-UNIT NAME	PLACE-PINCODE
SILICA GEL	INDICATING TYPE
BLUE :	ACTIVE
ROSE :	REDUCED ACTIVITY
WHITE :	NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

6.5.14 COTTON/ PLASTIC TAPE:

This is used for tying small items. And also to prevent vibrations of moving parts within the cubicles.

6.5.15 MARKING INK:

The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

6.5.16 POLYETHYLENE BAGS:

These are to be used for keeping the Packing slips. The bag shall be of size 70mm X 100mm (minimum).

6.5.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.**6.5.18 Mechanical Latching clamps:**

For CLW Railway panels and similar Panels self-locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. For reusable boxes, these clamps provide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

6.5.19 STICKERS

The following stickers to be put by the vendor on cubicles/Boxes after packing.

- 1) Case No sticker: 2 nos. Size 25.Cm x 0.45Cm
- 2) BHEL Monogram sticker: 1 no. Size 1.75Cm x 2.3Cm
- 3) Address sticker: 2 nos. Size 3.8Cm x 3.0Cm
- 4) Direction sticker "Front" & "Back" - 4 nos. Size 2.0Cm x 0.75Cm
- 5) Chain Mark Sticker: 4 Nos. Size – 3.0Cm x 0.75Cm
- 6) "Fragile" sticker: 2 Nos. Size. 2.1Cm x 1.5Cm
- 7) "DO NOT STACK" sticker - 2 Nos. Size 3.0Cm x 2.2Cm

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 5 of 24

In place of stickers, writing all the details legibly with paint shall be allowed & respective units may take decision accordingly.

7 PACKING OF CUBICLES:

7.1 The packing is to be done as per clause 5 in all respects.

7.2 The cubicles are already fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets normally.

7.3 The cubicles will be of different sizes both width wise and lengthwise. The cubicles may be made up of single suite, 2 Suite, 3 Suite, 4 Suite, etc., The width of the cubicles generally varies from 400 mm to 1650mm. The length of the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases, the height may be less/more.

7.4 MULTI LAYER CROSS LAMINATED POLY FILM

The inner surface of 4 sides of shooK's shall be nailed with Multi-layer cross laminated poly film (as per 6.5.7) using blue nails (as per 6.5.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.

The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 6.5.7). This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 6.5.7).

7.5 SILICA GEL:

Silica gel (as per 6.5.12) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 6.5.13).

7.6 LOOSE PARTS:

Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

7.7 WOODEN BATTENS:

In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

7.8 RUBBERISED COIR:

Gap between the cubicle and the case shall be filled with rubberized coir (as per 6.5.8) with distance between consecutive layers less than 500mm.

7.9 CLAMPING:

Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 6.5.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

7.10 PACKING SLIP:

Packing slip kept in the polyethylene bag (As per 6.5.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 6.5.11) shall be nailed to front / rear of case.

7.11 MARKING PLATE:

One no. (As per 6.5.10) shall be nailed to the front side of the case.

7.12 CASE MOUNTING:

After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

AA0490010

Rev. No. 02

PAGE 6 of 24

CORPORATE STANDARD**7.13 Different types (Typical) of Cubicles with sizes for Packing**

1. Single suite cubicle - 900 x 950 x 2500
2. Two suite cubicle - 1650 x 950 x 2500
3. Three suite cubicle - 2400 x 950 x 2500
4. Four suite cubicle - 3150 x 950 x 2500
5. Regulation cub - 1300 x 1350 x 2500
6. Thy cub - 2870 x 1350 x 2500
7. VFD Cub - 3800 x 1550 x 2500

7.14 PACKING OF CUBICLES FOR EXPORT

Refer Corporate Standard AA0490009.

8 PACKING OF LOOSE ITEMS/SPARES

- 1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.
- 2) Wood shall conform to specification AA51401 or AA51402 with Tongue and Groove joint as per clause 6.3.
- 3) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.
- 4) External surface of planks on front and rear shall be plane 100% (except bottom plank).
- 5) Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 6.5.7) using blue nails.
- 6) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
- 7) Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No: AA51420. Any space left between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.
- 8) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.
- 9) Silica gel as per clause 6.5.12 held in cotton bags as per clause 6.5.13 shall be kept at proper places in the box.
- 10) Packing slip kept in polyethylene bag (clause 6.5.16) shall be placed in the box.
- 11) Marking plate as per clause 6.5.10 shall be nailed to side of the box.
- 12) Two numbers of hoop iron strips as per clause 6.5.3 shall be strapped tightly on the case using clips.
- 13) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
- 14) Loose items to be kept inside the cubicle
 - The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.
 - Other items which are given loose in addition to cubicle shall be packed in separate boxes.

9 BOX SIZES**9.1 BOX SIZES**

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 7 of 24

Table 1 – SPARES WOODEN BOX DETAILS

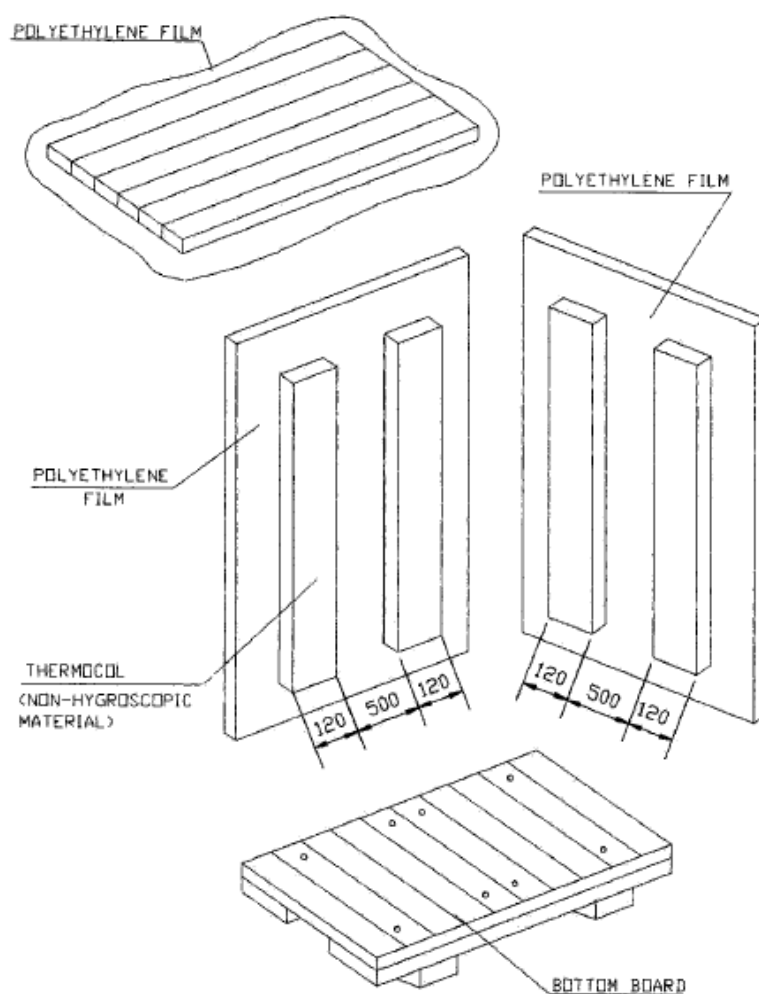
SNO	BOX TYPE	BOX SIZE (in mm)	BOX Wt (in KG)	Carrying Capacity
1	A	800 X 200 X 200	15	
2	B	1500 X 200 X 200	22	
3	C	2000 X 200 X 200	27	
4	D	1100 X 200 X 200	15	
5	E	200 X 200 X 200	5	
6	F	320 X 250 X 260	13	
7	G	320 X 250 X 430	16	
8	H	430 X 370 X 430	23	
9	I	1100 X 400 X 400	45	
10	J	1500 X 500 X 400	65	
11	K	2000 X 500 X 400	93	
12	L	2500 X 500 X 400	88	
13	M	900 X 600 X 600	100	
14	N	3000 X 400 X 400	60	
15	P	600 X 500 X 400	35	
16	Q	710 X 630 X 600	90	
17	R	850 X 630 X 670	102	
18	S	1000 X 770 X 670	140	
19	T	2500 X 850 X 800	180	
20	U	1500 X 700 X 700	120	
21	W	1200X900X600	120	
22	Y	450 X 200 X 200	10	

Table 2 – WOODEN BOX DETAILS

BOX TYPE	BOX SIZE (in MM)	BOX Wt (in KG)	Carrying Capacity
1	320X250X260	10	
2	320X250X430	15	
3	430X370X430	25	
4	670X670X470	65	
5	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	
9	1300X770X1050	155	
10	2500X850X800	225	
11	2000X1500X1200	305	
12	1850X1050X1250	260	
13	2000X800X800	180	
14	2600X1500X1600	470	
15	250X250X600	20	
16	250X250X880	30	
17	300X300X700	25	
18	380X380X880	45	
19	510X510X1400	60	
20	570X570X1400	80	
21	575X575X1875	105	
22	3600X1100X1100	390	
23	900X500X800	110	
24	2000X950X740	225	
25	1600X1120X700	220	
26	2500X2000X1200	490	
27	2900X1900X1400	525	
28	3000X1000X900	370	
29	3200X2200X950	450	
30	2150X1100X750	325	
31	2000X2000X700	130	
32	700X1200X1325	130	

CORPORATE STANDARD**Table 3 – STEEL BOXES**

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
1	I	2480	1680	1500	339	4500
2	II	1200	900	600	061	2000
3	IIB	1800	850	950	115	2500
4	III	900	600	600	029	1000
5	IV	600	450	500	019	750
6	V	400	350	300	011	500

TYPICAL PATTERN OF WOODEN BOX**Figure 1**

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 9 of 24

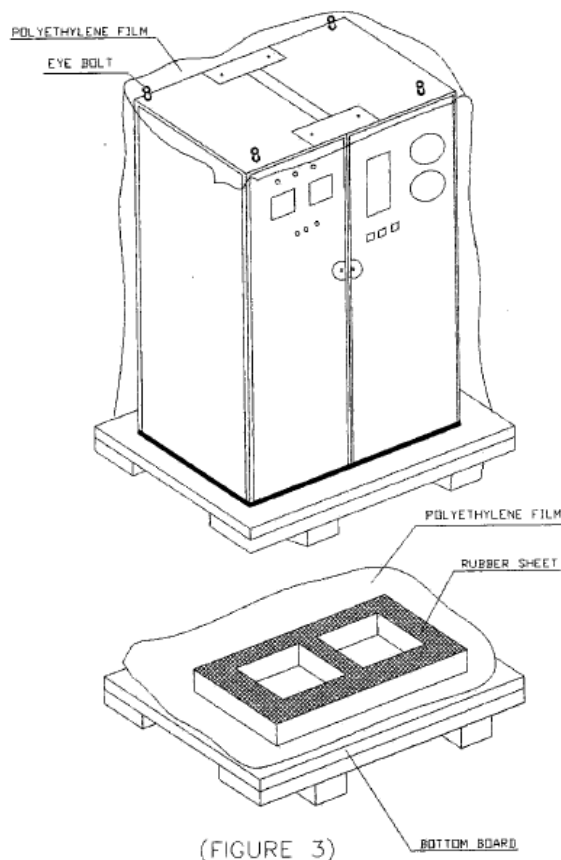


Figure 2

9.2 STEEL CONTAINERS:

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies. The containers are to be made of structural steel as per AA10108 with proper reinforcement with I, C and T Sections. Depends on the availability of resources & requirements units may be allowed to use standard cargo containers also instead of fabricated steel boxes.

- a) Following precautions are to be taken during packing: -
- b) Put the machine in the steel container properly,
- c) Cover the machine with polythene.
- d) To arrest the movement in the steel container necessary wooden Blocks/Battons may be put.
- e) Put cover on steel, container and Bolt Properly

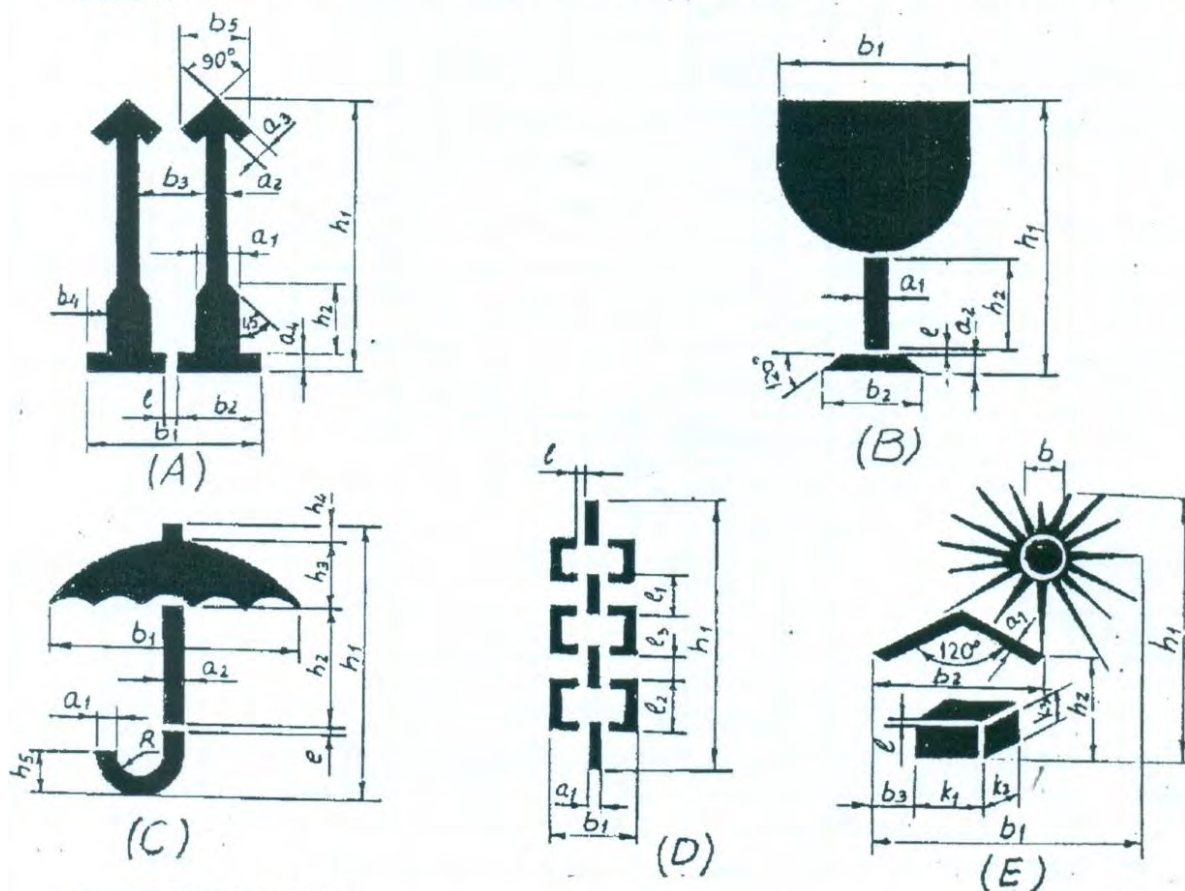
9.3 SEALED PACKING:

Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.

10 MARKINGS/STENCILINGS

MARKINGS ON PACKING CASES

1. THIS PLANT STANDARD PRESCRIBES THE VARIOUS CAUTION SIGNS AND OTHER MARKINGS ON PACKING CASES.
2. DIMENSIONS IN THE TABLE 1 SHALL BE USED FOR MAKING STENCILS ONLY.



- A. UPRIGHT
- B. FRAGILE
- C. PROTECTION FROM FALLING OR CONDENSING MOISTURE.
- D. SLINGING POSITION
- E. PROTECTION FROM DIRECT RADIATIONS.

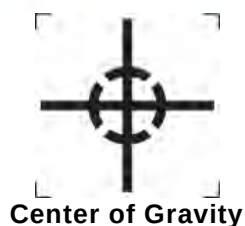


Figure 3

AA0490010	CORPORATE STANDARD	
Rev. No. 02		
PAGE 12 of 24		

	BHEL – <unit> - <location> - <pin>				
CONSIGNEE					
MATERIAL					
CUSTOMER REF.				MO. NO.	
DESPATCH ADVICE NOTE NO				CASE NO	
DIMENSIONS(MM) L x B x H				NET WT –KGS	GROSS WT –KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT				

Figure 4 – TYPICAL MARKING PLATE (225 X 170)

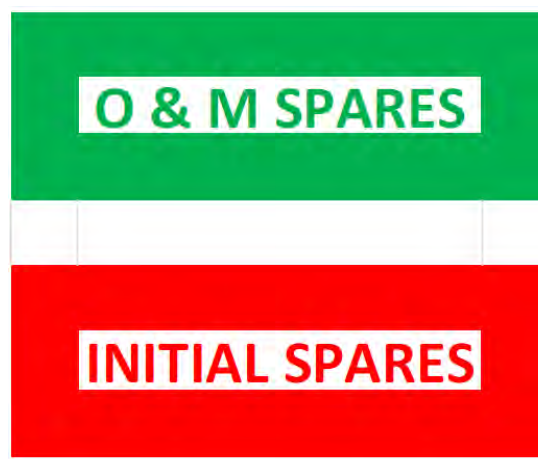


Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

11 RECYCLING OF INCOMING WOODEN PACKING CASES

OBJECTIVES

- To utilize useable wood of incoming packing cases, for manufacturing of new packing boxes.
- To recycle incoming wooden packing cases, as such, wherever possible.

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 13 of 24

- 1) All incoming wooden packing cases received from suppliers /customers will be opened carefully, with the intention of reusing them, by Shop.
- 2) After carefully taking out the contents, the empty wooden packing cases will be shifted by Shop to the specified locations i.e. bin / nearly spaces, already earmarked in stores.
- 3) Material shifting contractor engaged by store, will collect all such wooden packing cases and scrap wood from specified points, on a regular basis.
- 4) After collecting / loading the empty packing cases/ scrap wood, contractor will take the carrier first to Weighment Bridge for weighment, thereafter; he will go to Carpentry, where Carpentry representative will identify the packing cases which can be used by Carpentry for manufacturing of New Packing Boxes. All such identified packing boxes will be unloaded and handed over to Carpentry by contractor.
- 5) These packing boxes will be made re-useable after necessary rectification and additional work.
- 6) Contractor will again take the carrier for weighment and this second reading will also be recorded on the same "Weighment Slip".
- 7) Weight of empty packing cases / scrap wood taken will be calculated on the basis of 1st and 2nd weighment readings recorded on the "Weighment Slip". A copy of "Weighment Slip" (where both the weighment readings are recorded) will be given by the contractor to the carpentry representative. Based on this "Weighment Slip", carpentry will maintain a register in which details of quantity received will be recorded.
- 8) All "Weighment Slips" will invariably be signed by carpentry representative (even when no boxes have been unloaded by carpentry). Store will accept the scrap wood only if "Weighment Slips" are signed by carpentry representative.
- 9) Balance empty packing cases / scrap wood will be handed over by contractor to Store, for storing in scrap yard.
- 10) A separate area in Scrap yard will be provided, for executing the work of denailing of wooden packing cases, under supervision of carpentry.
- 11) Carpentry contractor will identify packing cases / scrap wood for denailing, which will be handed over to him by Store, at Scrap yard, for denailing and further operation.
- 12) Quality and Carpentry will jointly inspect the wood generated by de-nailing process and will prepare "INSPECTION CUM RECEIPT REPORT OF USEABLE WOOD RECEIVED FROM TPS – STORE BY CARPENTRY".
- 13) After acceptance of the wood by Quality and Carpentry, the same will be shifted to carpentry for receipt and its record will be maintained by carpentry.
- 14) This will be a Permanent Productivity Project executed by carpentry. "Productivity Savings" duly verified at the current Purchase Order rate of wood, will be sent every month to Resource Management Department, for highlighting it in their monthly progress report.

12 STANDARD METHOD OF PACKING

Table 5 - Standard Method of Packing

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
PRESSURE VESSELS								
TOWERS					O			
TANKS					O			
VESSELS					O			
GASKETS	O							
FASTENERS	O							
COVERS		O						
EXCHANGERS								

266568/2021/PS-PEM-MAX

AA0490010	CORPORATE STANDARD							
Rev. No. 02								
PAGE 14 of 24								
DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
AIR BOTTLES	O							
TITANIUM BOTTLE	O							
WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							
BOILER DRUMS					O			
BOILER ITEMS								
COILS			O					
PANELS					O			
HEADERS			O		O			
FEEDERS								
MACHINED ITEMS								
SHELL SEGMENTS					O			

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CORPORATE STANDARD

AA0490010

Rev. No. 02

PAGE 15 of 24

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
SHELL SEGMENTS IN STACKS					O			
SPHERE PETALS								
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O			
ROLLERS	O							
VALVE TRAYS								
VALVE TRAY COMPONENTS	O							
LATTICE GIRDERS		O						
FASTENERS	O							
GASKETS	O							
SUB CONTRACTS								
FAB STRUCTURALS					O			
SUPPORTING STRUCTURALS					O			
STRUCTURE SUB ASSEMBLY					O			
FAB PIPES					O			
GRATINGS					O			
STAIR CASES					O			
HANDRAILS/ PLATFORMS					O			
BOUGHT OUT COMPONENTS								
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)					O			
PIPE FITTINGS								
CS PIPES, TUBES					O			
SS PIPES, TUBES					O			
FIN TUBES	O							
ELBOWS		O			O			
FLANGES	O	O						
VALVES	O							
GAUGES	O							
DEMISTERS		O						
ABSCRIBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							
SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								
MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							

AA0490010	CORPORATE STANDARD	
Rev. No. 02		
PAGE 16 of 24		

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

13 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

- 13.1** Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.
- 13.2** Appropriate material handling equipment like fork lifters, cranes etc. shall be used where needed.
- 13.3** Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. shall be done carefully.
- 13.4** For critical items, where specified, special handling fixtures shall be used for lifting.
- 13.5** Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.
- 13.6** Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.
- 13.7** Precision machined components like blades, catches, rollers etc. shall be lifted using suitable wooden pallets.

13.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

- a) The markings showing the upright position.
- b) The markings showing the sling position
- c) Markings showing the fragile contents.
- d) Other required markings as per clause no.10

- 13.8.1** Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15°.
- 13.8.2** Handling and lifting should be done without jerks or impacts.
- 13.8.3** Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.
- 13.8.4** On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.
- 13.8.5** Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 17 of 24

13.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

14 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH

Based on the Dimensions/Weight indicated in the Transportation Sketch, the type of Trailer is decided and indicated in the Tender Enquiry.

14.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):

Well Bed Length	: 10000mm
Over Gooseneck	: 13000mm
Width	: 3000mm
Carrying Capacity	: 40MT

2. LOW BED TRAILERS (LB 16):

Well Bed Length	: 12000mm
Over Gooseneck	: 16000mm
Width	: 3000mm
Carrying Capacity	: 75MT

3. TOW TYPE TRAILERS (WITH FRONT DOLLEY 16 TYRES): 12000MM length (for Exceptional equipment length: 30000mm and above)

Bigger Dia equipment are loaded in the Well with overhanging.

Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.
The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/ Weight of the Consignment

14.2 PACKING:

For all ODCs, Wooden Saddles are cut to the diameter of equipment as per the Transportation Sketch.

Wooden Saddles	For Diameter up to 4000mm	For Diameter above 4000mm
Length:	1836/2743mm (6'0"/9'0")	3353mm (11'0")
Width:	300mm (1'0")	300mm (1'0")
Height:	Saddle + one/two wedges a top	Saddle + three/four wedges a top

Number of Saddles:	
Minimum	3 in case of Loading inside Well +1 when loaded on Gooseneck
Maximum:	4 in case of Loading inside Well +2 when loaded on Gooseneck

For Securing the equipment firmly on the Trailer, 19mm (3/4"), wire rope with 25mm (1") Heavy Duty Turn Buckles / BD Clamps are used as Lashing for the equipment.

14.3 NUMBER OF LASHINGS:

AA0490010

Rev. No. 02

PAGE 18 of 24

CORPORATE STANDARD

	CONSIGNMENT LOADED INSIDE WELL BED	CONSIGNMENT LOADED OVER GOOSENECK
a) up to 40MT	4 (2 Single Line lashing 2 Double Line Lashing)	5 (3 Single Line Lashing 2 Double Line Lashing)
b) 40MT to 60MT	5 (3 Single Line Lashing 2 Double Line Lashing)	5 (Single Line Lashing 3 Double Line Lashing)
c) 60MT and above	5 (2 Single Line Lashing 3 Double Line Lashing)	6 (3 Single Line Lashing 3 Double Line Lashing)

15 GUIDELINES FOR HANDLING/LOADING/LASHING**15.1 HANDLING****Figure 6**

Before unloading the jobs Completely painted and neatly stencilled will be checked.

Pipes with split type end cover will be checked



CORPORATE STANDARD

AA0490010

Rev. No. 02

PAGE 19 of 24



Figure 7

All Coil Tubes to be provided with End Caps.



Figure 8

Neatly stacked Coil Assemblies.

CORPORATE STANDARD**Figure 9**

Columns to be lifted with Nylon belts. This protect painting, edges and attachments.

**Figure 10****15.2 LOADING**

All the components to be transported by putting inside the properly fabricated Crating

	CORPORATE STANDARD	AA0490010
		Rev. No. 02
		PAGE 21 of 24



Figure 11

Small components may fall down while transporting without closed crating and there are chances of missing of small parts. Hence, it is always better to transport small components in closed containers/crating. Loose to be being shipped in a closed crating.



Figure 12

AA0490010

Rev. No. 02

PAGE 22 of 24

CORPORATE STANDARD

No component loaded over the crating.

**Figure 13**

Headers supported with wooden V blocks at 3 meters interval.

**Figure 14**

Spacers in between each coil assembly.



CORPORATE STANDARD

AA0490010

Rev. No. 02

PAGE 23 of 24



Figure 15

Goose pipe to be provided with rubber pad protects removal of painting and damage to the job.



Figure 16

15.3 LASHING

Use Nylon belts only for lashing of all components. It prevents removal off painting and cut in the materials.

CORPORATE STANDARD**Figure 17**

Nylon Belts used for lashing the beams.

**Figure 18****16 PRODUCT WISE SPECIAL INSTRUCTION**

Additional instructions of packing not included in this standard shall be covered by individual product standard.

17 REFERRED STANDARDS (Latest publications including amendments):

- | | | | | |
|------------|------------|------------|------------|------------|
| 1) AA51420 | 2) AA55619 | 3) AA51414 | 4) IS:3401 | 5) AA10108 |
| 6) AA56126 | 7) AA51402 | 8) AA51401 | 9) IS:1234 | |

	CORPORATE STANDARD	AA0490006
		Rev. No. 01
		PAGE 1 of 3

VACUUM PACKING FOR ELECTRONIC COMPONENTS

1 GENERAL

This standard lays down the packing instructions for packing of components / Electronic module / Assemblies to be dispatched against Customer contracts.

2 SCOPE

This procedure covers method of packing electronic components using vacuum packing in a wooden packing boxes.

3 OBJECTIVE

To establish a rust proof safe packing procedure and where the components required to protect against temperature and humidity. In general minimum temperature +5 deg C and maximum temperature 45 deg C, and relative humidity between 10% to 40%.

4 PACKING BOX

Wooden Box shall be made as per BHEL Standard AA0490010 for Domestic/ AA0490009 for Export/ AA0490004 for Seaworthy packing. Size of the box as per the contract requirement which has to be checked by QC.

5 PACKING PROCEDURE

- a) Cleaning parts shall be thoroughly cleaned just before VCI (Volatile Corrosion Inhibitor) Vacuum packing. Finger prints on cleaned items are to be avoided as the same are very corrosive.
- b) VCI Rust preventive oil (Ferrous grade oil base) shall be applied to all the components to withstand any corrosion.

6 VCI VACUUM PACKING

- a) Bubble wrapping the items VCI vacuum packing.
- b) Appropriate vapour corrosive packets one pouch (1 gm. /pouch) of VCI Anticorrosive Powder and one pouch (10gm./ pouch) of VCI Desiccant per 1000 cub. meter packing space shall be placed inside the VCI vacuum packing.
- c) All the components shall be separately packed using VCI laminated Aluminium foils from which air/moisture are removed by the air vacuum device and sealed thoroughly using heat sealing machine. At the time of the evacuation the vacuum inside the pack should be less than 0.5 ata.
- d) One identification slip containing component information such as description of item, Material No. Customer PO, Item No. Quantity etc. shall be put inside the VCI vacuum packing.
- e) Top cover of the wooden box shall be sealed only after final clearance from QC for confirmation of above.
- f) All boxes should be covered by water proof tarpaulin over top and on all sides.
- g) The packing boxes shall be covered with GI sheets (0.25 -0.4mm thick) on all the sides for Export / Seaworthy packing.
- h) Vacuum packing room temperature and Relative Humidity should be maintained as mentioned below:

Min. +5 deg. C and Max. 45 deg. C, Relative humidity between 10% to 40%.

Revisions:			APPROVED: PROCEDURAL GUIDELINES COMMITTEE – PGC (Packing)		
Rev. No. 01	Amd. No.	Reaffirmed	Prepared EDN, Bangalore	Issued Corp. R&D	Dt. of 1 st Issue 31-05-2018
Dt: 12-06-2018	Dt:	Year:			

AA0490006

Rev. No. 01

PAGE 2 of 3

CORPORATE STANDARD**7 COMPONENTS REQUIRED****7.1 VCI laminated Aluminium foil**

Volatile Corrosion Inhibitor (VCI) safe foil shall be with aluminium barrier laminated which is flexible, heat sealable, water vapour and anticorrosion resistant barrier laminate of polyester, Aluminium foil and VCI Polyethylene. It is used as a primary packaging material for packing metal components and sealed with the help of a heat sealer after vacuuming with vacuum machine maintaining the humidity level below 40 RH inside the package.

7.2 Composition construction of VCI laminated Aluminium foil

- a) PET Film : 12 Microns
- b) Bonding layer : 2 Microns
- c) Aluminium Foil : 9 Microns
- d) Bonding layer : 2 Microns
- e) VCI Poly film : 100 Microns
- f) Total thickness : 125 Microns + or – 5%

7.3 Properties of VC Laminated Aluminium foil

- a) Basic Weight : 138 gsm +/- 8%
- b) Sealing condition : 180 C/ 2 sec
- c) Tensile strength
MD: 20 kgf
CD: 18 kgf
- d) Tear Strength
MD 4.8 kg
CD:3.4 kg
- e) Heat Seal Strength : 30.380 N/cm
- f) WVTR Value : 0.05gms/m /24 hrs.
- g) OTR Value : 0.1 cc/m/24 hrs

8 MARKING OF PACKING BOX

Mark the following information on the two adjacent sides of the each package

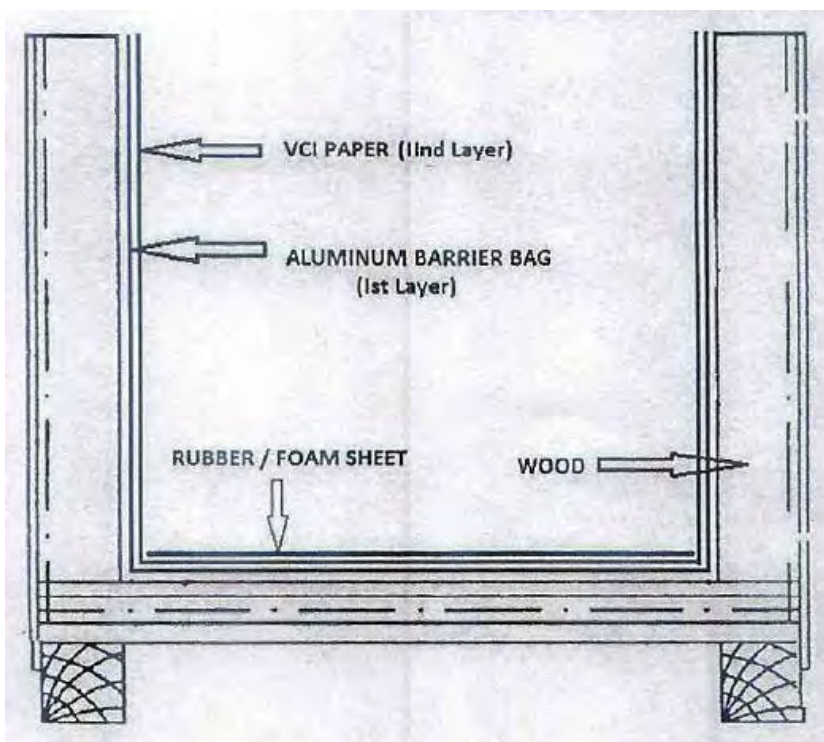
- a) Material No.
- b) Customer PO
- c) Item No.
- d) Quantity
- e) Storage Requirement : Indoor
- f) Content Description : Electronic Module
- g) Net weight (in kg)
- h) Dimension (L x W x H in centimetres)
- i) Project Name
- j) Consignee
- k) Water proofing (Umbrella Stencilling)
- l) Upside direction

**CORPORATE STANDARD**

AA0490006

Rev. No. 01

PAGE 3 of 3

**Figure 1**

	CORPORATE STANDARD	AA0490008
		Rev. No. 01
		PAGE 1 of 4

VACUUM PACKING FOR ELECTRICAL COMPONENT

1 GENERAL

This standard lays down the packing instructions for packing of components / Electrical components Stator/ Rim punching, Wound Pole/ Field Coils and Stator coils / bars to be dispatched against Customer contracts.

2 SCOPE

This procedure covers method of packing component in a wooden packing boxes.

3 OBJECTIVE

To establish a rust proof safe packing procedure and where the components required to protect against temperature and humidity. In general minimum temperature +5 deg C and maximum temperature 45 deg C, and relative humidity between 10% to 40%.

4 PACKING BOX

Wooden Box shall be made as per BHEL Standard AA0490010 for Domestic/AA0490009 for Export/AA0490004 for Seaworthy packing. Size of the box as per the contract requirement, which has to be checked by QC.

5 PACKING PROCEDURE

- All items packed are to be marked by QC with "OK" stickers. Varnished stator punchings are to be brought down to room temperature before labelling them "OK" for packing. Do not pack hot/warm stator punchings that have is just received from the varnishing.
- Packing of stator punchings, wound pole/ field coils and stator coils / bars should be done in a covered shed.
- Packed materials are to be stacked in proper alignment and to be kept in wooden packing.

6 Additional Packing Methodology for Stator / Rim Punchings (Double stacking) only

In order to eliminate the use of studs avoid double stack packaging per box. Where double stacked packing boxes are unavoidable, the stator /rim punchings are to be securely tightened using GI studs, nuts and soft material washers (rubber/plastic). GI studs, nuts and soft material only to be used in case of double stacking of rim / stator punchings (with holes). Use soft rubber washers to seal the punctured opening at the bottom from where the studs pass in each layer of VCI (Volatile Corrosion Inhibitor) paper, polythene and tarpaulin sheet in case of rim /stator punchings (with holes).

- GI studs with rubber washer to be placed initially inside the wooden packing box.
- Over the wooden base, place water proof tarpaulin sheet.
- Rubber washer shall be placed after the layer of tarpaulin sheet.
- Then place a layer of porous plastic sheet with total thickness of at least 5mm (for cushioning and reduces the chances of damage to punchings).
- Place the Aluminium Barrier laminated Bags over this porous sheet, place the rubber washer over it.
- Place VCI papers on the Aluminium barrier bag and fix with rubber washer.

Revisions:			APPROVED: PROCEDURAL GUIDELINES COMMITTEE – PGC (Packing)		
Rev. No. 01	Amd. No.	Reaffirmed	Prepared EDN, Bangalore	Issued Corp. R&D	Dt. of 1 st Issue 31-05-2018
Dt: 12-06-2018	Dt:	Year:			

AA0490008

Rev. No. 01

PAGE 2 of 4

CORPORATE STANDARD

- g) PVC Pipes shall be inserted over the GI studs. These pipes are to be used to cover each stud, to protect its direct contact and hence rubbing with punchings.
- h) Now place the stack of punchings over the VCI paper and securely tighten the punchings using nuts and soft material, washers.
- i) Each layer should be secured in position. Wrap the punchings with VCI paper and properly sealed separately using an adhesive tape.
- j) Silica Gel packets are to be placed over the VCI paper and uniformly distributed inside the boxes on the VCI paper to remove/prevent moisture.
- k) Aluminium barrier laminated bag has secured in position and properly sealed by using heat sealing machine and air to be drained out by using vacuum pump. At the time of the evacuation the vacuum inside the pack should be less than 0.5ata.

Use two separate VCI papers for doubled stacked boxes independently covering each stack. Similarly two Aluminium barrier laminated bag are to be used to wrap the two stacks independently, as explained above.

7 Additional Packing Methodology for Wound Pole/ Field Coils and Stator Coils/Bars only

- a) Over the wooden base, place the waterproof tarpaulin sheet.
- b) Then place a layer of porous plastic sheet with total thickness of at least 5mm (for cushioning and reduces the chances of damage to Wound pole/field coils and stator coils/ bars.
- c) Place the Aluminium barrier laminated bag over this porous sheet.
- d) Place the VCI paper (Volatile Corrosion Inhibitor as per BHEL Standard AA51406) on the Aluminium barrier laminated bag along with rubber washer.
- e) Bare copper portion of field coils and stator coils / bars to be covered by VCI paper pouch and fasten with VCI tape.
- f) Now place the wound pole, stack of field coil and stator coil / bars over the VCI paper.
- g) Each layer should be secured in position. Wrap wound pole / field coils and stator coils / bars with VCI paper and properly sealed separately using an adhesive tape.
- h) Silica Gel packets are to be placed and uniformly distributed inside the boxes on the VCI paper to remove/prevent moisture.
- i) Then Aluminium barrier laminated bag has secured in position and properly sealed by using heat sealing machine and air to be drained out by using vacuum pump. At the time of evacuation the vacuum inside the pack should be less than 0.5ata.
- j) The VCI paper must contact the stator / rim punchings, wound pole / field coils and stator coils/bars. It has to ensure that the VCI paper, Aluminium barrier bag should not get damage / puncture during the packing process.
- k) Top cover of the wooden box shall be sealed only after final clearance from QC for confirmation of above.
- l) All boxes should be covered by water proof tarpaulin over top and on all sides.
- m) The packing boxes shall be covered with GI sheets (0.25 -0.4mm thick) on all the sides for Export / Seaworthy packing.
- n) Vacuum packing room temperature and Relative Humidity should be maintained as mentioned below:
Min. +5 deg. C and Max. 45 deg. C, Relative humidity between 10% to 40%.

	CORPORATE STANDARD	AA0490008
		Rev. No. 01
		PAGE 3 of 4

8 COMPONENT REQUIRED

8.1 VCI laminated Aluminium foil

Volatile Corrosion Inhibitor (VCI) safe foil shall be with aluminium barrier laminated which is flexible, heat sealable, water vapour and anticorrosion resistant barrier laminate of polyester, Aluminium foil & VCI Polyethylene. It is used as a primary packaging material for packing metal components and sealed with the help of a heat sealer after vacuuming with vacuum machine maintaining the humidity level below 40 RH inside the package.

8.2 Composition construction of VCI laminated Aluminium foil

- a) PET Film : 12 Microns
- b) Bonding layer : 2 Microns
- c) Aluminium Foil : 9 Microns
- d) Bonding layer : 2 Microns
- e) VCI Poly film : 100 Microns
- f) Total thickness : 125 Microns + or – 5%

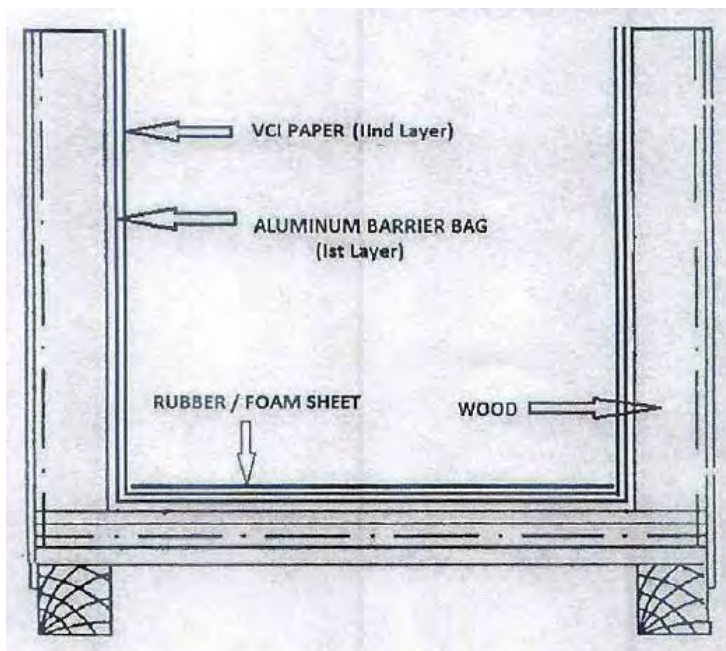
8.3 Properties of Aluminium Barrier laminated Bag

- a) Basic Weight : Unit: g/sq. m 150 +/- 5
- b) Tensile strength : Unit: N/sq. mm MD: 40 (min.)
Unit: N/sq. mm TD: 41 (min.)
- c) Water Vapour Transmission : Unit: g/m² 0.01 in 24 hrs. at 38 deg C & 90% RH(max)
- d) Oxygen Transmission : Unit: cm³/m² 0.02 in 24 hrs. at 38 deg C & 90% RH (max)
- e) Sealing Temp. : Unit : Degree C 180-220 deg C

9 MARKING ON PACKING BOX

Mark the following information on the two adjacent sides of the each package.

- a) Box No.
- b) Customer PO
- c) Product Name.
- d) Project Name
- e) Quantity
- f) Storage Requirement : Indoor
- g) Net weight (in kg)
- h) Dimension (L x W x H in centimetres)
- i) Consignee
- j) Water proofing (Umbrella Stencilling)
- k) Upside direction
- l) Sling position indicator

CORPORATE STANDARD**Figure 1****Figure 2****Figure 3****Figure 4****Figure 5**

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-445-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-VI	
		REV 00	DATE: Mar.21
		SHEET: 1 OF 2	

ANNEXURE-VI

LIST OF OPERATIONAL SPARES

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-445-555-A001	
		VOLUME : II B	
		SECTION : E / ANNEXURE-VI	
		REV 00	DATE: Mar.21
		SHEET: 2 OF 2	

LIST OF OPERATIONAL SPARES

Sl.no	Description	Qty. (Each compressor)			Unit	Qty. for 2 nos. Compress ors
		Initial fill (at vendor works)	Intervening Period	During PG Test		
1	Lube oil	Included	NA	1	Lot / Compressor	2
2	Lube oil filters with seals	Included	1	1	Sets / Compressor	4
3	Air filters with gaskets (as applicable)	Included	1	1	Sets / Compressor / Dryer	4
4	Service kit including seals, washers and rings for intercooler (as applicable)	NA	NA	1	Sets / Compressor / Dryer	2
5	Service kit including seals, washers and rings for after cooler (as applicable)	NA	NA	1	Sets / Compressor / Dryer	2

1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5

TECHNICAL SPECIFICATION

FOR

COMPRESSED AIR SYSTEM

VOLUME-III

(TECHNICAL SCHEDULES)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

	1 x 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : III	
		SECTION : 1	
		REV: 00	DATE: Mar.21
		SHEET 1 OF 1	

VOLUME: III
SECTION: 1

**LIST OF DOCUMENTS TO BE SUBMITTED
WITH BID**

266568/2021/PS-PEM-MAX



**1 X 660MW SAGARDIGHI TPS EXTN.
UNIT#5**

COMPRESSED AIR SYSTEM

SPEC. NO.: PE-TS-445-555-A001

VOLUME: III

SECTION: 1

REV. NO. 0 DATE: Mar.20

SHEET 1 OF 1

**CHECK LIST FOR LIST OF DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH
THE BID**

SI No.	Item Description	Yes/No
1	Schedules to be submitted dully filled up with bidder's signature and stamp. 1) Technical Deviation Schedule, if any. 2) Filled, Signed & Stamped copy of Guaranteed Power Consumption for Compressed Air System. 3) Compliance cum Confirmation certificate.	
2	Resolution to pre-bid clarifications, if any, duly stamped and signed by the bidder enclosed with the bid	
3	Un-priced bid- clearly indicating 'QUOTED' and 'NOT-QUOTED' against each item.	
4	Signed & stamped copy of Electrical feeder list attached with specification.	
5	Supporting Documents meeting PQR requirements	

Name: _____

Signature: _____

Designation: _____

Company: _____

Date: _____

Bidder Stamp

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : III	
		SECTION : 2	
		REV: 00	DATE: Mar.21
		SHEET 1 OF 1	

VOLUME-III
SECTION 2
COMPLIANCE CUM CONFIRMATION CERTIFICATE

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5	SPEC. NO.: PE-TS-445-555-A001
		VOLUME: III
		SECTION: 2
		REV. NO. 0 DATE: Mar.21
		SHEET 1 OF 2

COMPRESSED AIR SYSTEM

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions other than those mentioned under "exclusion" and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'.
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ NTPC approval & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ NTPC approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ NTPC decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ NTPC approval in the event of order.
- h) Guarantee for plant/equipment as applicable, shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to NTPC comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL / NTPC office for across the table resolution of issues and to get documents approved in the stipulated time.

266568/2021/PS-PEM-MAX



**1 X 660MW SAGARDIGHI TPS EXTN.
UNIT#5**

COMPRESSED AIR SYSTEM

SPEC. NO.: PE-TS-445-555-A001

VOLUME: III

SECTION: 2

REV. NO. 0 DATE: Mar.21

SHEET 2 OF 2

- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

	1 X 660 MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION No: PE-TS-445-555-A001	
		VOLUME: III	
		SECTION : 3	
		REV. 00	DATE: Mar.21
		SHEET 1	OF 1

VOLUME: III
SECTION: 3
PRE-BID CLARIFICATION SCHEDULE



1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-445-555-A001

VOLUME: III

SECTION: 3

REV 00

DATE: Mar.21

SHEET: 1 OF 1

PRE-BID CLARIFICATION SCHEDULE

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE : _____

NAME : _____

DESIGNATION : _____

COMPANY : _____

DATE : _____

COMPANY SEAL

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : III	
		SECTION : 4	
		REV: 00	DATE: Mar.21
		SHEET 1 OF 1	

VOLUME-III
SECTION 4
ELECTRICAL LOAD DATA

266568/2021/PS-PEM-MAX

RANGE BOUND ELECTRICAL LOAD LIST FOR COMPRESSED AIR SYSTEM

LOAD TITLE	RATING (KW)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE (KW)	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOS				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Instrument Air Compressor Motor	345		S	1	0	D	U		C		Compressor House							
Service Air Compressor Motor	345		S	1	0	D	U		C		Compressor House							
Instrument Air Compressor Oil pump / cubicle fan (if applicable)	2 – 3.5		S	1	0	D	S		C		Compressor House							
Service Air Compressor Oil pump / cubicle fan (if applicable)	2 – 3.5		S	1	0	D	S		C		Compressor House							
Instrument Compressor Control Panel	0.5-1.5		S	1	0	E	S		C		Compressor House						UPS grade supply by C&I	
Service Compressor Control Panel	0.5-1.5		S	1	0	E	S		C		Compressor House						UPS grade supply by C&I	
Energy Saver/ Sequential Panel	1-1.5		S	2	0	E	S		C		Compressor House						UPS grade supply by C&I	
Air Dryer Panel	0.12		S	2	0	E	S		C		Compressor House							
AUTO DRAIN TRAP	0.3		S	7	0	E	S		I		2 nos. feeder for air receivers outside compressor house.							

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
 2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
 : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)

LOAD DATA
(ELECTRICAL)

JOB NO.	481	ORIGINATING AGENCY		PEM (ELECTRICAL)	
PROJECT TITLE	SAGARDIGHI TPS -1 X 660 MW	NAME	SAYAN ROY	DATA FILLED UP ON	
SYSTEM	COMPRESSED AIR SYSTEM	SIGN.	-sd-	DATA ENTERED ON	
DEPTT. / SECTION	MAUX / PF	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	Page 488

	1 X 660MW SAGARDIGHI TPS EXTN. UNIT#5 COMPRESSED AIR SYSTEM	SPECIFICATION NO. PE-TS-445-555-A001	
		VOLUME : III	
		SECTION : 5	
		REV: 00	DATE: Mar.21
		SHEET 1 OF 2	

VOLUME-III
SECTION 5
LIST OF DRAWINGS



**1 X 660MW SAGARDIGHI TPS EXTN.
UNIT#5**

COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-445-555-A001

VOLUME : III

SECTION : 5

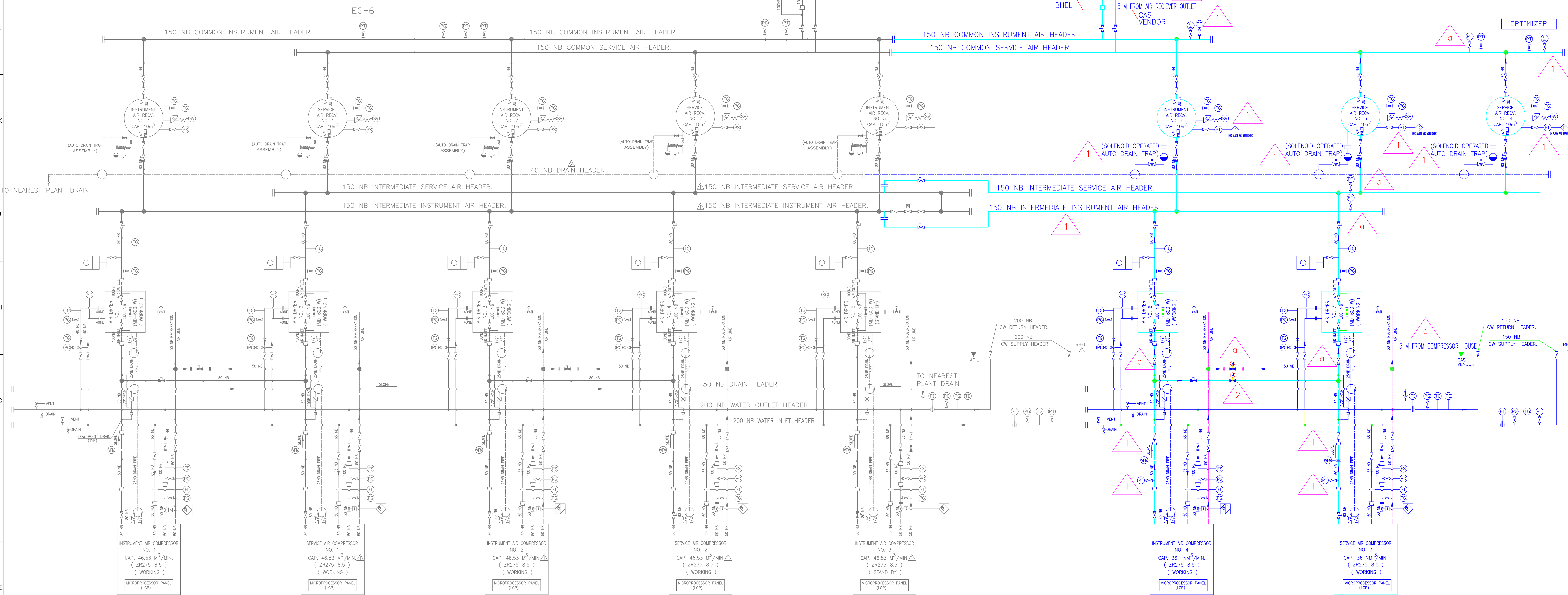
REV: 00

DATE: Mar.21

SHEET 2 OF 2

SL.NO	DESCRIPTION	DOCUMENT NUMBER
1	P&ID FOR COMPRESSED AIR SYSTEM	PE-DG-445-555-A005
2	COMPRESSOR HOUSE LAYOUT	PE-V0-373-555-A001
3	DATASHEET OF COMPRESSOR	PE-V0-373-555-A007
4	GA DRAWING OF ZR275 AIR COMPRESSOR	PE-V0-373-555-A004
5	P&I DIA. FOR ZR275 AIR COMPRESSOR	PE-V0-373-555-A005
6	QAP OF COMPRESSOR	PE-V0-373-555-Q001
7	GA DRAWING OF MOTOR	PE-V0-373-555-A013
8	TDS & CURVES OF MOTOR	PE-V0-373-555-A014
9	QAP OF MOTOR	PE-V0-373-555-Q004
10	GA DRAWING OF MD 600 (W) AIR DRYER	PE-V0-373-555-A008
11	P&I DIAGRAM OF MD 600 (W) AIR DRYER	PE-V0-373-555-A009
12	DATASHEET OF AIR DRYER	PE-V0-373-555-A010
13	QAP OF AIR DRYER MD 600	PE-V0-373-555-Q002
14	SYSTEM ARCHITECHTURE OF COMPRESSED AIR SYSTEM	PE-DG-445-555-A006

NOTE: THE DETAILES INDICATED IN THE DOCUMENT ARE FOR TENDER PURPOSE ONLY. THE EQUIPMENTS/INST./PIPE SIZES AND VALVES ETC. SHOWN IN THIS DOCUMENT ARE MINIMUM REQUIREMENT.



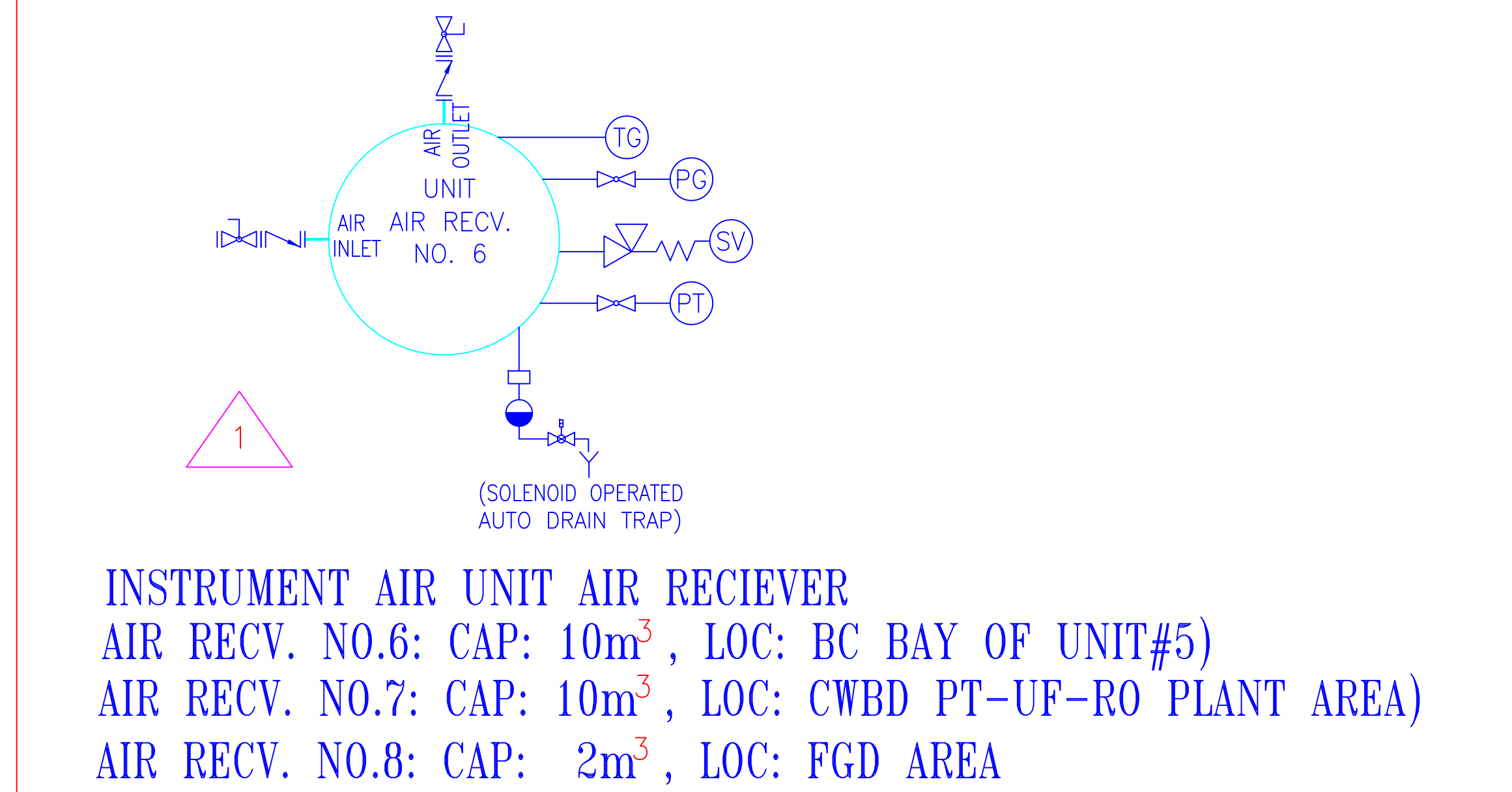
PHASE-II

PHASE-III, SAGARDIGHI UNIT#5

SYMBOL	T.NAME	DESCRIPTION	SYMBOL	T.NAME	DESCRIPTION	SYMBOL	T.NAME	DESCRIPTION
	PG	PRESSURE GAUGE.		--	NON RETURN VALVE		--	FLOAT TYPE DRAIN TRAP
	TG	TEMPERATURE GAUGE.		VFM	VERTEX FLOW METER		--	ISOLATION VALVE (GATE TYPE)
	SG	SIGHT GLASS		--	2 WAY NEEDLE VALVE (OPEN)		--	FLOW CONTROL VALVE (MANUALLY OPERATED)
	FI	FLOW INDICATOR		--	RELIFE/SAFETY VALVE (OPEN)		--	MOTORIZED VALVE
	FS	FLOW SWITCH		--	BALL VALVE		--	VORTEX FLOW METER
	DPT	DEW POINT TRANSMITTER.		--	BUTTERFLY VALVE			
	PT	PRESSURE TRANSMITTER.		SOV	SOLENOID OPERATED VALVE			

NOTES :-

- 1.) ALL INTERCONNECTING COMPRESSED AIR & WATER PIPING SHALL BE STAINLESS STEEL AS PER ASTM-A312 Gr. 304 & CONFORM AS PER ANSI B36.19, SCH 40S FOR SIZE UPTO 50 NB & SCH. 10S FOR 65 NB & ABOVE.
- 2.) FITTINGS FOR AIR & WATER PIPING SHALL BE STAINLESS STEEL AS PER ASTM-A182 F304.
- 3.) COMPRESSED AIR PIPING HANDLING HOT AIR SHALL BE SUITABLY INSULATED.
- 4.) ALL COMPRESSED AIR LINE AND WATER LINE VALVES SHALL BE SS BALL TYPE.
- 5.) VALVES UP TO 50 NB SHALL HAVE THREADED ENDS & VALVES ABOVE 50 NB SHALL HAVE FLANGED ENDS.
- 6.) SCREWED PIPE JOINT CONNECTIONS SHALL BE SEAL WELDED TO AVOID LEAKAGE.
- 7.) INSTRUMENTS ON AIR RECEIVER SHALL BE MOUNTED LOCALLY AT ACCESSIBLE ELEVATION.
- 8.) ALL SS BALL VALVES UP TO 50 NB SHALL HAVE THREADED ENDS & ABOVE 50 NB SHALL HAVE FLANGED ENDS.



CUSTOMER:		THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.(WBPDCL)	
CONSULTANT:		DEVELOPMENT CONSULTANTS PRIVATE LIMITED KOLKATA	
JOB NO.		445	
STATUS		CONTRACT	
DISTRIBUTION			
TITLE		P&I DIAGRAM FOR COMPRESSED AIR SYSTEM	
DEPT.		POWER SECTOR	
SHEET		01	
DATE		18.01.2021	

2X500 MW SAGARDIGHI TPP PHASE 2.**COMPRESSED AIR SYSTEM**

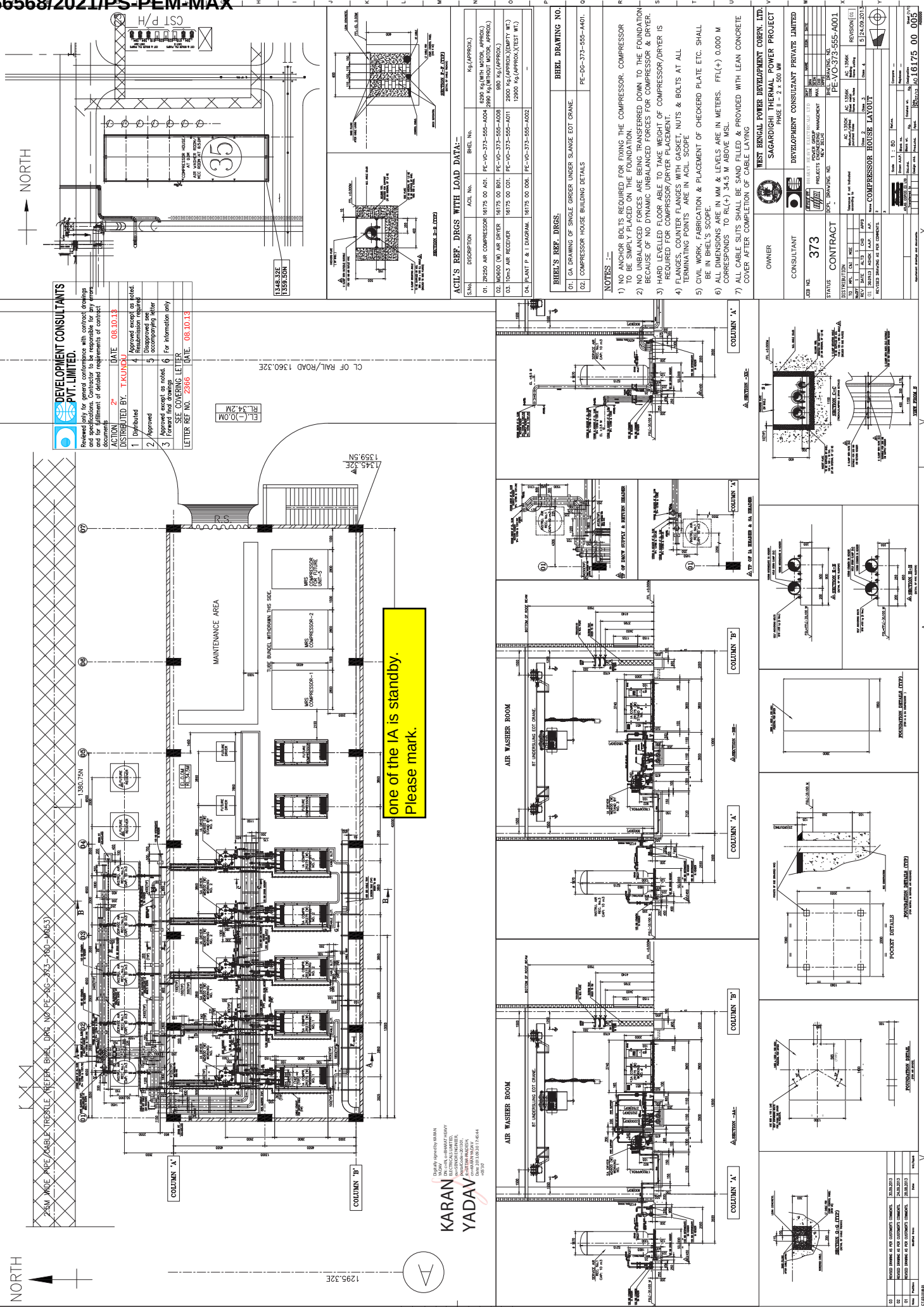
Reference: DCPL transmittal no. DCPL-K8A07/DCH-4/BHLPEM/2185 Dated 14.08.2013

Reply/Compliance to DCPL comments on Compressor House Layout (Rev 00)**Doc. No.: PE-VO-373-555-A001.**

S.No.	DCPL Comment	BHEL / ACIL Reply
1	Piping from Air Receivers to adjacent Pipe rack shall be shown.	Piping from air receiver to adjacent pipe rack shall be site routed as per site conditions. However terminal points between CAS supplier (ACIL) and BHEL has been marked in line with Drg no. PE-DG-373-100-M053, Titled "Yard piping layout".
2	Please show Air Receivers for future unit as per BHEL dwg. no. PE-DG-373-555-A401/Rev 01.	Noted and incorporated.
3	Please show the Key Plan locating two Air Receivers(10 cub. metre each) adjacent to the BC bay.	As the document title is Compressor house layout, unit air receivers are not shown in this drawing. For location of unit air receivers drg no PE-DG-373-100-M003 Titled "TG equipment layout plan at 0.0m" shall be referred.
4	WORKING, as per BHEL doc. no. PE-DC-373-555-A001/Rev 03	Noted and incorporated.
5	Electrical/MCC room shall be shown.	As per drawing no PE-DG-373-100-E003, Rev 05 Titled "LV switchgear room layout at EL 12.0m" Electrical / MCC panels are shifted at TG Hall 12.0 m elevation. As such MCC room is removed.
6	Relative positions of IA & SA Compressors shall be checked with BHEL(PEM) drawing no. PE-DG-373-555-A401/Rev 01.	Noted and Relative positions of IA & SA Compressors maintained as per BHEL(PEM) drawing no. PE-DG-373-555-A401/Rev 01.
7	Side wall view along column A & B shall be provided showing the provision of supply air fans / louver for entry of outside air for compressor suction.	As BHEL standard practice, fans are not shown in this drawing. A separate drawing titled, "Ventilation arrangement for various auxiliary buildings" shall be submitted.
8	Pipe material shall be Stainless Steel . Clamps and structural supports contact with SS shall be preferably GI material.	Noted and incorporated.

NOTE:

- 1 In rev 0 of compressor house layout, Air receivers were shown with air inlet and outlet on the same side, however we are revising the GA of air receivers and putting inlet and out let on opposite site for better erection of system. Reveised GA drawings of air receivers shall be submitted for approval soon.



2X500 MW SAGARDIGHI TPP PHASE 2.

COMPRESSED AIR SYSTEM

Reference: DCPL transmittal no. DCPL-K8A07/DCH-4/BHLP/1991 Dated 28.06.2013

Reply/Compliance to DCPL comments on TDS of Compressor (Rev 00)

Doc. No.: PE-VO-373-555-A007.

S.No.	DCPL Comment	BHEL / ACIL Reply
1	Before forwarding this document to DCPL for review / approval purpose, BHEL shall check providing their approval stamp.	Noted and incorporated.
2	As per approved DBR, clause no. 2.1.1, all service air compressors are working. No one is standby.	Noted and incorporated.
3	Please furnish calculation for KW rating of drive motor.	KW input required to compressor shaft is 291 KW; motor is selected 15% higher than this. i.e. $291 \times 1.15 = 334.65$ KW So Selected motor is 345 KW.
4	Please confirm whether Cast –Iron is coated with corrosion resistant material.	Confirmed, same is coated & baked for corrosion resistant.
5	As per tender Spec. Rotor & shaft shall be single piece construction.	Yes, Rotor & Rotor Shaft is single pieced construction, in TDS it is shown as Rotor only. (TDS Sr. No. 4.02.00) And Drive Shaft mentioned in TDS is Main Drive Shaft to couple with Motor. (TDS Sr. No. 4.06.00)
6	As per tender spec. cooling water inlet temperature subject to a maximum of 39 Deg. Celsius.	Noted and incorporated.

**KARAN
YADAV**

Digitally signed by KARAN YADAV
DN: c=IN, o=BHARAT HEAVY
ELECTRICALS LIMITED, ou=SENIOR
ENGINEER, postalCode=201301,
st=UTTAR PRADESH, cn=KARAN
YADAV

Date: 2013.08.08 12:42:28 +05'30'

	SAGARDIGHI EXTENSION TPP (2 X 500 MW)		BHEL Doc No: PE-VO-373-555-A007																														
			REV	01																													
			DATE	24.07.2013																													
			SHEET 1 OF 5																														
 Digitally signed by KARAN YADAV DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=SENIOR ENGINEER, postalCode=201301, st=UTTAR PRADESH, cn=KARAN YADAV Date: 2013.08.08 12:44:31 +05'30'  DEVELOPMENT CONSULTANTS PVT. LIMITED. Reviewed only for general conformance with contract drawings and specifications. Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents <table border="1" style="width: 100%;"> <tr> <td>ACTION</td> <td>2</td> <td>DATE</td> <td>13.08.13</td> </tr> <tr> <td colspan="4">DISTRIBUTED BY: T.KUNDU</td> </tr> <tr> <td>1</td> <td>Distributed</td> <td>4</td> <td>Approved except as noted. Resubmission required</td> </tr> <tr> <td>2</td> <td>Approved</td> <td>5</td> <td>Disapproved see accompanying letter</td> </tr> <tr> <td>3</td> <td>Approved except as noted. Forward final drawings</td> <td>6</td> <td>For information only</td> </tr> <tr> <td colspan="4">SEE COVERING LETTER</td> </tr> <tr> <td colspan="2">LETTER REF NO. 2169</td> <td colspan="2">DATE. 13.08.13</td> </tr> </table>						ACTION	2	DATE	13.08.13	DISTRIBUTED BY: T.KUNDU				1	Distributed	4	Approved except as noted. Resubmission required	2	Approved	5	Disapproved see accompanying letter	3	Approved except as noted. Forward final drawings	6	For information only	SEE COVERING LETTER				LETTER REF NO. 2169		DATE. 13.08.13	
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24.07.2013	01	Submitted for Approval																															
30.04.2013	00	Submitted for Approval																															
Date	Rev	Description of Revision	ALT	CHD	APPD																												
		CUSTOMER : WB POWER DEVELOPMENT CORPN. LTD. SAGARDIGHI TPP PHASE 2 (2X500 MW)																															
		CUSTOMER'S CONSULTANT : DEVELOPMENT CONSULTANTS (P) LTD.																															
		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																															
		ATLAS COPCO INDIA LIMITED, PUNE																															
JOB No.	373	BHEL Doc. No: PE-VO-373-555-A007			Rev: 01																												
STATUS	CONTRACT																																
PACKAGE		COMPRESSED AIR SYSTEM																															
TITLE		Datasheet of Compressor		ACIL Doc. No : 1617500A04																													
PREPARED BY		Dnyaneshwar Mahajan	-sd-																														
CHECKED BY		Manish Gandhi	-sd-																														
APPROVED BY		Manish Gandhi	-sd-																														
																																	



2x500 MW PH II, Sagardighi, TPP
Compressed Air System

ACIL Doc No: 1617500A04

BHEL Doc No: PE-VO-373-555-A007

Clause No.	Bidder's Name	ATLAS COPCO (INDIA) LTD.	
	Air compressor		
1.00.00	General		
1.01.00	Manufacturer name	Atlas Copco (India) Ltd.	
1.02.00	Model No.	ZR 275	
1.03.00	Type of compressor	Oil Free Screw	
1.04.00	Total numbers offered	Instrument Air	Service Air
		3 Nos [2W + 1 S]	2 Nos [1W + 1 W]
1.05.00	Testing standard	ISO 1217 Annexure C, Ed 3	
2.00.00	Performance Data		
2.01.00	Capacity of each Air compressor as per design criteria specified and above requirement (Nm ³ /min)	36 NM ³ / Min	
2.02.00	Discharge pressure (kg/cm ² (g)) at rated condition at After cooler outlet.	8 kg/cm ² (g)	
2.04.00	Capacity considering design ambient condition (i.e. 45 °C and 100 % RH) m ³ /min of free air discharge (FAD) at 35 m above MSL.	46.53 m ³ /min	
2.05.00	Outlet air temperature after high pressure stage of compressor (deg. C) at design capacity	160 - 190 ° C	
2.06.00	Outlet air temperature after cooler or Plant air system (°C)	45 °C	
2.07.00	KW input required at the compressor shaft at rated condition.(BKW)	291 KW	
2.08.00	KW input required at the compressor shaft at unloaded condition	59 KW	

** All Performance figures are subject to tolerance as per ISO 1217 ed 1996

#Noise level is only for reference purpose and measured as per ISO 2151:2004 and using ISO 9614-2



2x500 MW PH II, Sagardighi, TPP
Compressed Air System

ACIL Doc No: 1617500A04

BHEL Doc No: PE-VO-373-555-A007

2.09.00	KW rating of drive motor	345 KW
2.10.00	Total cooling water requirement considering Delta T as 10°C at rated condition.	28 m3/hr
3.00.00	Construction Features	
3.01.00	Type of drive	Electric Motor
3.02.00	Number of screw and screw arrangement	2 Nos [1 male + 1 Female] / stage
3.02.01	Number of lobes in male rotor	4
3.02.02	Number of flutes in female rotor	6
3.03.00	Main bearings	Anti Friction Type
3.03.01	Make	S K F
3.03.03	Method of lubrication	Forced Feed
3.04.00	Size of connection	
3.04.01	Air Outlet	80 NB
3.04.02	Cooling water inlet	50 NB
3.04.03	Cooling water outlet	50 NB
4.00.00	Material of construction	
4.01.00	Compressor chamber casing	Cast iron (CG20)
4.02.00	Rotors	Forged Carbon Steel Teflon coated. (C35)
4.03.00	Bull gear	Low alloy steel
4.04.00	Pinion Gear	Low alloy steel
4.05.00	Timing Gears	Low alloy steel (21 Ni Cr Mo2)
4.06.00	Drive shaft	Carbon steel
4.07.00	Oil cooler [Plate type]	Stainless steel (AISI 316)
4.08.00	Inter cooler and After cooler casing	Cast Iron
4.09.00	Inter cooler and After cooler Tubes	Stainless Steel

** All Performance figures are subject to tolerance as per ISO 1217 ed 1996
 #Noise level is only for reference purpose and measured as per ISO 2151:2004 and using ISO 9614-2



2x500 MW PH II, Sagardighi, TPP
Compressed Air System

ACIL Doc No: 1617500A04

BHEL Doc No: PE-VO-373-555-A007

5.00.00	Drive Details		
5.01.00	Motor RPM full load	2984	
5.02.00	Motor rating	345 KW	
6.00.00	Weights		
6.01.00	Each comp. Assembly with Motor	7 Ton Appxo.	
6.02.00	Weight to be handled during maintenance.	Weight of Motor Apx 3.0 Ton	
7.00.00	Compressor Accessories		
7.01.01	<u>Air Intake filter type</u>	Dry type filter cartridge	
7.01.02	Number per compressor	1	
7.01.03	Filtering media	Paper	
7.01.04	Particle removing efficiency	99.9% up to particle size of 3 Micron	
7.01.05	Silencer provided	Yes	
7.02.01	<u>Heat Exchangers</u>	Inter Cooler	After Cooler
7.02.02	Nos Offered on each Air Compressor	1	1
7.02.03	Type of coolers used	Shell and tube type	Shell and tube type
7.02.04	Compressed Air inlet / Outlet Temp ° C	160-180 ° C / 48 ° C	160-190 ° C / 48 ° C
7.02.05	Cooling water inlet / Outlet Temp	39 ° C / 49 ° C	39 ° C / 49 ° C
7.02.06	Moisture trap Provided	Yes	Yes
7.03.01	<u>Oil Cooler</u>		
7.03.02	Type of cooler	Plate type heat Exchanger	
7.03.03	No of oil cooler per compressor	1	

** All Performance figures are subject to tolerance as per ISO 1217 ed 1996
 #Noise level is only for reference purpose and measured as per ISO 2151:2004 and
 using ISO 9614-2



2x500 MW PH II, Sagardighi, TPP
Compressed Air System

ACIL Doc No: 1617500A04

BHEL Doc No: PE-VO-373-555-A007

FAD CALCULATIONS

SITE CONDITION (DESIGN)

Site atmospheric pressure as provided in tender documents under climatological table

$$(P_s) \text{ at } 35.00 \text{ m MSL} = 1.009 \text{ bar (A)}$$

$$RH = 100 \%$$

$$\text{Design Ambient Temperature [} T_s] = 45^\circ \text{ C} = 318^\circ \text{ K}$$

$$P_{vs} \text{ at } 45^\circ \text{ C} = 95.86 \text{ m bar} = 0.09586 \text{ bar}$$

$$\text{Compressor capacity (} V_s) = ?$$

NORMAL CONDITIONS

$$\text{Pressure (} P_n) = 1.013 \text{ bar (A)}$$

$$\text{Temperature (} T_n) = 273^\circ \text{ K}$$

$$\text{Relative humidity} = 0\%$$

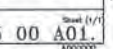
$$\text{Compressor capacity (} V_n) = 36 \text{ Nm}^3 / \text{min}$$

$$\frac{P_n V_n}{T_n} = \frac{(P_s - RH\% \times P_{V_s}) V_s}{T_s}$$

$$\frac{1.013 \times 36}{273} = \frac{(1.009 - [1.0 \times 0.09586]) \times V_s}{318}$$

$$V_s = 46.52 \text{ m}^3/\text{min}$$

** All Performance figures are subject to tolerance as per ISO 1217 ed 1996
 #Noise level is only for reference purpose and measured as per ISO 2151:2004 and using ISO 9614-2

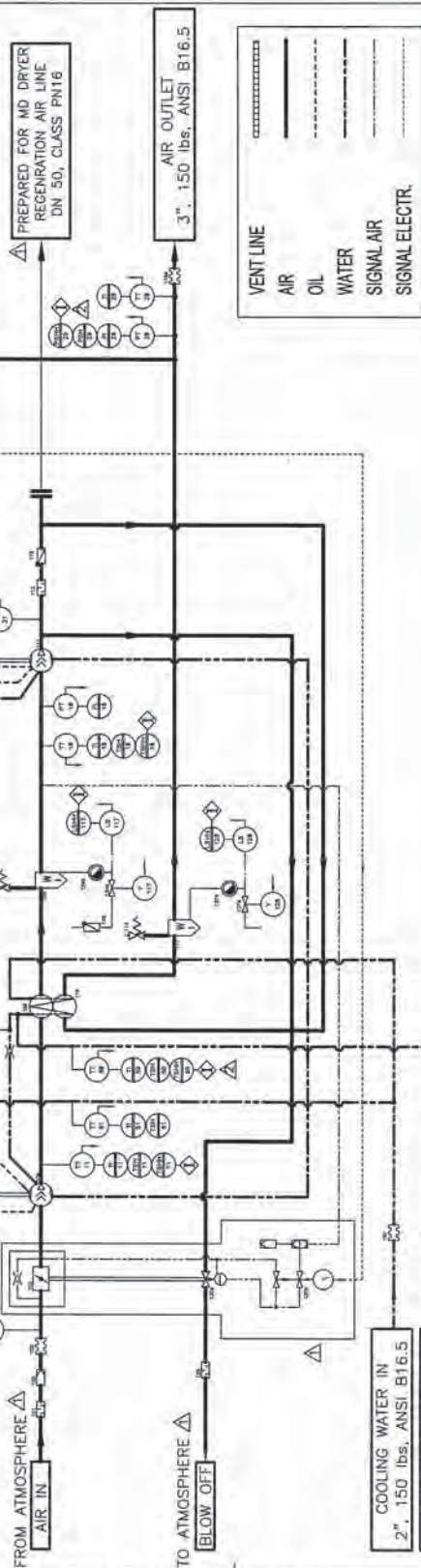
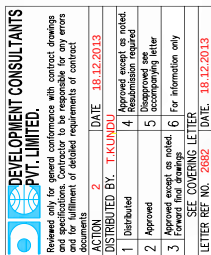


2x500 MW SAGARDIGHI PHASE II - CAS**BHEL / ACIL's Reply to DCPLComments**

Sr. No.	DWG/DOC.NO.	REV	TITLE	REMARKS
A	PE-VO-373-555-A005	01	P&ID of Air Compressor	Approved in code 3

Sr. No.	DCPL Comments	BHEL / ACIL Reply
1	1) Vibration Monitoring probe shall provided for both Driven & Drive equipment [i.e, Compressor & Motor]. 2) Monitoring system is required and hence supply is must. BHEL-PEM to clearly specify where it shall be monitored. 3) We are yet to receive the revised Control Panel wiring diagram which was earlier commented. noted	1&2) Vibration Monitoring probes for screw compressor not required for ACIL standard screw machines. ACIL recommendation is also attached. Please accept. 3) Revised Control panel wiring diagram shall be send shortly.
2	NOTED but indicate the same in the PID. (Condensate drain from inter cooler lead to drain header outside of compressor)	For the same refer compressor house P&ID noted (Doc No: PE-V0-373-555-A002)
3	Please clarify whether the Temperature sensor used is RTD or thermocouple?	As per ACIL standard these are – RTD. noted
4	Please clarify the type of instrument used for indicating service life of oil filter. noted	It is basically display only & timer base logic in built to indicate about change the oil after certain period.
5	Please indicate "I-Interlock" as indicated for ESHH-91.	Noted & Incorporated. noted
6	Please clarify the type of instrument used.(typical)	It is basically display only & timer base logic in built to indicate about change the greasing after certain period. noted
7	1. Please indicate PSH instead of PSR. 2. Please provide PSHH with interlock to trip the compressor on " High-High Compressor outlet pressure"	Noted & Incorporated. noted
8	Please indicate "I-Interlock" for TSHH-59.	Noted & Incorporated. noted

9	Please clarify the type of temperature sensor/transducer used.	Temperature Transducer. noted
10	Please indicate the type of level indicator.	Sight Glass type. noted
11	1. Root valves shall be applicable for all Pressure and differential pressure instruments. 2. Thermowells shall be applicable for all Temperature instruments.	Noted. noted



INSTRUMENT'S ACT TAG	DESCRIPTION	INSTRUMENT'S ACT TAG	DESCRIPTION	INSTRUMENT'S ACT TAG	DESCRIPTION
TI 11	TEMPERATURE SENSORS :	LS 117	LEVEL SWITCH FOR CONDENSATE DRAIN AT INTERCOOLER OUTLET.	PSL 02	LOW AIR FILTER VACUUM WARNING-INDICATION.
TI 18	AIR TEMP. AT COMPRESSOR STAGE 1 AIR OUTLET.	LS 128	TEMPERATURE DISPLAYS :	PSH 28	HIGH COMPRESSOR AIR OUTLET PRESSURE WARNING-INDICATION.
TI 21	AIR TEMP. AT COMPRESSOR STAGE 2 AIR INLET.			PSL 45	LOW OIL PRESSURE AT OIL FILTER OUTLET WARNING-INDICATION.
TI 29	AIR TEMP. AT COMPRESSOR STAGE 2 AIR OUTLET.	TI 11	AIR TEMP. DISPLAY AT COMPRESSOR STAGE 1 AIR OUTLET.	TSI 11	HIGH AIR TEMP. AT COMP. STAGES OUTLET WARNING-INDIC.
TI 41	AIR TEMP. AT COMPRESSOR AIR OUTLET.	TI 19	AIR TEMP. DISPLAY AT COMPRESSOR STAGE 2 AIR INLET.	TSI 18	HIGH AIR TEMP. AT COMP. STAGES INTLET WARNING-INDIC.
TI 44	OIL TEMPERATURE AT OIL COOLER OUTLET.	TI 21	AIR TEMP. DISPLAY AT COMPRESSOR STAGE 2 AIR OUTLET.	TSI 21	HIGH AIR TEMP. AT COMP. STAGES OUTLET WARNING-INDIC.
TI 51	WATER TEMP. AT COOLING WATER INLET.	TI 29	AIR TEMP. DISPLAY AT COMPRESSOR AIR OUTLET.	TSI 44	HIGH OIL TEMPERATURE AT OIL COOLER OUTLET WARNING-INDIC.
TI 58	WATER TEMP. AT COOLING WATER COMP. STAGE 1 OUTLET.	TI 44	OIL TEMP. DISPLAY AT OIL COOLER OUTLET.	TSI 51	HIGH WATER TEMP. AT C/W INLET - WARNING INDICATION.
TI 59	WATER TEMP. AT COOLING WATER OUTLET	TI 51	WATER TEMP. DISPLAY AT COOLING WATER INLET.	TSI 59	HIGH WATER TEMP. AT C/W OUTLET - WARNING INDICATION.
	PRESSURE TRANSDUCERS :	TI 58	WATER TEMP. DISPLAY AT COOLING WATER COMP. STAGE 1 OUTLET		TRIP / SHUT DOWN :
POT 02	DP AIR FILTER PRESSURE TRANSDUCER.	TI 59	WATER TEMP. DISPLAY AT COOLING WATER OUTLET.	ESM 81	DRIVE MOTOR OVER LOAD RELAY-SHUT-DOWN.
PI 18	PRESSURE TRANSDUCER AT INTERCOOLER OUTLET.		PRESSURE DISPLAYS :	TSI 11	HIGH AIR TEMP. AT COMP. STAGE 1 OUTLET-SHUT-DOWN.
PI 29	PRESSURE TRANSDUCER AT COMPRESSOR AIR OUTLET	PDI 02	DP AIR FILTER VACUUM DISPLAY	TSI 18	HIGH AIR TEMP. AT COMP. STAGE 2 INLET-SHUT-DOWN.
PI 45	OIL INJECTION PRESSURE TRANSDUCER AT OIL FILTER OUTLET.	PI 16	PRESSURE DISPLAY AT INTERCOOLER OUTLET.	TSI 21	HIGH AIR TEMP. AT COMP. STAGE 2 OUTLET-SHUT-DOWN.
	LEVEL INSTRUMENTS :	PI 29	PRESSURE DISPLAY AT COMPRESSOR AIR OUTLET	TSI 44	HIGH OIL TEMP. AT OIL COOLER OUTLET-SHUT-DOWN.
		PI 45	OIL INJECTION PRESSURE DISPLAY AT OIL FILTER OUTLET.	PSH 29	HIGH WATER TEMP. AT WATER OUTLET-SHUT-DOWN.
			ALARM :	PSH 45	HIGH COMPRESSOR AIR OUTLET PRESSURE-SHUT-DOWN.
LI 41	OIL LEVEL INDICATOR.			PSL 02	LOW OIL PRESSURE AT OIL FILTER OUTLET-SHUT-DOWN.
VI	SOLENOID VALVE.	KSH48	HIGH SERVICE LIFE OF OIL FILTER-WARNING-INDICATION.	LSM 117	HIGH LEVEL CONDENSATE DRAIN SHUT-DOWN INDICATION AT INTERCOOLER OUTLET.
VI17	SOL. VALVE AT INTERCOOLER OUTLET DRAIN COLLECTOR.	KSH48	HIGH SERVICE LIFE OIL-WARNING-INDICATION.	LSM 128	HIGH LEVEL CONDENSATE DRAIN SHUT-DOWN INDICATION AT AFTERCOOLER OUTLET.
VI28	SOL VALVE AT AFTERCOOLER OUTLET DRAIN COLLECTOR.	KSH93	HIGH SERVICE LIFE OF DRIVE MOTOR REGRESSING-WARNING-INDIC.		

OWNER	CONSULTANT		WEST BENGAL POWER ELECTRICALS CORPN. LTD. SAGARDIGHI THERMAL POWER PROJECT PHASE II - 2 x 500 MW			
			DEVELOPMENT CONSULTANT PRIVATE LIMITED			
JOB NO.	373		BHARAT HEAVY ELECTRICALS LTD. POWER GROUP MANAGEMENT PROJECT B - NEW BELUR			
			DCP DRAWING NO.			
STATUS	CONTRACT	PE-30-373-555-A005				
DISTRIBUTION						
TO	WKS.	CM	ME			
REV	DATE	ALT	CHG	APPR		
-	-	-	-	-		
				AG 1350K Standard Motor Protected Motor		
		Class 2		Class 3		
				Class 4		
				Revision [02] 3 19.11.2013.		
						
				Scale 1 : 1 Ratio 1:1 Ratio 1:1 Ratio 1:1		
				Ratio 1:1 Ratio 1:1 Ratio 1:1		
				Ratio 1:1 Ratio 1:1 Ratio 1:1		
				Ratio 1:1 Ratio 1:1 Ratio 1:1		
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266568/2021/PS-PEM-MAX

Atlas Copco

Our ref: BHEL/SAGARDIGHI/01

Dt.29.11.2013

Bharat Heavy Electricals Limited
Power Sector – Project Engineering Management,
PPEI Building, HRD & ESI Complex,
Plot no. 25, Sec.16A
Noida – 201301(UP)

Kind Attention: Mr. Karan Yadav
MAUX / PEM - BHEL

Dear Sirs,

Subject: Compressed Air System for Sagardighi TPP (2x500MW)Tender Ref: PSER: SCT: SDG-M1396:13: PO: 3400 Dated 24-08-2013

This has reference to above mentioned PO; we are pleased to confirm you as under –

We would like to inform you that Atlas Copco screw air compressor does not need any vibration monitoring system. We do not recommend the same as not required.

We trust that above information in line with your requirement and clarify the point.

Yours faithfully
For Atlas Copco (I) Ltd.

Dnyaneshwar Mahajan
Senior Project Engineer

Atlas Copco Compressor Sales

A Division of Atlas Copco (India) Ltd.

Address:
Sveanagar, Dapodi
Pune Mumbai Road,
Pune – 411 012

Website: www.atlascopco.com

2X500 MW SAGARDIGHI TPP PHASE 2.
COMPRESSED AIR SYSTEM
Reference: DCPL transmittal no. DCPL-K8A07/DCH-4/BHLPEM/2169 Dated 13.08.2013
Reply/Compliance to DCPL comments on QAP of compressor (Rev 01)
Doc. No.: PE-VO-373-555-Q001.

S.No.	DCPL Comment	BHEL / ACIL Reply
1	Pls put 1,2 in all boxes under W column for inprocess inspection.	Please note that all the components listed at inprocess inspection are imported from ACIL Belgium or other worldwide ACIL factory, only Final Assembly is being done in ACIL, Pune. So ACIL is not able to offer witness to any in Process inspection, however final Inspection performance test shall offer for witness to BHEL & WBPDCCL.

	SAGARDIGHI EXTENSION TPP (2 X 500 MW)		BHEL Doc No: PE-VO-373-555-Q001																															
			REV	02																														
			DATE	23.07.2013																														
			SHEET 1 OF 5																															
 Digitally signed by KARAN YADAV DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=SENIOR ENGINEER, postalCode=201301, st=UTTAR PRADESH, cn=KARAN YADAV Date: 2013.10.05 17:26:17 +05'30'  DEVELOPMENT CONSULTANTS PVT. LIMITED. Reviewed only for general conformance with contract drawings and specifications. Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents <table border="1" style="width: 100%;"> <tr> <td>ACTION</td> <td>2</td> <td>DATE</td> <td>16.10.13</td> </tr> <tr> <td colspan="4">DISTRIBUTED BY. T.KUNDU</td> </tr> <tr> <td>1</td> <td>Distributed</td> <td>4</td> <td>Approved except as noted. Resubmission required</td> </tr> <tr> <td>2</td> <td>Approved</td> <td>5</td> <td>Disapproved see accompanying letter</td> </tr> <tr> <td>3</td> <td>Approved except as noted. Forward final drawings</td> <td>6</td> <td>For information only</td> </tr> <tr> <td colspan="4" style="text-align: center;">SEE COVERING LETTER</td> </tr> <tr> <td>LETTER REF NO.</td> <td>2387</td> <td>DATE.</td> <td>16.10.13</td> </tr> </table>							ACTION	2	DATE	16.10.13	DISTRIBUTED BY. T.KUNDU				1	Distributed	4	Approved except as noted. Resubmission required	2	Approved	5	Disapproved see accompanying letter	3	Approved except as noted. Forward final drawings	6	For information only	SEE COVERING LETTER				LETTER REF NO.	2387	DATE.	16.10.13
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	02	Submitted for Approval																																
Date	Rev	Description of Revision	ALT	CHD	APPD																													
		CUSTOMER : WB POWER DEVELOPMENT CORPN. LTD. SAGARDIGHI TPP PHASE 2 (2X500 MW)																																
		CUSTOMER'S CONSULTANT : DEVELOPMENT CONSULTANTS (P) LTD.																																
		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																																
		ATLAS COPCO INDIA LIMITED, PUNE																																
JOB No.	373	BHEL Doc. No: PE-VO-373-555-Q001			Rev: 02																													
STATUS	CONTRACT																																	
PACKAGE		COMPRESSED AIR SYSTEM																																
TITLE		QAP of Compressor		ACIL Doc. No : 16175 00 A05																														
PREPARED BY	Dnyaneshwar Mahajan	-sd-																																
CHECKED BY	Manish Gandhi	-sd-																																
APPROVED BY	Manish Gandhi	-sd-																																

MANUFACTURER'S NAME & ADDRESS			MANUFACTURING QUALITY PLAN					PROJECT								
 ATLAS COPCO AIRPOWER N.V, BELGIUM ATLAS COPCO INDIA LTD.			ITEM: OIL FREE SCREW AIR COMPRESSOR MODEL ZR 275 SUB SYSTEM COMPRESSED AIR SYSTEM.		QP NO. : 16175 00 A05. BHEL DOC NO : PE-VO-373-555-Q001 Rev: 02 DATE : 23.07.2013		CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD. CONSULTANT: DEVELOPMENT CONSULTANTS (P) LTD.									
			TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE	FORMAT OF RECORD	AGENCY**			REMARKS					
			3	4	5	6	7	8	9	D*		10	11			
			CHARACTERISTICS	CLASS												
Sr. NO.	COMPONENTS AND OPERATORS	2														
A MATERIAL INSPECTION																
1.1	ROTOR		MATERIAL CHECK	MAJOR	MECH. TEST CHEM.ANALYSIS	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERTF.	✓	3	1,2				
1.2	COMPRESSOR CASING / ROTOR HOUSING		MATERIAL CHECK	MAJOR	MECH. TEST CHEM.ANALYSIS	1/BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERTF.	✓	3	1,2				
1.3	BULL GEAR		MATERIAL CHECK	MAJOR	MECH. TEST CHEM.ANALYSIS	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERTF.	✓	3	1,2				
1.4	PINION		MATERIAL CHECK	MAJOR	MECH. TEST CHEM.ANALYSIS	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERTF.	✓	3	1,2				
MANUFACTURER SUBCONTRACTOR			CONTACTOR		LEGEND : 3 - MANUFACTURER / SUBCONTRACTOR 2 - WBPDCL 1 - BHEL				FOR CUSTOMER USE					NAME & SIGN OF APPROVING AUTHORITY		
			SIGNATURE											PAGE 1 OF 4		

MANUFACTURER'S NAME & ADDRESS			MANUFACTURING QUALITY PLAN				PROJECT					
ATLAS COPCO AIRPOWER N.V. BELGIUM ATLAS COPCO INDIA LTD.			ITEM: OIL FREE SCREW AIR COMPRESSOR MODEL ZR 275 SUB SYSTEM COMPRESSED AIR SYSTEM. DATE: 23.07.2013				SAGARDIGHT TPP PHASE - II (2 X 500 MW) CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD. CONSULTANT: DEVELOPMENT CONSULTANTS (P) LTD.					
Sr. No.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE	FORMAT OF RECORD	AGENCY**			REMARKS
									P	W	V	
1	1.5 DRIVE SHAFT	MATERIAL CHECK	MAJOR	MECH. TEST CHEM. ANALYSIS	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERT.	3			11
1.6	INTERCOOLER TUBES	MATERIAL CHECK	MAJOR	CHEM. ANALYSIS TENSILE STRENGTH	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERT.	3			
1.7	INTERCOOLER SHELL	MATERIAL CHECK	MAJOR	CHEM. ANALYSIS TENSILE STRENGTH	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERT.	3			
1.8	AFTER COOLER TUBE	MATERIAL CHECK	MAJOR	CHEM. ANALYSIS TENSILE STRENGTH	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERT.	3			
1.9	AFTER COOLER SHELL	MATERIAL CHECK	MAJOR	CHEM. ANALYSIS TENSILE STRENGTH	1/ BATCH	APPROVED DATA SHEET	COMPLIANCE WITH "7"	CONF. CERT.	3			
2.0	OIL COOLER PLATE TYPE	MATERIAL CHECK DIMENSION CHECK	MAJOR MAJOR	CHEM. ANALYSIS TENSILE STRENGTH MEASUREMENT	1/BATCH 100%	APPROVED DATA SHEET ACIL STD DRG.	COMPLIANCE WITH "7"	CONF. CERT.	3			
MANUFACTURER SUBCONTRACTOR			CONTRACTOR			LEGEND :			FOR CUSTOMER USE			
						3 - MANUFACTURER / SUBCONTRACTOR 2 - WBPDCI 1 - BHEL			NAME & SIGN OF APPROVING AUTHORITY			
SIGNATURE									PAGE 2 OF 4			

		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT				
ATLAS COPCO AIRPOWER N.V. BELGIUM ATLAS COPCO INDIA LTD.		ITEM: OIL FREE SCREW AIR COMPRESSOR MODEL ZR 275 SUB SYSTEM COMPRESSED AIR SYSTEM.		QP NO. : 16175 00 A05. BHEL DOC NO : PE-VO-373-555-Q001 Rev: 02 DATE : 23.07.2013		CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD. CONSULTANT: DEVELOPMENT CONSULTANTS (P) LTD.		SAGARDIGHT TPP PHASE - II (2 X 500 MW)				
Sr. No.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE	FORMAT OF RECORD	AGENCY**			REMARKS
1	2	3	4	5	6	7	8	9	D*	10	11	
B IN PROCESS INSPECTION												
2.1	OIL COOLERS PLATE TYPE	TIGHTNESS	MAJOR	HYDROSTATIC	100%	ACIL MFG STD	NO LEAKAGE	CONF. CERT.	✓	3	1,2	
2.2	INTERCOOLER [SHELL & TUBE]	LEAK TIGHTNESS	MAJOR	HYDROSTATIC	100%	ACIL MFG STD	NO LEAKAGE	CONF. CERT.	✓	3	1,2	
2.3	AFTERCOOLER [SHELL & TUBE]	LEAK TIGHTNESS	MAJOR	HYDROSTATIC	100%	ACIL STD MFG DRG	NO LEAKAGE	CONF. CERT.	✓	3	1,2	
2.4	SAFETY VALVE	SET PRESSURE	MAJOR	MEASUREMENT	100%	ACIL STD	SET PRESSURE	CONF. CERT.	✓	3	1,2	
2.5	ROTOR ELEMENT	SURFACE FINISH COATING QUALITY DYNAMIC BALANCING	MAJOR MAJOR MAJOR	VISUAL MEASUREMENT BALANCING	100% 100% 100%	ACIL MFG STD ACIL MFG STD ACIL MFG STD.	COMPLIANCE WITH "7"	CONF. CERT.	✓ ✓ ✓	3 3 3	1,2 1,2 1,2	
2.6	COMPRESSOR CASING / ROTOR HOUSING LP & HP.	DIMENSION CHECK LEAK TIGHTNESS	MAJOR MAJOR	MEASUREMENT HYDROTEST	100% 100%	Apprd.GA Drg ACIL MFG STD	COMPLIANCE WITH "7" NO LEAKAGE	CONF. CERT. CONF. CERT.	✓ ✓	3 3	1,2 1,2	
2.7	AIR ENDS [HP & LP SCREW ELEMENTS]	RUN TEST	MAJOR	FAD LEAKAGE ABNORMAL NOISE	100%	ACIL MFG STDS / ISO 1217 Ed 1996 std.	COMPLIANCE WITH "7"	CONF. CERT.	✓	3	1,2	
MANUFACTURER SUBCONTRACTOR		CONTRACTOR		LEGEND :		FOR CUSTOMER USE						
				3 - MANUFACTURER / SUBCONTRACTOR 2 - WBPDCI 1 - BHEL								
		SIGNATURE				INDICATE "P" PERFORM "W" WITNESS & "V" VERIFICATION AS APPROPRIATE		NAME & SIGN OF APPROVING AUTHORITY				
								PAGE 3 OF 4				

MANUFACTURER'S NAME & ADDRESS			MANUFACTURING QUALITY PLAN					PROJECT																															
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1	2	APPEARANCE	MAJOR	VISUAL	1 per batch.	ACIL Mfg sdb	AS PER DRAWING	CONF. CERT.	3	1.2	11																												
2.8 a	OIL FILTER AIR FILTER THROTTLE VALVES																																						
2.8 b	CANOPY BASE FRAME	APPEARANCE	MAJOR	VISUAL	100%	AS PER DRAWING	AS PER DRAWING	CONF. CERT.	3	1.2																													
C FINAL INSPECTION																																							
3.0	OVERALL ASSLY. ALONG WITH MOTOR AND OTHER ACC.	DIMENSION & APPEARANCE	MAJOR	MEASUREMENT VISUAL	100%	DIMENSION INT DRAWING	DIMENSION DRAWINGS	INSP REPORT	3	1.2																													
3.1	RUN TEST AND PERFORMANCE TEST	FREE AIR DELIVERY PRESSURE SPECIFIC POWER	CRITICAL	OPERATION & CONFORMANCE	100%	APPD. DATA SHEETS PERFORMANCE TEST AS PER ISO 1217	APPD. DATA SHEETS / DRGS & PERFORMANCE TEST AS PER ISO 1217	INSPECTION REPORT	3	1.2																													
D PACKING AND DESPATCH																																							
4.1	PACKING AND TRANSPORTATION	PACKING	MAJOR	VERIFICATION	100%	AS PER ACIL PACKING PROCEDURE	AS PER PACKING PROCEDURE	ALL SHIPPING DOCUMENTS	3																														
4.2	PAINTING	PAINTING	MAJOR	VERIFICATION	100%	AS PER ACIL STD PAINTING PROCEDURE	AS PER ACIL STD PAINTING PROCEDURE	CONF. CERT	3	1.2																													
REVIEW OF Q/A DOCUMENT						AS PER APPROVED Q.A.P																																	
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		1 - BHEL																																					

Note :- 1. All material of construction shall be as per Specifications / Approved Drawings / Approved Datasheet by WBPDCI / DCPL as and where applicable. Drawing / Documents which are not under the approval of WBPDCI / DCPL must be approved by BHEL.

2. * : Record Identified with ✓ **shall be essentially included by the Contractor in QA Documentation.**

2X500 MW SAGARDIGHI TPP PHASE 2.

COMPRESSED AIR SYSTEM

Reference: DCPL transmittal no. DCPL-K8A07/DCH-4/BHLPEN/2013 Dated 04.07.2013

Reply/Compliance to DCPL comments on GA drawing of Motor (Rev 00)

Doc. No.: PE-VO-373-555-A013.

S.No.	DCPL Comment	BHEL / ACIL Reply
1	Before forwarding this document to DCPL for review / approval purpose, BHEL shall check providing their approval stamp.	Noted and incorporated.
2	Mounting: B35	It is the terminology as per internal contract between ACIL Engg. & M/s Marathon. However, Mounting is foot cum flange.
3	BHEL shall show grounding details arrangement.	Motor shall be mounted inside the compressor canopy on same base frame of compressor. Grounding arrangement shall be initiated in compressor house layout.
4	BHEL to Check & Correct - Cable Size.	Offered cable size (1x3Cx185 Sq mm XLPE) is maximum suitable size. Actual cable size shall be mentioned in cable schedule.
5	Terminal Fault Level to Check.	Fault level 250MVA for 3.3KV (for 0.25 Sec) is applicable for this project, However in drawing it shows suitability level for both 3.3 KV & 6.6 KV.
6	Terminal box are suitable for rotation in steps of 180Deg	Noted & Accepted.
7	The prepared dates of drawings.	The mentioned dates on drawings are internal of M/s ACIL and M/s Marathon and are associated with product development. Being standard drawings please accept these drawings with dates.

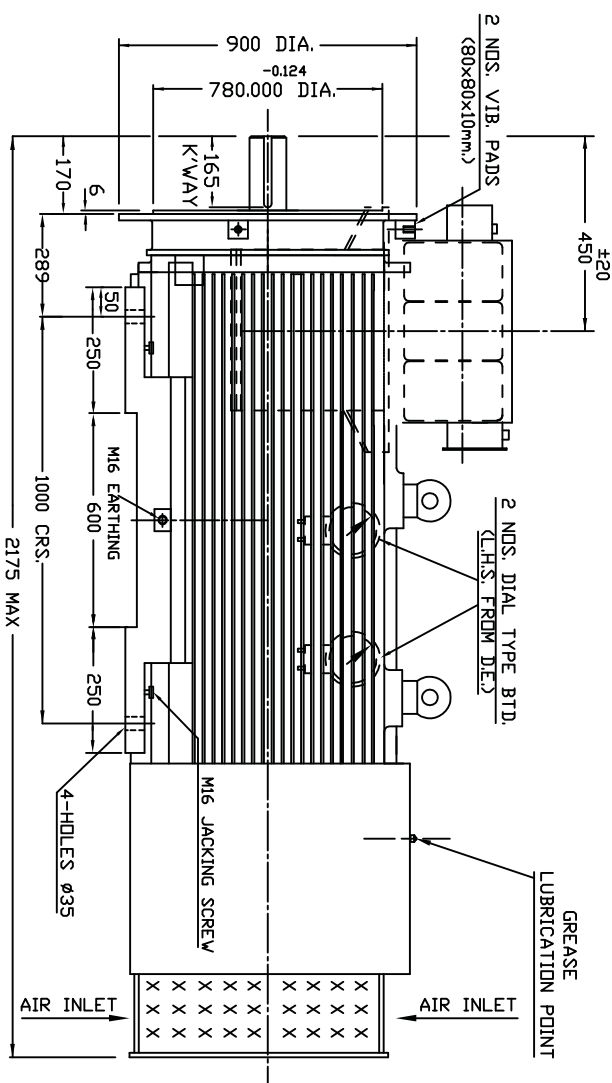
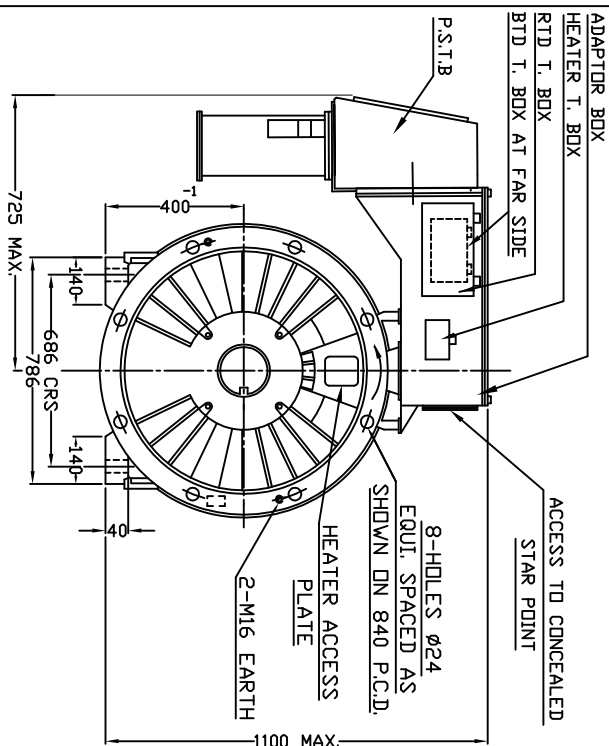
KARAN
Digitally signed by KARAN
YADAV
DN: c=IN, o=BHARAT HEAVY
ELECTRICALS LIMITED,
ou=SENIOR ENGINEER,
postalCode=201301, st=UTTAR
PRADESH, cn=KARAN YADAV
Date: 2013.08.07 18:28:35
+05'30'

YADAV

	SAGARDIGHI EXTENSION TPP (2 X 500 MW)		BHEL Doc No: PE-VO-373-555-A013																								
			REV	01																							
			DATE	30.07.2013																							
			SHEET 1 OF 9																								
KARAN YADAV Digitally signed by KARAN YADAV DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=SENIOR ENGINEER, postalCode=201301, st=UTTAR PRADESH, cn=KARAN YADAV Date: 2013.08.07 18:28:19 +05'30'  DEVELOPMENT CONSULTANTS PVT. LIMITED. Reviewed only for general conformance with contract drawings and specifications. Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents <table border="1" style="width: 100%;"> <tr> <td colspan="2">ACTION 6</td> <td colspan="2">DATE 13-08-2013</td> </tr> <tr> <td colspan="4">DISTRIBUTED BY. N.M</td> </tr> <tr> <td>1</td> <td>Distributed</td> <td>4</td> <td>Approved except as noted. Resubmission required</td> </tr> <tr> <td>2</td> <td>Approved</td> <td>5</td> <td>Disapproved see accompanying letter</td> </tr> <tr> <td>3</td> <td>Approved except as noted. Forward final drawings ☒</td> <td>6</td> <td>For information only</td> </tr> </table> SEE COVERING LETTER <table border="1" style="width: 100%;"> <tr> <td>LETTER REF NO. 2167</td> <td>DATE. 13-08-2013</td> </tr> </table>						ACTION 6		DATE 13-08-2013		DISTRIBUTED BY. N.M				1	Distributed	4	Approved except as noted. Resubmission required	2	Approved	5	Disapproved see accompanying letter	3	Approved except as noted. Forward final drawings ☒	6	For information only	LETTER REF NO. 2167	DATE. 13-08-2013
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	00	Submitted for Approval																									
Date	Rev	Description of Revision	ALT	CHD	APPD																						
CUSTOMER : WB POWER DEVELOPMENT CORPN. LTD. SAGARDIGHI TPP PHASE 2 (2X500 MW)																											
CUSTOMER'S CONSULTANT : DEVELOPMENT CONSULTANTS (P) LTD.																											
 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																											
 ATLAS COPCO INDIA LIMITED, PUNE																											
JOB No.	373	BHEL Doc. No: PE-VO-373-555-A013			Rev: 01																						
STATUS	CONTRACT																										
PACKAGE		COMPRESSED AIR SYSTEM																									
TITLE		GA Drawings of Motor		ACIL Doc. No : 16175 00 D01																							
PREPARED BY	Dnyaneshwar Mahajan	-sd-																									
CHECKED BY	Manish Gandhi	-sd-																									
APPROVED BY	Manish Gandhi	-sd-																									
																											

DRAWING NO.	REV.
A4C 17867-757	00

ALL DIMENSIONS ARE IN mm.

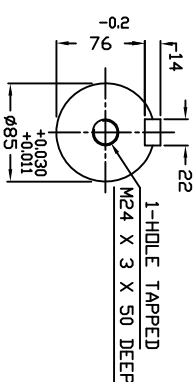


ROTATION : UNI-DIRECTIONAL
DIRECTION OF ROTATION : C.C.W. VIEWING FROM D.E

FRAME	RATING	POLE	VOLTAGE/Ph./Hz.
DC400F3	345 KW	2	3.3KV/3PH/50HZ.
ENCLOSURE	MOUNTING	WEIGHT	PAINT SHADE
T.E.F.C./ IP55	B35	3700 KG.	RAL 7032

ACCESSORIES

1. 1 NO. P.S.T.B.
2. 12 NOS. RD Pt.100-SIMPLEX TYPE
3. 2 NOS. BTD Pt.100-DUPLEX TYPE
4. 2 NOS. DIAL TYPE BTD
5. 1 NO. HEATER T. BOX.
- 2 x 65 WATTS, 240V, 1PH, 50HZ. SP.HEATER



DETAILS OF SHAFT DRIVE END

CUSTOMER : ACIL

REV.	CHK'D.	REV.	CHK'D.	REV.	CHK'D.
APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.

REF. SO. NO.	SO. NO.

GENERAL ARRANGEMENT DRAWING OF DC400E3: 2P: FOOT CIM FLANGE H T MOTOR

G4	G3	G2	G1		PT.
QUANTITY					NO.
REF. DRG.					
A4C 17867-522					

DESCRIPTION

MATERIAL SPEC
DRAWING NO.



Marathon Electric Motors (India) Ltd
AEI WORKS, 1, TARATALA ROAD,
KOLKATA-700024, INDIA

GENERAL ARRANGEMENT DRAWING OF

GEN. TOLERANCE		DRAWING NO.	REV NO.
	DRAWN	RAMANJ.C	25.07.2013
	TRACED	—	—
	CHECKED	P.D.S	25.07.2013
	APPR'D	G.MONDAL	25.07.2013
SCALE		A4C 17867-757	
NTS.		00	

**CONFIDENTIAL AND PROPERTY OF Marathon Electric Motors (India) Limited
NOT TO BE REPRODUCED OR LENT WITHOUT PERMISSION**

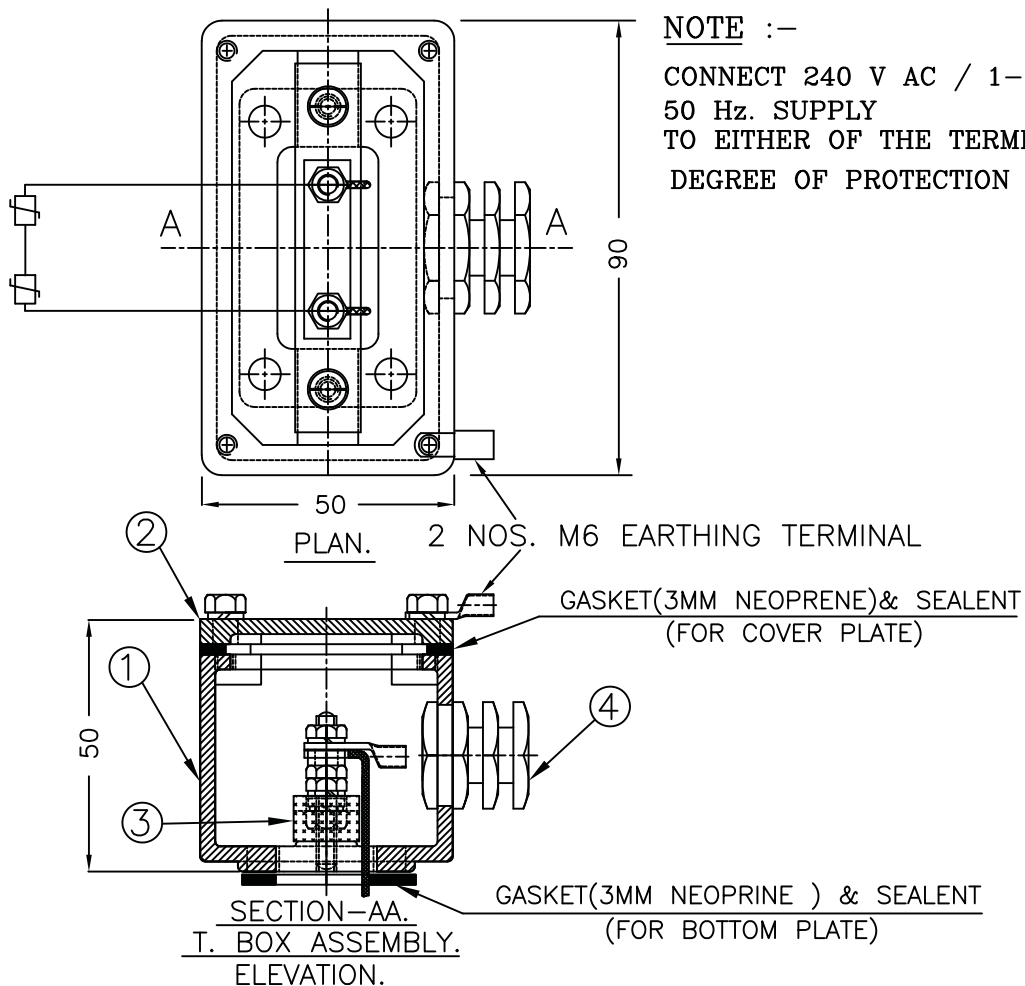
266568/2021/PS-PEM-MAX

CONFIDENTIAL AND PROPERTY OF Marathon Electric Motors (India) Limited

NOT TO BE REPRODUCED OR LENT WITHOUT PERMISSION

REV.	CHK'D	REV.	CHK'D	REV.	CHK'D	REV.	CHK'D	REV.	CHK'D
	APPV'D.		APPV'D.		APPV'D.		APPV'D.		APPV'D.

ALL DIMENSION, IN MM. UNLESS STATED OTHERWISE

CONNECTION & ASSEMBLY DRAWING FOR
SPACE HEATER

				4	FLAME PROOF DOUBLE COMPRESSION GLAND 2C x 4 SQ. mm	BRASS NICKEL PLATED
				3	TERMINAL BAR.	D.M.C.
				2	COVER.	ALUMINIUM
				1	TERMINAL BOX.	ALUMINIUM
G4	G3	G2	G1	PT. NO.	DESCRIPTION	MATERIAL SPEC. DRAWING NO.
QUANTITY						

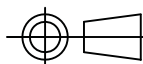
REF. DRG.

 **marathon**
electric
A Regal Beloit Company

Marathon Electric Motors (India) Ltd.
AEI WORKS, 1, TARATALA ROAD,
KOLKATA-700024, INDIA

HEATER TERMINAL BOX ASSLY.

GEN. TOLERANCE	DRAWN	R.CHAUDHRI	05.07.2011	DRAWING NO.	REV NO.
	TRACED	-	-		
SCALE N.T.S.	CHECKED	P.DAS	05.07.2011	A4C 14150-001	00
	APPV'D	P.K.PAL	05.07.2011		

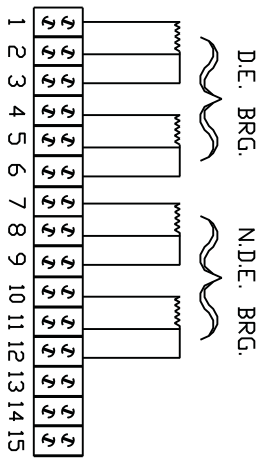
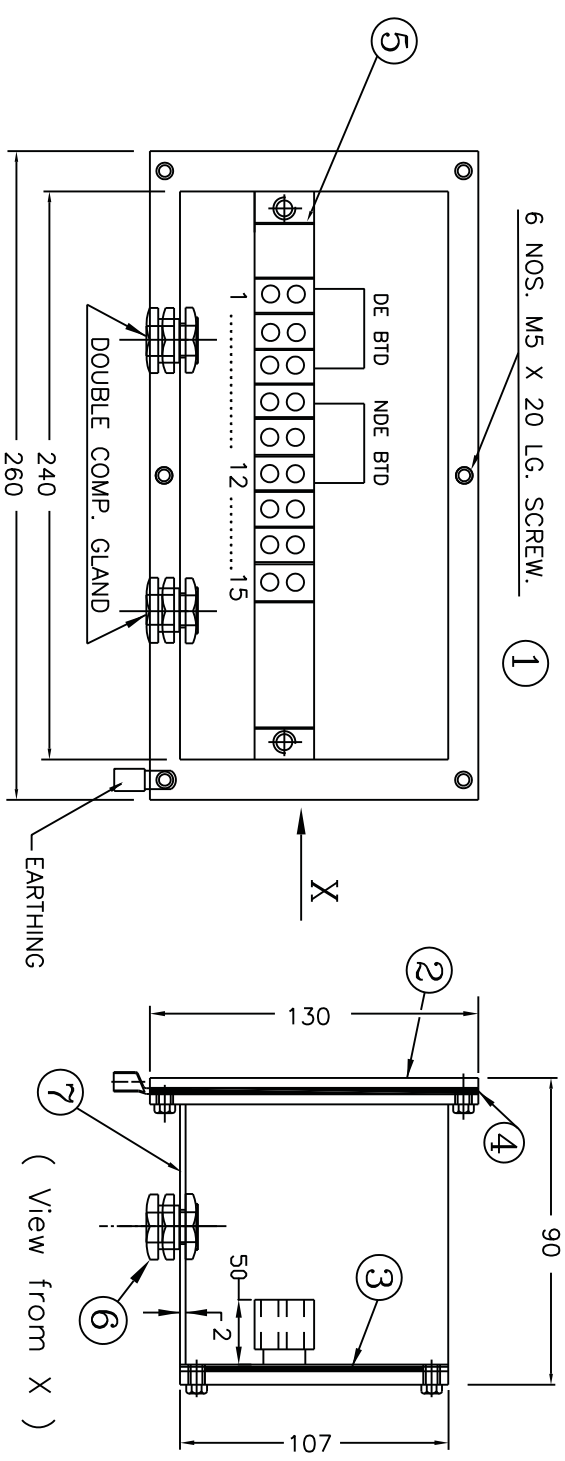


Page 54/5

DRAWING NO. REV.
A4C 16098-BTD 00

DEGREE OF PROTECTION OF T. BOX - IP55.

ALL DIMENSIONS ARE IN mm.



REV.	CHK'D.	REV.	CHK'D.	REV.	CHK'D.	REV.	CHK'D.	REV.	CHK'D.
APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.	APPV'D.

			1	7	GLAND PLATE	M.S. 2 THK.
			1	6	DOUBLE COPM. GLAND (SEE NOTE)	BRASS/ALUMINIUM
			1	5	TERMINAL BLOCK(2.5 mm ² TERMINALS)	PHENOLIC BONDED INSULATOR
			1	4	GASKET TOP	NEOPRENE
			1	3	GASKET BOTTOM	NEOPRENE
			1	2	BOX COVER	M.S.
			1	1	BTD TERMINAL BOX(ASSLY)	M.S. 2 THK.
			</			



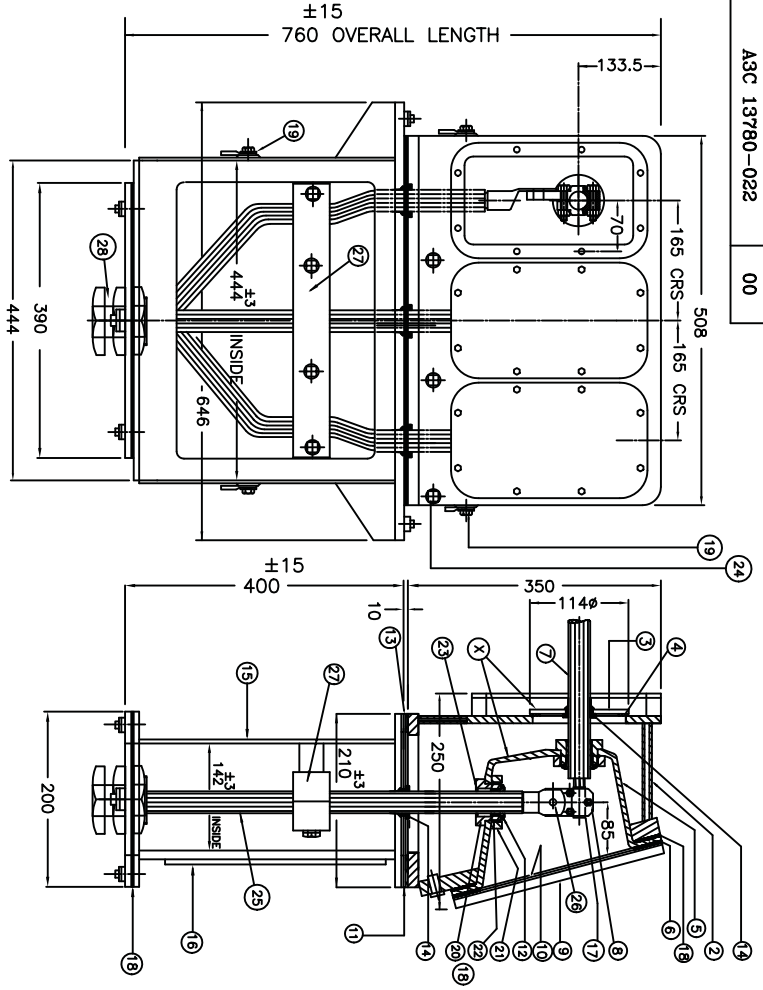
Marathon Electric Motors (India) Ltd.
AEI WORKS, 1, TARATALA ROAD,
KOLKATA-700024, INDIA

ARRANGEMENT OF BTD T.BOX

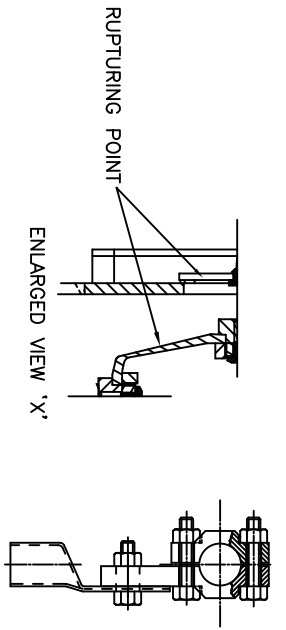
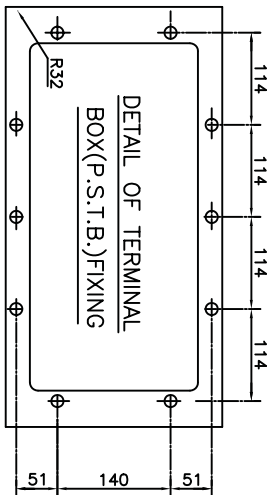
DRAWN	P.DAS	25.06.2010	DRAWING NO.	REV NO.
CHECKED	P.LAHIRI	25.06.2010	A4C 16098-BTD	00
APPV'D	P.K.PAL	25.06.2010		

(View from X)

DRAWING NO. REV.
A3C 13780-022 00



- NOTE :-
1. T.BOX IS SUITABLE FOR FAULT LEVEL OF 500MVA FOR 6.6KV (FOR 0.25 SECS) 250MVA FOR 3.3KV (FOR 0.25 SECS)
 2. PROVISION OF EARTHING TERMINATION ON THE BOX/SLG. CHAMBER GIVEN-REF. ITEM NO.19
 3. DEGREE OF PROTECTION IP55.
 4. CABLE SIZE : 1x3Cx185 Sq.mm. XLPE.



ALL DIMENSIONS ARE IN mm.

QTY	G1	G2	G3	G4	PT.	NO.	DESCRIPTION	MATERIAL SPEC.	DRAWING NO.
28							DOUBLE COMPRESSION GLAND (FLP)	BRASS NI PLATED	
27							CABLE SUPPORT	FRP	
26							THIMBLE(CUSTOMER CABLE)	COPPER TIN PLATED	
25							CUSTOMER CABLE	1x3Cx185 Sq.mm. XLPE.	
24							DESSICATOR & HUMIDITY INDICATOR	M.S. PLATED	
23							GLAND WASHER	NYLON	
22							GLAND BUSH	NEOPRINE	
21							RING NUT	NYLON	
20							GLAND BODY	NYLON	
19							EARTHING TERMINAL M12 WITH THIMBLE	COPPER	
18							GASKET FOR JOINT BOX.	NEO-PRINE	
17							FERRULE (MOTOR CABLE)	COPPER TIN PLATED	
16							SLG. CHAMBER COVER PLATE	M.S.	
15							SEALING CHAMBER	M.S. FAB. ASSLY.	
14							GROMMET	NEO-PRINE	
13							TERMINAL SEALING PLATE	FRP	
12							GLAND NUT	NYLON	
11							GASKET FOR SLG. CHEMBER	NEOPRENE	
10							EPOXY LINING ON TERMINAL COVER	EPOXY	
9							TERMINAL COVER	M.S.	
8							T CONNECTOR	FORGED BRASS	
7							CABLE (MOTOR)	CSP/SILICON CABLE	
6							GASKET FOR LID	NEO-PRINE	
5							JOINT BOX	EPOXY MOULDED	
4							GASKET FOR SLG. PLATE	NEO-PRINE	
3							SEALING PLATE (ROUND)	FRP	
2							TERMINAL BOX	M.S.	
1							P.S.T.B. ASSLY.	ASSEMBLY	

REF. ASSY. DRG. S.C.-A3C18126

Marathon electric
A Regal Beloit Company

Marathon Electric Motors (India) Ltd.
AEI WORKS, 1, TARATALA ROAD,
KOLKATA-700024, INDIA

ASSLY. DRG. OF PHASE SEGREGATED/PHASE SEPARATED TERMINAL BOX.

SCALE	GEN. TOLERANCE	DRAWN	P.DAS	09.03.2011	DRAWING NO.	REV NO.
NTS.		TRACED				
		CHECKED	P.LAHIRI	09.03.2011	A3C 13780-022	00
		APPVD	G.MONDAL	09.03.2011		

2X500 MW SAGARDIGHI TPP PHASE 2.
COMPRESSED AIR SYSTEM

Reference: DCPL transmittal no. DCPL-K8A07/DCH-4/BHLPEN/2013 Dated 04.07.2013

Reply/Compliance to DCPL comments on TDS and curves of Motor (Rev 00)

Doc. No.: PE-VO-373-555-A014.

S.No.	DCPL Comment	BHEL / ACIL Reply
1	Before forwarding this document to DCPL for review / approval purpose, BHEL shall check providing their approval stamp.	Noted and incorporated.
2	Mounting: B35	It is the terminology as per internal contract between ACIL Engg. & M/s Marathon. However, Mounting is foot cum flange.
3	2 Nos. Duplex BTD	Noted & Accepted.
4	Starting current shall be 600% inclusive of tolerance.	Noted & Accepted. Due to the same, frame size is changed to "DC400F3" against the earlier frame size of DC355F3.
5	Indication shall be provided as per cl. no. 7.04.00 of V.II-F1/S-II: 9 of specification.	As the motor is mounted inside compressor canopy, this clause is not applicable.
6	BHEL shall confirm compliance cl. no. 7.10.00 of V.II-F1/S-II: 10 and cl. no. 6.08.00 of V.II-F1/S-II: 7 of specification.	As the motor is mounted inside completely enclosed compressor canopy, shade shall be as per M/s Marathon standard, details mentioned in GA of motor. Regarding grounding, compliance to technical specification is confirmed.

KARAN
YADAV

Digitally signed by KARAN
YADAV
DN: c=IN, o=BHARAT HEAVY
ELECTRICALS LIMITED,
ou=SENIOR ENGINEER,
postalCode=201301, st=UTTAR
PRADESH, cn=KARAN YADAV
Date: 2013.08.07 17:42:57 +05'30'

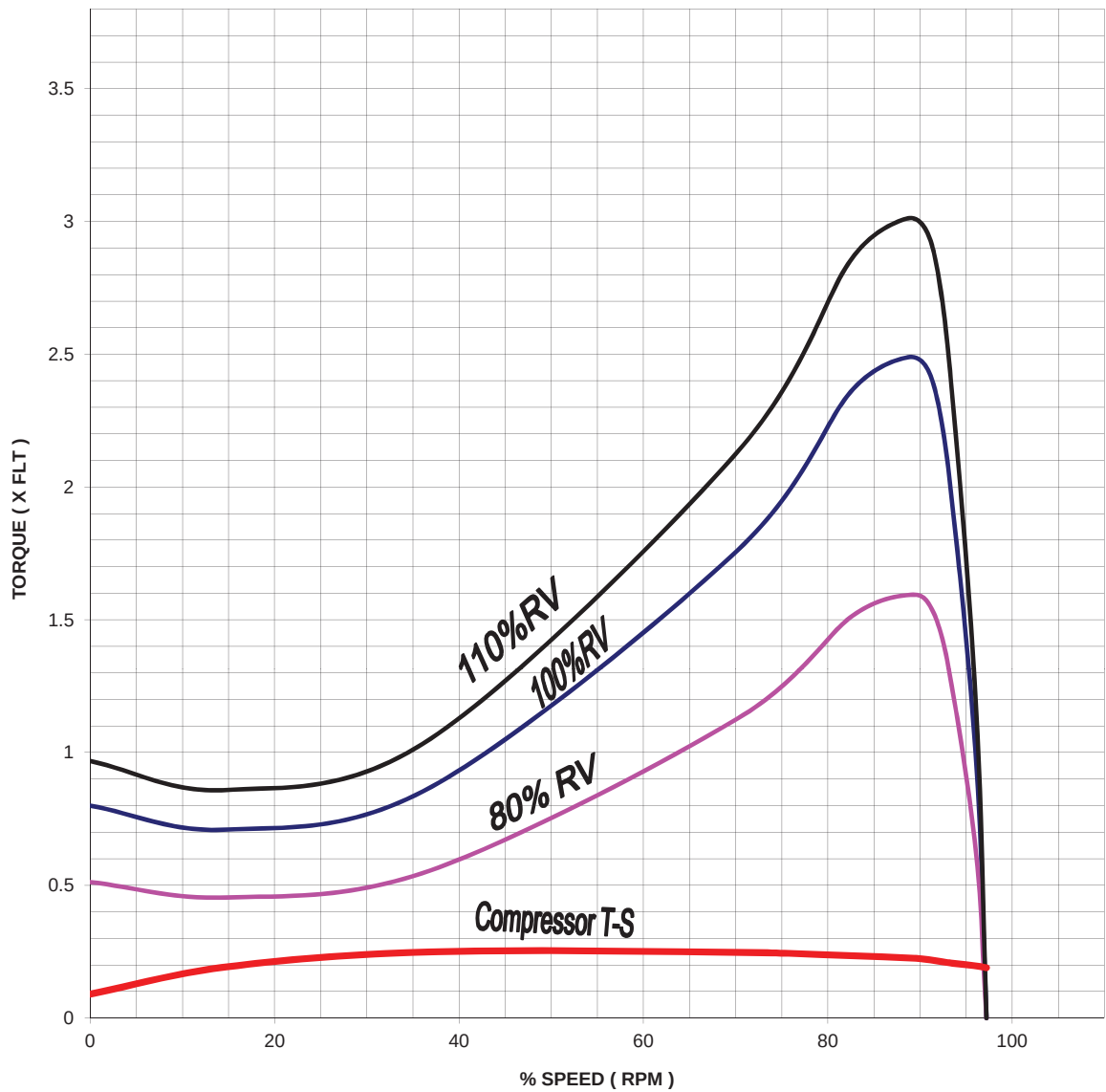
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			REV	01																													
			DATE	30.07.2013																													
			SHEET 1 OF 9																														
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		CUSTOMER'S CONSULTANT : DEVELOPMENT CONSULTANTS (P) LTD.																															
		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																															
		ATLAS COPCO INDIA LIMITED, PUNE																															
JOB No.	373	BHEL Doc. No: PE-VO-373-555-A014			Rev: 01																												
STATUS	CONTRACT																																
PACKAGE		COMPRESSED AIR SYSTEM																															
TITLE		TDS & Curves of Motor		ACIL Doc. No : 16175 00 D02																													
PREPARED BY		Dnyaneshwar Mahajan	-sd-																														
CHECKED BY		Manish Gandhi	-sd-																														
APPROVED BY		Manish Gandhi	-sd-																														

MARATHON ELECTRIC MOTORS (INDIA) LTD.

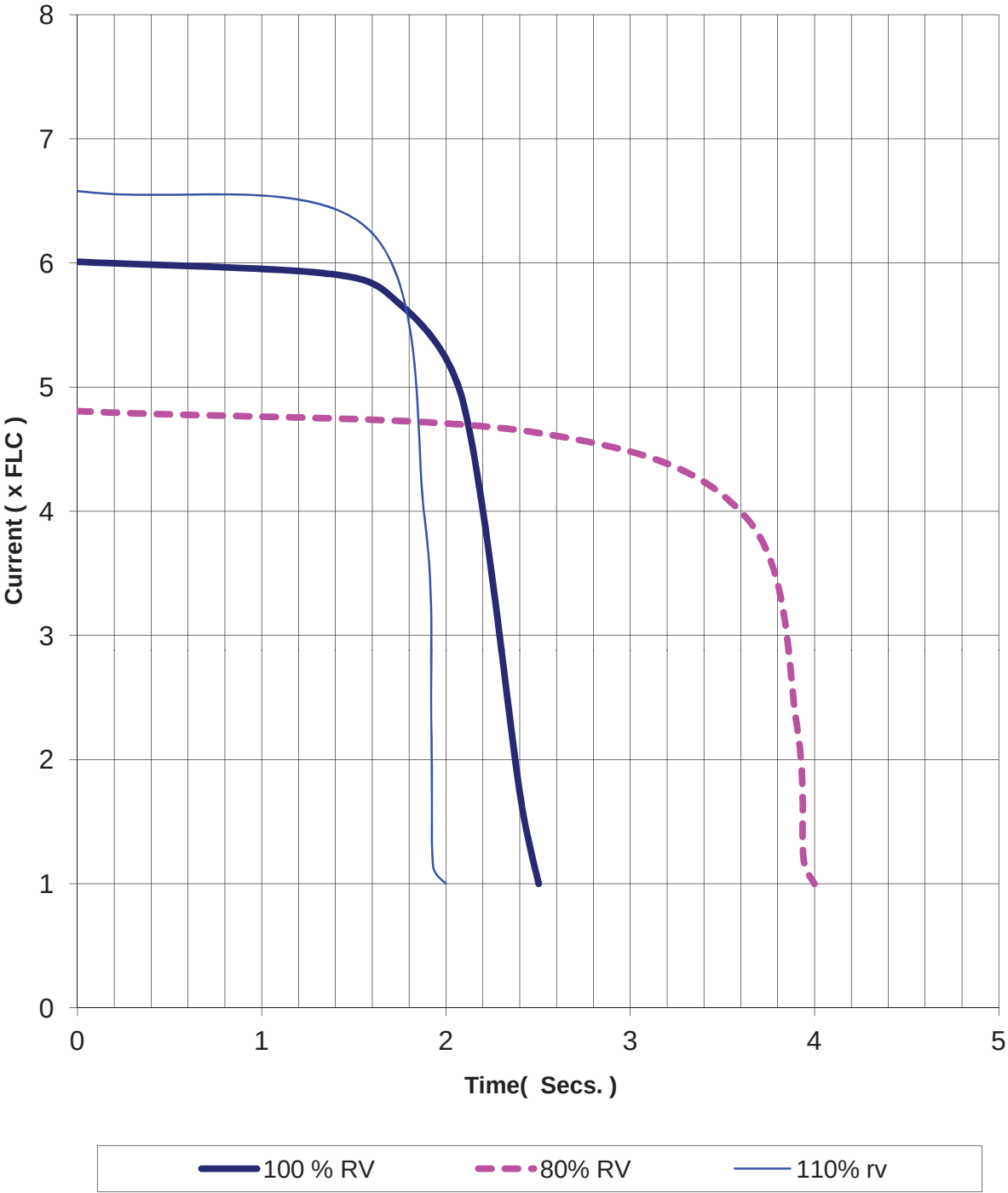
	DATE :25.04.2013 Rev.00
	DATE :25.07.2013 Rev.01
TECHNICAL DATA SHEET	
RATING	345 KW
SERVICE FACTOR	1.0
POLE	2 POLE
VOLTAGE	3.3KV +/-10%
FREQUENCY	50HZ+/- 5%
Combined variation	10%
AMBIENT TEMP.	50 DEG C
TEMP. RISE	Class 'B limit (BY RESISTANCE METHOD)
INSULATION	CLASS F (VPI)
MOUNTING	B35
DEGREE OF PROTECTION	IP55
COOLING	IC 411 (TEFC)
DUTY	S1
TYPE OF CONSTRUCTION	SQ. CAGE
APPLICATION	COMPRESSOR
STARTING	DOL Stg.
	PERFORMANCE AT FULL VOLTAGE (DOL)
FRAME SIZE	DC400F3
EFFICIENCY AT(100%, 75%, 50%) LOAD	95/94/92.5
POWER FACTOR AT (100%, 75%, 50%) LOAD	0.90/0.88/0.78
Full load current	70.5 Amps
Starting current	600% of FLC
Starting torque	80% of FLT
Pull out torque	250% of FLT
Rated Speed	2980
Locked rotor withstand time(Hot/Cold) at 100% RV	15/20 Secs.
Locked rotor withstand time(Hot/Cold) at 80% RV	23/31Secs.
Locked rotor withstand time (Hot/Cold) at 110% RV	12/16 Secs.
GD2 (Motor)	40 KGMT2
Starting Time (100%V/80%/110%V) with load	2.5Secs/4 secs/2 secs
MINIMUM PERMISSIBLE STARTING VOLTAGE	80% RV
Stator winding resistance per phase(ohms at 20 Deg C)	0.1399(+5%)
No. of consecutive Starts/hour	
A) Hot Start	2
B) Cold Start	3
C) Equally Spreads per hour	3
Terminal Details for RTD/BTD	
(A) Temperature detector for stator winding	
a. Type	Pt.100, Simplex type
b. Nos. provided	4 Nos. per phase
c. Location	Between windings
d. Make	Jindal make.1
e. Resistance value at 0 deg. C. (ohms)	100
(B) Temperature detector for bearing	
a. Type	Pt.100, Duplex type
b. Nos. provided	2 Nos. duplex for each bearing.

d. Make	M/s Ghanakon Electronics
e. Resistance value at 0 deg. C. (ohms)	100
Fault level withstand capacity of TB	40KA for 0.25secs
DIRECTION OF ROTATION	CCW from DE
OVERLOAD CAPACITY	160% LOAD FOR 15SECS
OVERSPEED CAPACITY	120% SPEED FOR 2 MINS
RELIABILITY, LIFE TIME OF MOTOR	For 1000 Starts, 10Years.
LIFTING HOOKS	PROVIDED
NOISE LEVEL	AS PER IS12065
VIBRATION	AS PER IS12075
BEARING TYPE	ANTI-FRICTION
GREASING FREQUENCY & AMOUNT	2800 Hrs/31 Gms
MATERIAL OF CONSTRUCTION OF MOTOR	CAST IRON
WEIGHT OF THE MOTOR	3700Kg.
ROTOR MASS	900Kg.
SPACE HEATER	2x65W,240V,50Hz,1Phase.
Note: 1) All performance figs. are subject to I.S tolerance. 2) Motor is fitted with 2 nos. heater, 12 nos. PT100(Simplex) RTD & 2 nos. Bearing RTD PT100(Duplex). & PSTB.	

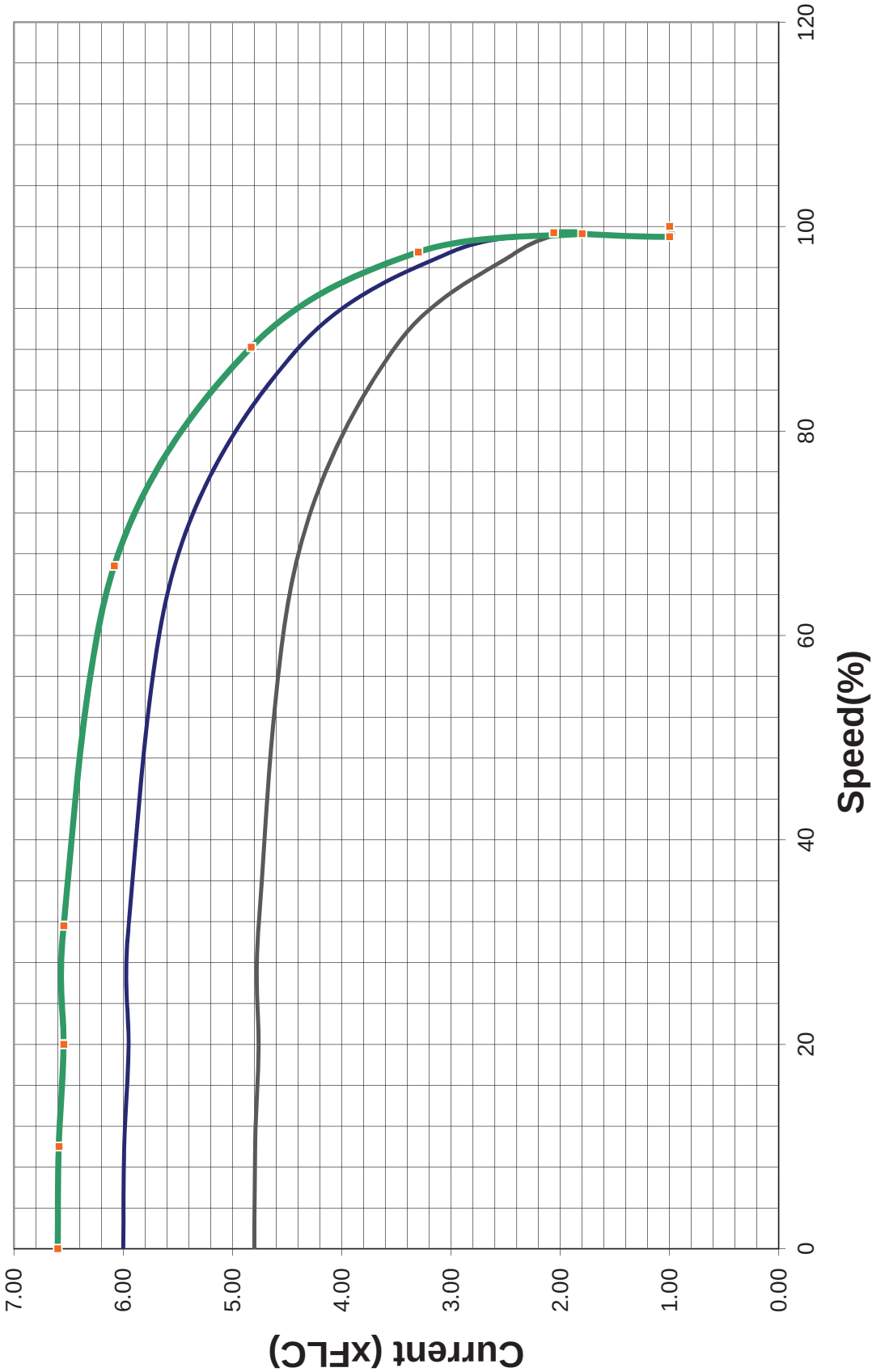
TORQUE Vs. SPEED CHARACTERISTIC CURVE
345KW, 2 POLE, 3300 V, DC400F3

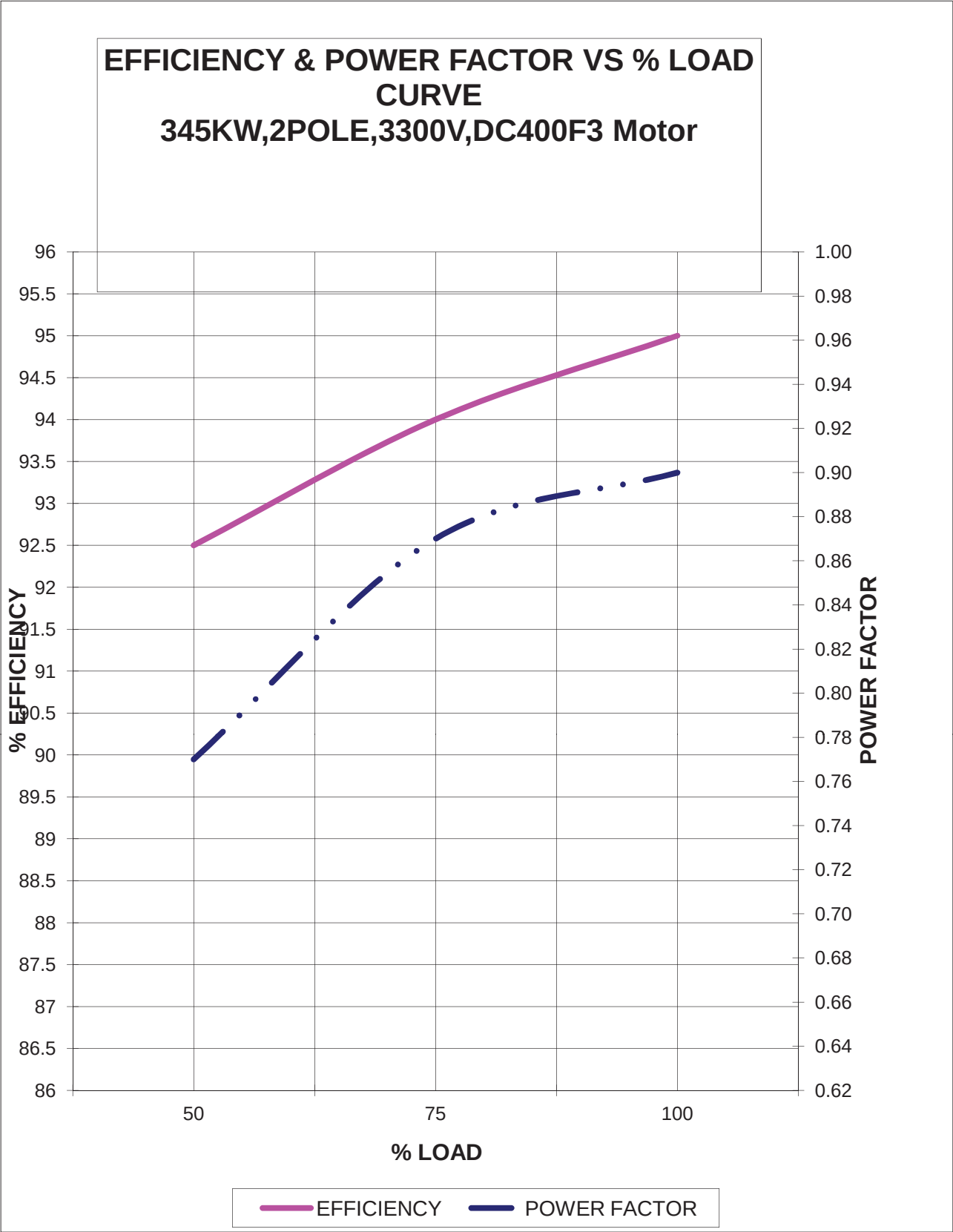


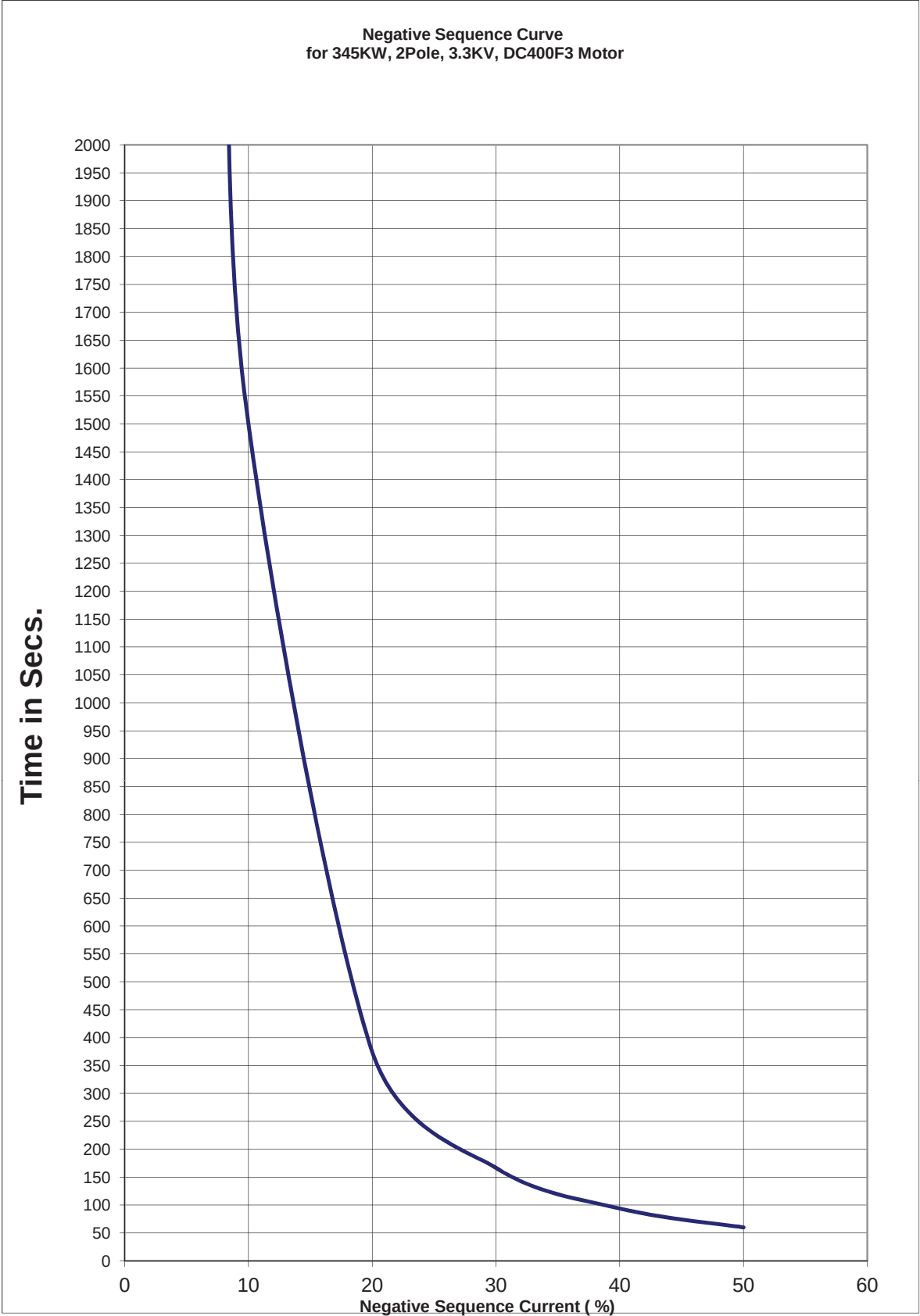
CURRENT Vs. TIME CHARACTERISTIC CURVE
OF 345 KW, 2Pole, 3.3KV, DC400F3 Motor



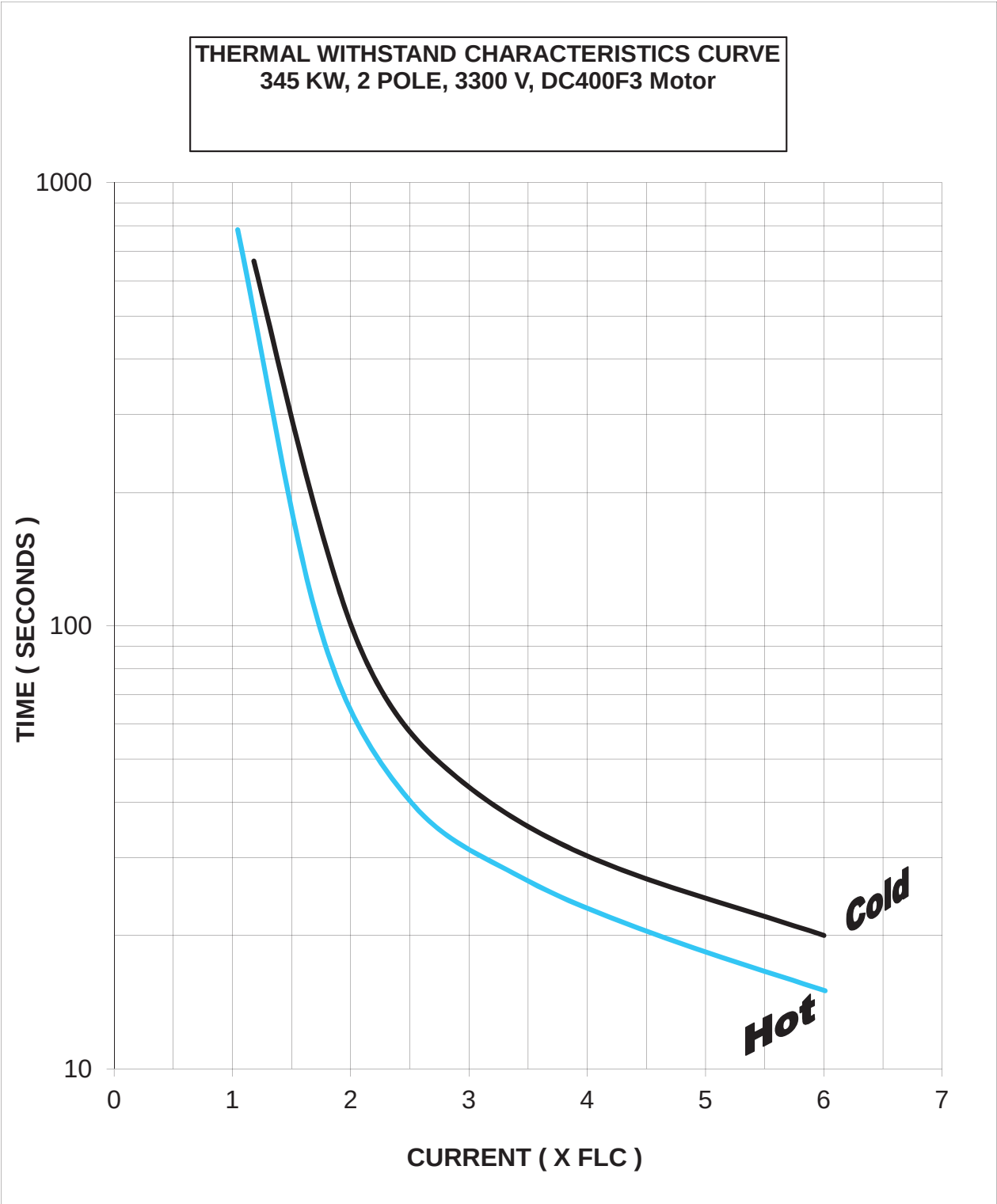
Current -Speed curve for 345 KW,2Pole, 3.3KV,DC400F3







REV:01



2X500 MW SAGARDIGHI TPP PHASE 2.
COMPRESSED AIR SYSTEM

Reference: DCPL transmittal no. DCPL-K8A07/DCH-4/BHLPEN/2167 Dated 13.08.2013

Reply/Compliance to DCPL comments on QAP of Motor (Rev 01)

Doc. No.: PE-VO-373-555-Q004.

S.No.	DCPL Comment	BHEL / ACIL Reply
1	Shall be corrected w.r.t test mentioned on left side.	Noted and corrected.
2	What does 'D' stand for?	D' stands for document : RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. Same is mentioned in the legends.
3	Pls incorporate the note as below Wherever WBPDCCL shall not witness the test, verification of the test documents shall be undertaken by them.	Noted & incorporated.

KARAN
YADAV

Digitally signed by KARAN
YADAV
DN: c=IN, o=BHARAT HEAVY
ELECTRICALS LIMITED,
ou=SENIOR ENGINEER,
postalCode=201301,
st=UTTAR PRADESH,
cn=KARAN YADAV
Date: 2013.08.21 15:25:27
+05'30'

	SAGARDIGHI EXTENSION TPP (2 X 500 MW) DESIGN PHILOSOPHY COMPRESSED AIR SYSTEM		BHEL Doc No: PE-VO-373-555-Q004																															
			REV	02																														
			DATE	16.08.2013																														
			SHEET 1 OF 10																															
KARAN YADAV Digitally signed by KARAN YADAV DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=SENIOR ENGINEER, postalCode=201301, st=UTTAR PRADESH, cn=KARAN YADAV Date: 2013.08.21 15:25:39 +05'30'   DEVELOPMENT CONSULTANTS PVT. LIMITED. Reviewed only for general conformance with contract drawings and specifications. Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents <table border="1"> <tr> <td>ACTION</td> <td>2</td> <td>DATE</td> <td>23-08-2013</td> </tr> <tr> <td colspan="4">DISTRIBUTED BY. N.M</td> </tr> <tr> <td>1</td> <td>Distributed</td> <td>4</td> <td>Approved except as noted. Resubmission required</td> </tr> <tr> <td>2</td> <td>Approved</td> <td>5</td> <td>Disapproved see accompanying letter</td> </tr> <tr> <td>3</td> <td>Approved except as noted. Forward final drawings</td> <td>6</td> <td>For information only</td> </tr> <tr> <td colspan="4">SEE COVERING LETTER</td> </tr> <tr> <td>LETTER REF NO.</td> <td>2210</td> <td>DATE.</td> <td>23-08-2013</td> </tr> </table>							ACTION	2	DATE	23-08-2013	DISTRIBUTED BY. N.M				1	Distributed	4	Approved except as noted. Resubmission required	2	Approved	5	Disapproved see accompanying letter	3	Approved except as noted. Forward final drawings	6	For information only	SEE COVERING LETTER				LETTER REF NO.	2210	DATE.	23-08-2013
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CUSTOMER : WB POWER DEVELOPMENT CORPN. LTD. SAGARDIGHI TPP PHASE 2 (2X500 MW)																																		
CUSTOMER'S CONSULTANT : DEVELOPMENT CONSULTANTS (P) LTD.																																		
 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																																		
 ATLAS COPCO INDIA LIMITED, PUNE																																		
JOB No.	373	BHEL Doc. No: PE-VO-373-555-Q004				Rev: 02																												
STATUS	CONTRACT																																	
PACKAGE		COMPRESSED AIR SYSTEM																																
TITLE		QAP of Motor		ACIL Doc. No : 16175 00 D04																														
PREPARED BY		Dnyaneshwar Mahajan	-sd-																															
CHECKED BY		Manish Gandhi	-sd-																															
APPROVED BY		Manish Gandhi	-sd-																															
																																		

QUALITY PLAN		CUSTOMER		PROJECT		Sagardighi STPP Project															
345KW / 2P / DC355F900 / 3.3KV		ACIL-BHEL		TITLE		Motor QAP															
BIDDER DOC NO: PE-YO-373-555-Q004		ACIL DOC NO: 1617500 D04		QUALITY PLAN																	
SYSTEM		Compressed air system		ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)		NUMBER PED-506-00-Q-007/2															
CAT.		EXTENT OF CHECK		REFERENCE DOCUMENT		FORMAT OF RECORD															
METHOD OF CHECK		CHECK		NORM		D															
M		C		N		11															
1		2		3		4		5		6		7		8		9		10		11	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL																				
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	P	V											
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	P	V											
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSP. REPORT	P	V											
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	P	-											
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	P	V										PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR	
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	P	-											
		2. PHY. PROP.	MA	MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	P	V										HEAT NO. SHALL BE VERIFIED	
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	P	V											
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOGBOOK	P	V											
BHEL		PARTICULARS		BIDDER/VENDOR																	
		NAME																			
		SIGNATURE																			
		DATE																			
		BIDDER'S/VENDORS COMPANY SEAL																			

QUALITY PLAN		CUSTOMER		PROJECT		Sagardighi STPP Project				
345KW / 2P / DC355F900 / 3.3KV		ACIL/BHEL Sagardighi Project		TITLE		Motor QAP				
SHEET 2 OF 10		BIDDER DOC NO: PE-VO-373-555-Q004		QUALITY PLAN						
ACIL DOC NO: 1617500 D04		Compressed air system		NUMBER PED-506-00-Q-007/2						
SYSTEM		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM				
CAT.		TYPE/METHOD OF CHECK		7		8				
3		4		5		6				
CHARACTERISTIC CHECK		3		4		5				
COMPONENT/OPERATION		2		3		4				
1		2		3		4				
SL. NO.		1		2		3				
1.5		SHAFT (FORGED OR ROLLED)		1. SURFACE COND.		2. CHEM. & PHYSICAL PROPERTIES				
1.6		SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S (as applicable)		1. MAKE & RATING		2. PHYSICAL COND.				
3. DIMENSIONS (WHEREVER APPLICABLE)		4. PERFORMANCE/ CALIBRATION		3. DIMENSIONS (WHEREVER APPLICABLE)		4. PERFORMANCE/ CALIBRATION				
BHEL		PARTICULARS		BIDDER/VENDOR		BHEL				
NAME		SIGNATURE		DATE		BIDDER'S/VENDORS COMPANY SEAL				
1	1.5	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	P	V	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	P	V	
		MA	MEASUREMENT	100%	-DO-	MANUF'R'S DRG.	LOG BOOK	P	V	
		CR	UT	-DO-	ASTM-A388	MANUF'R'S SPEC.	-DO-	P	V	FOR DIA OF 55 MM & ABOVE
		MA	VISUAL	-DO-	MANUF'R'S DRG. / SPEC.	MANUF'R'S DRG. / SPEC.	-DO-	P	V	
		MA	-DO-	-DO-	-	NO BREAKAGE ON OTHER PHY. DESIGN	-DO-	P	V	
		MA	MEASUREMENT	SAMPLE	MANUF'R'S DRG. / SPEC.	MANUF'R'S DRG. / SPEC.	-DO-	P	V	
		MA	TEST	100%	-DO-	-DO-	INSP. REPORT	P	V	

QUALITY PLAN		CUSTOMER		PROJECT		Sagardighi STPP Project		TITLE		QUALITY PLAN		VOLUME III	
345KW / 2P / DC355F900 / 3.3KV		ACIL:BHEL		Sagardighi Project		Motor QAP				NUMBER PED-506-00-Q-00712			
BIDDER DOC NO: PE-VO-373-555-Q004		ACIL DOC NO: 1617500 D04								ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION				REMARKS
									D	M	C	N	
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.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	P	V			FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURR HEIGHT
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	P	V			
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURR)	LOG BOOK	P	V			
		2.DIMENSIONS INCLUDING BURR HEIGHT	MA	MEASUREMENT	SAMPLE	MANUF'S DRG. .	MANUF'S DRG.	-DO-	P	V			
1.9	CONDUCTORS	3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	P	V			
		1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	P	V			
		2.ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	P	V				
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	P	V			
BHEL		PARTICULARS		BIDDER/VENDOR									
		NAME											
		SIGNATURE											
		DATE											
													BIDDER'S/VENDORS COMPANY SEAL

345KW / 2P / DC355F900 / 3.3KV		QUALITY PLAN		CUSTOMER	PROJECT		Sagardighi STPP Project		TITLE		Sagardighi Project		Motor QAP		VOLUME III	
SHEET 4 OF 10		BIDDER DOC NO: PE-YO-373-555-Q004		ACIL DOC NO: 1617500 D04		QUALITY PLAN		NUMBER PED-506-00-Q-007/2		ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)		SECTION		REMARKS		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			VOLUME III				
									D	M	C		N			
1	2	3	4	5	6	7	8	9	10			11				
1.10	BEARINGS (SKF / FAG / NTN make)	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG.	MANFR'S DRG.	-DO-	P	V						
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET / BEARING CATALOGUES	-DO-	P	V						
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	P							
1.11	SLIP RING (if applicable)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	P	V						
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	P	V						
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT. TEST / Heat shock tes.	-DO-	MANUF'S SPEC.	MANUF'S SPEC.	-DO-	P	V						
1.12	OIL SEALS & GASKETS	4.HVIR	MA	-DO-	100%	-DO-	-DO-	-DO-	P	V						
		1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG / SPECS.	-DO-	P	-						
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	P	V						
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	P	V						
BHEL		PARTICULARS		BIDDER/VENDOR												
		NAME														
		SIGNATURE														
		DATE														
												BIDDER'S/VENDORS COMPANY SEAL				

QUALITY PLAN		CUSTOMER		PROJECT		Sagardighi STPP Project	
345KW / 2P / DC355F900 / 3.3KV		ACIL:BHEL		Sagardighi Project		Motor QAP	
BIDDER DOC NO: PE-VO-373-555-Q004		ACIL DOC NO: 1617500 D04		QUALITY PLAN			
ACIL DOC NO: 1617500 D04		Compressed air system		NUMBER PED-506-00-Q-007/2			
SHEET 5 OF 10		SYSTEM		ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)		VOLUME III	
CHARACTERISTIC CHECK		CAT.		EXTENT OF CHECK		REFERENCE DOCUMENT	
COMPONENT/OPERATION		TYPE/METHOD OF CHECK		ACCEPTANCE NORM		FORMAT OF RECORD	
SL. NO.		4		5		6	
1		3		2		1	
2.0	IN PROCESS						
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	LOG BOOK
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	-DO-
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	LOG BOOK
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	-DO-
		3.SHAFT SURFACE FLAWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	-DO-
2.3	PAINING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC./BHEL SPEC./ SAME AS RELEVANT STAND	LOG BOOK
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-
		3.SHADE	MA	VISUAL	-DO-	-DO-	Log Book
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	Log Book
BHEL		PARTICULARS		BIDDER/VENDOR			
		NAME					
		SIGNATURE					
		DATE					
						BIDDER'S/VENDORS COMPANY SEAL	

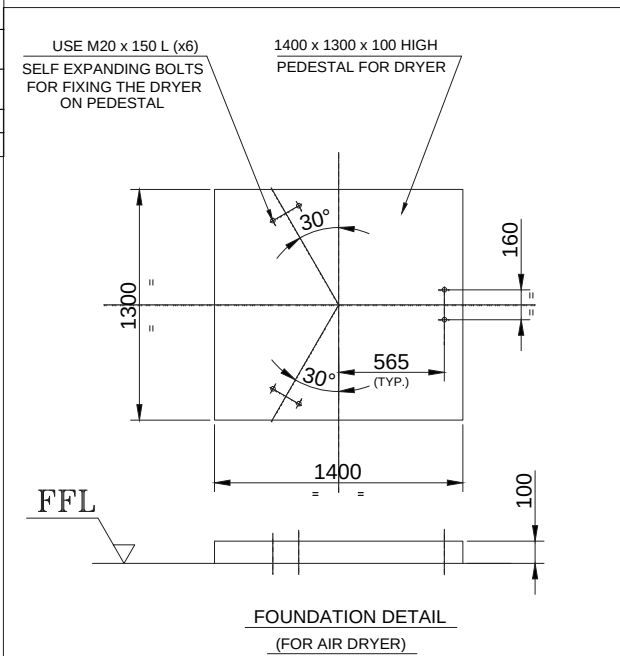
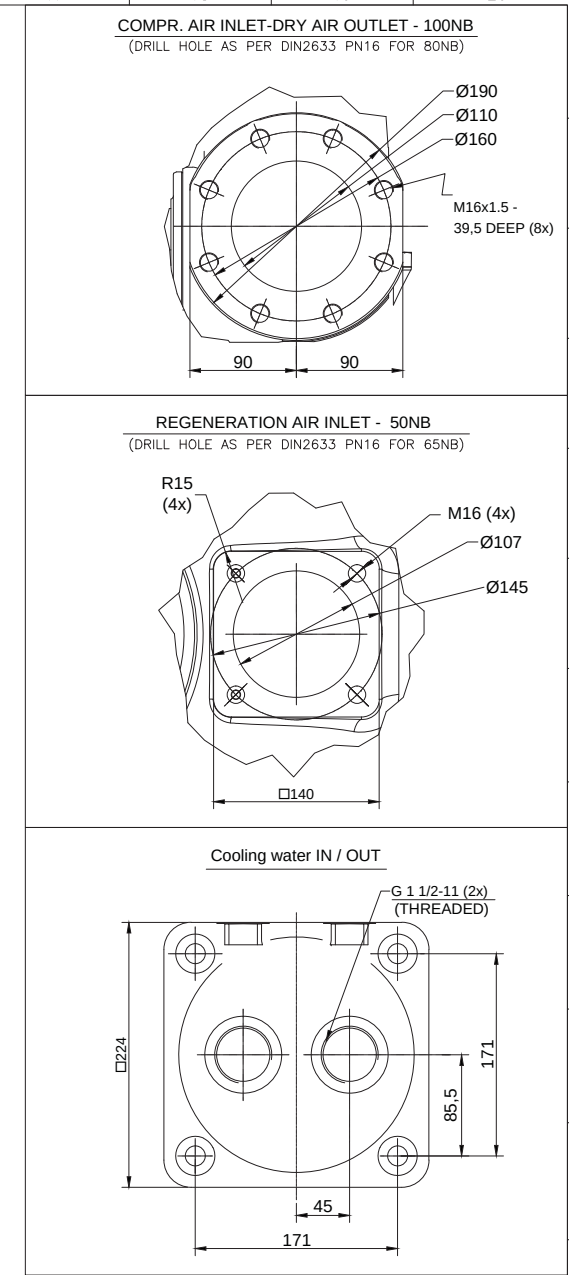
QUALITY PLAN		CUSTOMER	PROJECT TITLE		Sagardighi STPP Project Motor QAP							
345KW / 2P / DC355F900 / 3.3KV		BIDDER DOC NO: PE-VO-373-555-Q004 ACIL DOC NO: 1617500 D04	QUALITY PLAN NUMBER PED-506-00-Q-007/2		ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)							
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	SHEET 6 OF 10	SYSTEM		EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION		VOLUME III
				CAT.	TYPE/METHOD OF CHECK					AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11		
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUF'R'S SPEC.	MANUF'R'S SPEC.	Log Book	P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	P	-	-	
		3.CORE LOSS & HOT SPOT	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	P	V	(FOR MOTORS OF 2MW AND ABOVE)	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUF'R'S SPEC./BHEL SPEC.	MANUF'R'S SPEC./BHEL SPEC.	Log Book	P	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	P	V	-	
2.6	IMPREGNATION [Resin for resin poor / varnish for resin rich)	4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	P	V	-	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	P	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	P	W	FOR MV MOTOR (Tan delta - In complete motor for resin poor & on coil for resin rich)	
		1.VISCOSITY / Gel time.	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	P	-	-	
		2.TEMP.	MA	PROCESS	CONTINUOUS	-DO-	-DO-	Log Book	P	V	-	
		PRESSURE VACCUUM		CHECK								
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	P	V	THREE DIPS TO BE GIVEN in case of varnish treatment.	
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	P	V		
		BHEL		PARTICULARS	BIDDER/VENDOR							
				NAME								
		SIGNATURE										
		DATE										
										BIDDERS/VENDORS COMPANY SEAL		

		QUALITY PLAN		CUSTOMER		PROJECT		Sagardighi STPP Project			
		345KW / 2P / DC355F900 / 3.3KV		ACIL:BHEL		Sagardighi Project		Motor QAP			
		BIDDER DOC NO: PE-YO-373-555-Q004		TITLE		QUALITY PLAN					
		ACIL DOC NO: 1617500 D04		REFERENCE		ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)		FORMAT		VOLUME III	
		SYSTEM Compressed air system		EXTENT OF CHECK		ACCEPTANCE		OF RECORD		REMARKS	
SL. NO.		CHARACTERISTIC CHECK		CAT.		TYPE/ METHOD OF CHECK		DOCUMENT		NORM	
1		2		3		4		5		6	

QUALITY PLAN		CUSTOMER	ACIL:BHEL Sagardighi Project		PROJECT		Sagardighi STPP Project		Motor QAP				
345KW / 2P / DC355F900 / 3.3KV		BIDDER DOC NO: PE-VO-373-555-Q004 ACIL DOC NO: 1617500 D04		TITLE		QUALITY PLAN		NUMBER PED-506-00-Q-007/2		VOLUME III			
SHEET 9 OF 10		SYSTEM Compressed air system		ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)		SECTION		AGENCY		REMARKS			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	D	M	C	N
1	2	3	4	5	6	7	8	9	10	11			
3	ROUTINE TEST	I) MARKING ON NAME PLATE II) LOCATION OF MAIN TERMINAL BOX , ACCESSORIES & COMPLETENESS OF MOTOR III) DIMENSION CHECK AND ORIENTATION IV) DEGREE OF PROTECTION BY FEELER GAUGE V) MEAS. OF WDG. RESISTANCE AT AMBIENT TEMP VI) IR TEST FOR WDG.SPACE HEATER & RTD BEFORE & AFTER HV VII) NO-LOAD TEST READING AT STEADY STATE CONDITION VOLT.,CURRENT & INPUT WATTS ,SPEED AND BEARING TEMP VIII) LOCKED ROTOR TEST AT REDUCED VOLTAGE & READING OF VOLT., CURRENT & WATTAGE IX) REDUCED VOLTAGE RUNNING UP TEST (FOR SQ. CAGE MOTORS ONLY) (X) HIGH VOLTAGE TEST FOR WINDING & SPACE HEATER	NA NA NA NA NA NA NA NA	VISUAL VISUAL MEASUREMENT & VISUAL ELECT. & MECH. TEST ELEC. ELEC. ELEC.	100% 100% 100% 1/TYPE/ SIZE 100% 100% 100%	IS-325/ BHEL SPEC./ DATA SHEET APPROVED DRG/DATA RELEVANT IS BHEL SPEC./ DATA SHEET BHEL SPEC./ DATA SHEET BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET APPROVED DRG/DATA BHEL SPEC.AND DATA SHEET BHEL SPEC./ DATA SHEET BHEL SPEC./ DATA SHEET	INSPC. REPORT INSPC. TC INSPC. REPORT INSPC. REPORT INSPC. REPORT	P P P P P P P	W W W W W W W	TC FROM AN INDEPENDENT LABORATORY NOTE-3		
BHEL													
PARTICULARS													
BIDDER/VENDOR													
NAME													
SIGNATURE													
DATE													
BIDDER'S/VENDORS COMPANY SEAL													

[illegible]

	QUALITY PLAN 345KW / 2P / DC355F900 / 3.3KV		CUSTOMER ACIL-BHEL Sagardighi Project		PROJECT Sagardighi STPP Project					
			BIDDER DOC NO: PE-VO-373-555-Q004 ACIL DOC NO: 1617500 D04		TITLE QUALITY PLAN NUMBER PED-506-00-Q-007/2					
SHEET 10 OF 10			SYSTEM Compressed air system		ITEM: AC ELECT. MOTORS 75KW & ABOVE (MV)		SECTION			
COMPONENT/OPERATION			CAT.		REFERENCE DOCUMENT		AGENCY			
CHARACTERISTIC CHECK			TYPE/ METHOD OF CHECK		EXTENT OF CHECK		FORMAT OF RECORD			
			CHECK		NORM		D M C N			
SL. NO.							VOLUME III 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 BHEL . 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. CURRENT TEST REPORT TO BE SUBMITTED (within last 5 yrs. 0 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION WITH THE CUSTOMERS, AGENCY (I) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 5. WHEREVER WBPDCIL SHALL NOT WITNESS THE TEST, VERIFICATION OF THE TEST DOCUMENTS SHALL BE UNDERTAKEN BY THEM. Legends :- P : PERFORM, W: WITNESS, V: VERIFICATION. M= Manufacturer, C= Contractor/ Vendor, N= BHEL/ WBPDCIL. AME = AC Motor Engineering CAL = Calculation CHEM = Chemical, H = Customer Hold Point, DP = Dye penetration Test, Drg = Drawing, ELECT = Electrical, INSK = Insulation Sketch, IR = Inspection RR, MA = Major, CR=Critical,MI=Minor, MECH = Mechanical MEAS =Measurement, MPI = Magnetic Particle Inspection, PS = Purchase Specification, QC = BHEL/ BHEL nominated agency TC = Test Certificate of BHEL/ Supplier, TI = Test Instruction , UT = Ultrasonic Test, VIS = Visual TR = Test Report.										
BHEL			PARTICULARS		BIDDER/VENDOR					
			NAME							
			SIGNATURE							



**KARAN
YADAV** Digitally signed by KARAN
YADAV
DN: c=IN, o=BHARAT HEAVY
ELECTRICALS LIMITED,
ou=SENIOR ENGINEER,
postalCode=201301, st=UTTAR
PRADESH, cn=KARAN YADAV
Date: 2013.08.08 12:10:50
+05'30'

- 1) NO UNBALANCED FORCES ARE BEING TRANSFERRED DOWN TO THE FOUNDATION BECAUSE OF NO DYNAMIC UNBALANCED FORCES.
- 2) ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
- 3) FFL (+) 0.0M CORRESPONDS TO RL (+) 34.5M ABOVE MSL.
- 4) FOR TECHNICAL PARAMETERS, APPROVED DATA SHEETS SHOULD PREFERRED.

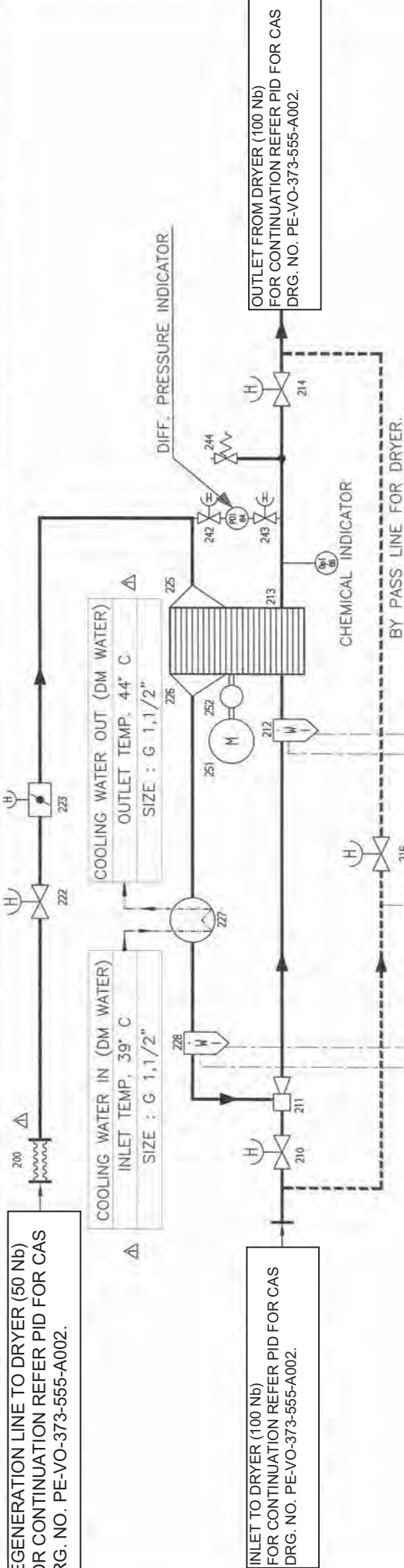
OWNER			WEST BENGAL POWER DEVELOPMENT CORPN. LTD.																						
			SAGARDIGHI THERMAL POWER PROJECT PHASE II – 2 x 500 MW																						
CONSULTANT			DEVELOPMENT CONSULTANT PRIVATE LIMITED																						
JOB NO. 373				BHARAT HEAVY ELECTRICALS LTD POWER GROUP PROJECTS ENGINEERING MANAGEMENT NEW DELHI		<table><tr><td>DEPT CODE</td><td>NAME</td><td>SIGN</td><td>DATE</td></tr><tr><td>DRN</td><td></td><td></td><td></td></tr><tr><td>DESN</td><td></td><td></td><td></td></tr><tr><td>CHD</td><td></td><td></td><td></td></tr><tr><td>APPD</td><td></td><td></td><td></td></tr></table>	DEPT CODE	NAME	SIGN	DATE	DRN				DESN				CHD				APPD		
DEPT CODE	NAME	SIGN	DATE																						
DRN																									
DESN																									
CHD																									
APPD																									
STATUS CONTRACT		DCPL DRAWING. NO. -		BHEL DRAWING. NO. PE-VO-373-555-A008																					
DISTRIBUTION				AC 1350K Mach.surf./airltd punched holes	AC 1356K Sheet metal flame cut holes	AC 1356K Welding flame cutting	REVISION	01																	
TO	MPL	C&I	MSE																						
No.OFF	1	1	1																						
REV	DATE	ALTD	CHD	APPD																					
-	-	-	-	-																					
		Name		GA DRAWING OF MD600 (W) AIR DRYER.																					
		2																							
		3																							
				Scale 1 : 1		Ref.no.		Compare 9827 5034 00. REV.03.																	
		ATLAS COPCO (I) LTD		Drawn HVG		Blank no.		Replaces —																	
		Transferred to		Std.chd.		Blank wt.																			
				Design chd.		Prod.chd.		Appd.																	
						29.04.2013.		Designation																	
								Sheet 1/1																	
Appurtenant drawings and documents.								A1 16175 00 B01																	

Page 570

2x500 MW SAGARDIGHI PHASE II - CAS**BHEL / ACIL's Reply to DCPL Comments**

Sr. No.	DWG/DOC.NO.	REV	TITLE	REMARKS
A	PE-VO-373-555-A009	02	P&ID of Air Dryer	Approved in code 3

Sr. No.	DCPL Comments	BHEL / ACIL Reply
1	1) DP transmitter being external component to the Air Dryer can be replaced in place of the Differential pressure gauge being provided. 2) Please refer sheet 14/19 in System write-Up; where it is mentioned that only the root valves (Reference 1 & 2) is provided with the Air Dryer.	It is confirmed that Differential pressure gauge provided on Air dryer comes from Atlas Copco Belgium along with dryer itself. Pressure drop across Air dryer is very less because of dryer design (only 0.3 kg/cm ²) and this parameter need not to be monitored, in isolation, from remote.
2	PDI to be rectified by DPT.	Also as per Atlas Copco standard and recommendation, the same is not required for the system. Please accept. noted & accepted
3	Are these timer based Auto Drain Trap.	Yes.



KARAN
YADAV

Digitally signed by KARAN YADAV
DN: c=IN, o=BHARAT HEAVY
ELECTRICALS LIMITED, ou=SENIOR
ENGINEER, postalCode=201301,
street=UTTAR PRADESH, cn=KARAN
YADAV

CONDENSATE COLLECTOR & DIVERTOR
LOCAL MOUNTING
MOUNTED ON CONTROL CABINET
AIR
WATER
MECHANICAL LINK
DRAIN PIPE
OPTIONAL BYPASS

[illegible]

228		WATER SEPARATOR
234		ELECTRONIC DRAIN VALVE
235		ELECTRONIC DRAIN VALVE
242		ISOLATION VALVE FOR CHECKING DIFF. PR.
243		ISOLATION VALVE FOR CHECKING DIFF. PR.
244		SAFETY VALVE
251		MOTOR
252		COUPLING (FLANGED COUPLING)
253		MANUAL DRAIN.
		DIFF. PRESSURE INDICATOR
		CHEMICAL INDICATOR

LEGEND	
200	 FLEXIBLE HOSE (LOOSE SUPPLY) Δ
210	 COMPRESSOR AIR INLET VALVE
211	 EJECTOR
212	 WATER SEPARATOR
213	 ROTOR—DRUM
214	 COMPRESSOR AIR OUTLET VALVE
216	 BYPASS ISOLATION VALVE
222	 REGENERATION LINE ISOLATION VALVE (LOOSE SUPPLY)
223	 REGENERATION LINE FLOW CONTROL VALVE (LOOSE SUPPLY)
225	 REGENERATION LINE INLET
226	 REGENERATION LINE OUTLET
227	 REGENERATION AIR COOLER (WATER COOLED)

 DEVELOPMENT CONSULTANTS PVT. LIMITED.		referred only for general comments with contract drawings and for fulfillment of detailed requirements of contract documents	
ACTION	2	DISTRIBUTED BY	T. KUNDU
DATE	18.12.2013	1	Approved except as noted. Re-issuance required
2	Approved	5	Disapproved see accompanying letter
3	Approved except as noted. Forward final drawings	6	For information only
LETTER REF NO.		2682	DATE
			18.12.2013

5X500 MW SAGARDIGHI PHASE II**COMPRESSED AIR SYSTEM****BHEL / ACIL's reply to DCPL Comments**

Sr. No.	DWG/DOC.NO.	REV	TITLE	REMARKS
A	PE-VO-373-555-A010	01	Datasheet of Air Dryer	Approved in code 3

Sr. No.	DCPL Comments	BHEL / ACIL Reply
A	Datasheet of Air Dryer.	
1	MOC of the Vessel shall be SS-304, as per Technical Specification.	These Air dryers are fully imported from Atlas Copco Belgium. As per their manufacturing standard, MOC of vessel is: SA 395 / EN-GJS-400-18 that is suitable for high temperature, Pressure retaining casting. This is proprietary in nature and manufacturing with alternate material is not possible. Please accept.

	SAGARDIGHI EXTENSION TPP (2 X 500 MW)		BHEL Doc No: PE-VO-373-555-A010																															
			REV	02																														
			DATE	28.11.2013																														
			SHEET 1 OF 2																															
Digitally signed by KARAN YADAV DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=SENIOR ENGINEER, postalCode=201301, st=UTTAR PRADESH, cn=KARAN YADAV Date: 2013.11.29 15:27:04 +05'30'  DEVELOPMENT CONSULTANTS PVT. LIMITED. Reviewed only for general conformance with contract drawings and specifications. Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents <table border="1"> <tr> <td>ACTION</td> <td>2</td> <td>DATE</td> <td>13.12.2013</td> </tr> <tr> <td colspan="4">DISTRIBUTED BY. T.KUNDU</td> </tr> <tr> <td>1</td> <td>Distributed</td> <td>4</td> <td>Approved except as noted. Resubmission required</td> </tr> <tr> <td>2</td> <td>Approved</td> <td>5</td> <td>Disapproved see accompanying letter</td> </tr> <tr> <td>3</td> <td>Approved except as noted. Forward final drawings</td> <td>6</td> <td>For information only</td> </tr> <tr> <td colspan="4">SEE COVERING LETTER</td> </tr> <tr> <td>LETTER REF NO.</td> <td>2665</td> <td>DATE.</td> <td>13.12.2013</td> </tr> </table>							ACTION	2	DATE	13.12.2013	DISTRIBUTED BY. T.KUNDU				1	Distributed	4	Approved except as noted. Resubmission required	2	Approved	5	Disapproved see accompanying letter	3	Approved except as noted. Forward final drawings	6	For information only	SEE COVERING LETTER				LETTER REF NO.	2665	DATE.	13.12.2013
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Date	Rev	Description of Revision	ALT	CHD	APPD																													
CUSTOMER : WB POWER DEVELOPMENT CORPN. LTD. SAGARDIGHI TPP PHASE 2 (2X500 MW)																																		
 CUSTOMER'S CONSULTANT : DEVELOPMENT CONSULTANTS (P) LTD.																																		
 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA																																		
 ATLAS COPCO INDIA LIMITED, PUNE																																		
JOB No.	373	BHEL Doc. No: PE-VO-373-555-A010				Rev: 02																												
STATUS	CONTRACT																																	
PACKAGE		COMPRESSED AIR SYSTEM																																
TITLE		Datasheet of Air Dryer			ACIL Doc. No : 16175 00 B04																													
PREPARED BY		Dnyaneshwar Mahajan		-sd-																														
CHECKED BY		Manish Gandhi		-sd-																														
APPROVED BY		Manish Gandhi		-sd-																														

PROJECT		2x500 MW PH II, Sagardighi, TPP
ACIL Doc. No: 16175 00 B04, BHEL Doc. No: PE-VO-373-555-A010		
SR. NO.	DATA SHEET	DESCRIPTION
A	AIR DRYER	
1	MANUFACTURER	ATLAS COPCO AIRPOWER, BELGIUM
2	MODEL NUMBER	MD 600W
3	TYPE OF DRYER	ROTARY DRUM TYPE DRYER
4	TOTAL NOS. OFFERED	05 NOS.
5	TYPE OF OPERATION	CONTINUOUS
6	LOCATION	INDOOR
7	QUALITY SURVEILLANCE BY	BHEL / WBPDC
8	MATERIAL TESTING & IDENTIFICATION	AS PER APPROVED QAP
B	GUARANTEED PERFORMANCE	
1	RATED FLOW [Maximum]	36 Nm ³ /Min
2	DEW POINT METER AT AIR DRYER OUTLET (AT ATMOSPHERIC PRESSURE)	- 40 DEG. C
3	AIR PRESSURE DROP	0.3 BAR
4	MAX. ELECTRIC POWER INPUT	0.12 KW
5	COOLING WATER CONSUMPTION CORRESPONDING TO WATER TEMP. RISE OF 5 DEG.C	2.5 LPS
C	MATERIAL OF CONSTRUCTION	
1	VESSEL	SA 395 / EN-GJS-400-18
2	ROTORS	INORGANIC FIBRE
3	DESICCANT	SILICA GEL
4	REGENERATION COOLER	ALUMINIUM
5	GEAR BOX	
	HOUSING	CAST IRON (CG 20)
	GEARS	CAST BRONZE
6	THROTTLE VALVE	
	HOUSING	STAINLESS STEEL
	SPINDLE & VALVE	STAINLESS STEEL
7	DRAIN VALVE	
	HOUSING	CAST AL
	FLOAT	STAINLESS STEEL
8	EJECTOR	CAST AL. (G-AL Si 5Mg)
9	INLET SEALING SECTOR	CAST AL. (G-Al Si 7Mg Wa)
D	SIZE & TYPE OF CONNECTION	
1	COMPRESSED AIR INLET	100 NB
2	DRY AIR OUTLET	100 NB
3	WATER INLET & OUTLET	G 1 1/2 "
E	NET WEIGHT	980 KG

2X500 MW SAGARDIGHI TPP PHASE 2.
COMPRESSED AIR SYSTEM
Reference: DCPL transmittal no. DCPL-K8A07/DCH-4/BHLPEM/2169 Dated 13.08.2013
Reply/Compliance to DCPL comments on QAP of Air dryer (Rev 01)
Doc. No.: PE-VO-373-555-Q002.

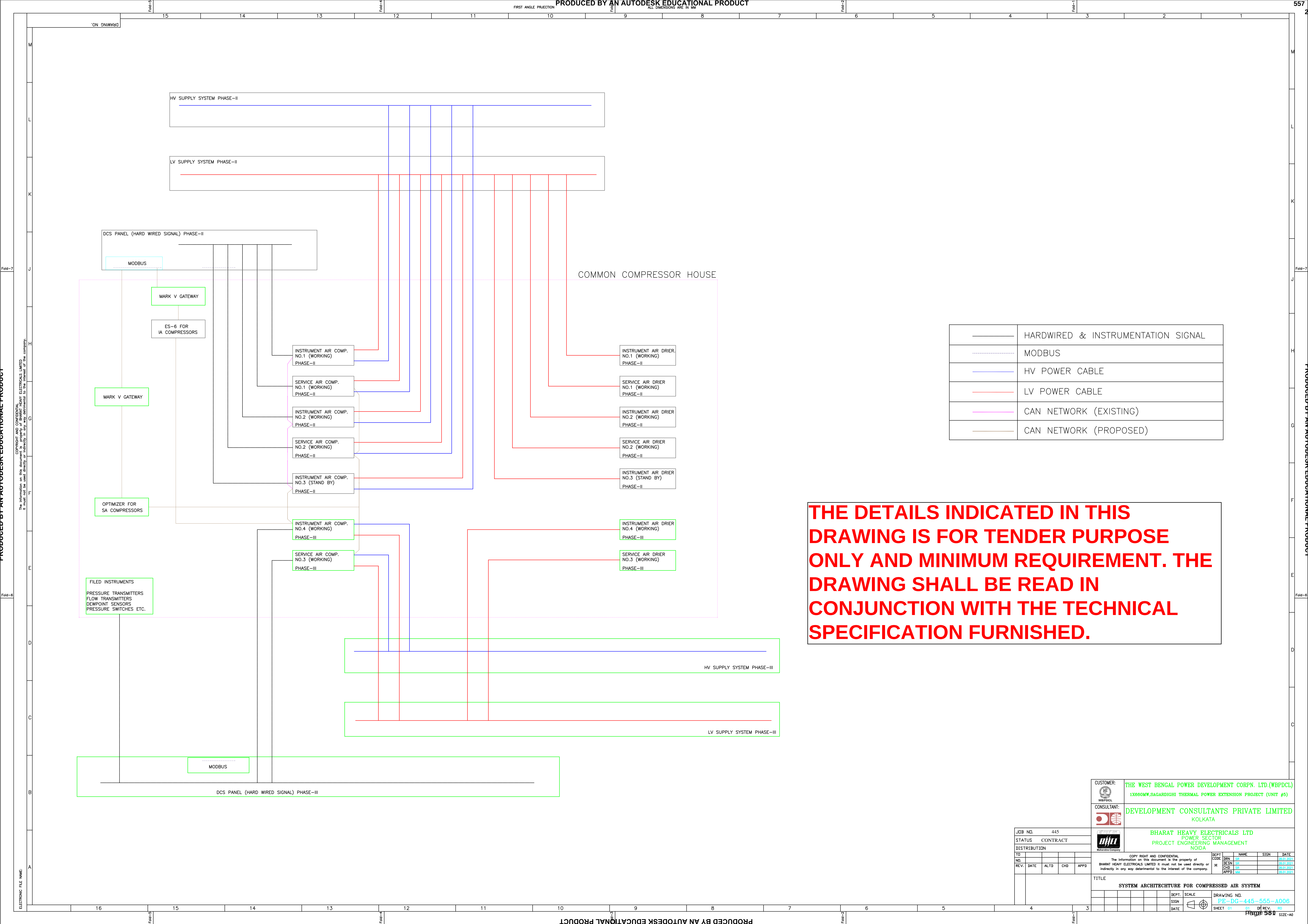
S.No.	DCPL Comment	BHEL / ACIL Reply
1	Pls put 1,2 in all boxes under W column for inprocess inspection.	Please note that Air Dryers are completely assembled & tested at ACIL Belgium only. nNo any additional activity is carried on Air dryer at ACIL, Pune. Normally Air Dryers is not offered for inspection since it is completely Imported Item but as a special case final inspection, mechanical run test, of the Air Dyers is being offered. Please accept.

	SAGARDIGHI EXTENSION TPP (2 X 500 MW)		BHEL Doc No: PE-VO-373-555-Q002																							
			REV	02																						
			DATE	05.10.2013																						
			SHEET 1 OF 3																							
Digitally signed by KARAN YADAV DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=SENIOR ENGINEER, postalCode=201301, st=UTTAR PRADESH, cn=KARAN YADAV Date: 2013.10.05 17:45:18 +05'30' KARAN YADAV  DEVELOPMENT CONSULTANTS PVT. LIMITED. Reviewed only for general conformance with contract drawings and specifications. Contractor to be responsible for any errors and for fulfillment of detailed requirements of contract documents <table border="1"> <tr> <td colspan="2">ACTION 2*</td> <td>DATE 16.10.13</td> </tr> <tr> <td colspan="3">DISTRIBUTED BY: T.KUNDU</td> </tr> <tr> <td>1</td> <td>Distributed</td> <td>4 Approved except as noted. Resubmission required</td> </tr> <tr> <td>2</td> <td>Approved</td> <td>5 Disapproved see accompanying letter</td> </tr> <tr> <td>3</td> <td>Approved except as noted. Forward final drawings</td> <td>6 For information only</td> </tr> <tr> <td colspan="3">SEE COVERING LETTER</td> </tr> <tr> <td colspan="2">LETTER REF NO. 2387</td> <td>DATE. 16.10.13</td> </tr> </table>						ACTION 2*		DATE 16.10.13	DISTRIBUTED BY: T.KUNDU			1	Distributed	4 Approved except as noted. Resubmission required	2	Approved	5 Disapproved see accompanying letter	3	Approved except as noted. Forward final drawings	6 For information only	SEE COVERING LETTER			LETTER REF NO. 2387		DATE. 16.10.13
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05.10.2013	02	Submitted for approval.																								
23.07.2013	01	Submitted for Approval																								
13.05.2013	00	Submitted for Approval																								
Date	Rev	Description of Revision	ALT	CHD	APPD																					
		CUSTOMER : WB POWER DEVELOPMENT CORPN. LTD. SAGARDIGHI TPP PHASE 2 (2X500 MW)																								
		CUSTOMER'S CONSULTANT : DEVELOPMENT CONSULTANTS (P) LTD.																								
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JOB No.	373	BHEL Doc. No: PE-VO-373-555-Q002			Rev: 02																					
STATUS	CONTRACT																									
PACKAGE		COMPRESSED AIR SYSTEM																								
TITLE		QAP of Air Dryer MD 600		ACIL Doc. No : 16175 00 B05																						
PREPARED BY		Dnyaneshwar Mahajan	-sd-																							
CHECKED BY		Manish Gandhi	-sd-																							
APPROVED BY		Manish Gandhi	-sd-																							
																										

		MANUFACTURER'S NAME & ADDRESS ATLAS COPCO AIRPOWER N.V, BELGIUM ATLAS COPCO INDIA LTD.		MANUFACTURING QUALITY PLAN					PROJECT		SAGARDIGHI TPP PHASE - II (2 X 500 MW)	
				ITEM : AIR DRYER MODEL MD 600 SUB SYSTEM COMPRESSED AIR SYSTEM.	QP NO. : PE-VO-373-555-Q002 REV : 02 DATE : 11.09.2013	ACCEPTANCE	CONTRACTOR CONSULTANT	CONTACTOR CONSULTANT	REMARKS			
SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTITY OF CHECK	REFERENCE DOCUMENTS	8	9	10	11		
1	2	3	4	5	6	7	8	9	10	11		
A MATERIAL INSPECTION												
1.1	ROTOR DRUM	CHEMICAL	MAJOR	CHEMICAL ANALYSIS	1 / BATCH	APPROVED DATASHEET	COMPLIANCE TO "7"	CONFIRMITY CERTIFICATE	3	1,2		
1.2	DRYER VESSEL COMPLETE	DIMENSIONS MECHANICAL	MAJOR	DIMENSIONS MECH. PROPERTIES	100% 1 / BATCH	APPROVED GA DRAWING APPROVED DATASHEET	COMPLIANCE TO "7"	CONFIRMITY CERTIFICATE	3	1,2		
1.3	REGENERATION COOLERS	MECHANICAL CHEMICAL	MAJOR	CHEMICAL & MECHANICAL	1 / BATCH	APPROVED DATASHEET	COMPLIANCE TO "7"	CONFIRMITY CERTIFICATE	3	1,2		
B INPROCESS INSPECTION												
2.1	REGENERATION COOLERS	TIGHTNESS	MAJOR	HYDROSTATIC	100%	ACIL MFG. STD	COMPLIANCE TO "7"	CONFIRMITY CERTIFICATE	3	1,2		
2.2	DRYER VESSEL WATER SEPARATOR	TIGHTNESS	MAJOR	HYDROSTATIC	100%	ACIL MFG. STD	COMPLIANCE TO "7"	CONFIRMITY CERTIFICATE	3	1,2		
2.3	WATER SEPARATOR GEAR BOX DRAIN VALVES MOTOR	FUNCTIONAL	MAJOR	FUNCTIONAL	1 / BATCH	ACIL MFG. PROCEDURE	COMPLIANCE TO "7"	CONFIRMITY CERTIFICATE	3	1,2		
MANUFACTURER SUBCONTRACTOR		CONTRACTOR		LEGEND : * RECORDS IDENTIFIED WITH ✓ SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION. ** 3 - MANUFACTURER / SUBCONTRACTOR 2 - WBPCL / Nominated IA , 1 - BHEL INDICATE "p" PERFORM "w" WITNESS & "v" VERIFICATION AS APPROPRIATE								
		SIGNATURE										

MANUFACTURER'S NAME & ADDRESS				MANUFACTURING QUALITY PLAN					PROJECT		SAGARDIGHT TPP PHASE - II (2 X 500 MW)			
ATLAS COPCO AIRPOWER N.V, BELGIUM ATLAS COPCO INDIA LTD.				ITEM :		QP NO. : PE-VO-373-555-Q002					CONTRACTOR CONSULTANT BHARAT HEAVY ELECTRICALS LTD. DEVELOPMENT CONSULTANTS (P) LTD.			
				AIR DRYER		REV : 02								
				MODEL MD 600		DATE : 11.09.2013								
				SUB SYSTEM		COMPRESSED AIR SYSTEM.								
SR. NO.	COMPONENTS AND OPERATORS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE	FORMAT OF RECORD	AGENCY**			REMARKS		
1	2	3	4	5	6	7	8	9	10			11		
3.1	ASSEMBLY & TESTING	DIMENSIONAL APPERANCE & COMPLETENESS MECH. RUN TEST LEAK TIGHTNESS	MAJOR	MEASUREMENT VISUAL FUNCTIONAL TEST HYDROSTATIC	100%	APPROVED GA DRG ACIL MFG. STD	COMPLIANCE TO "7" APPROVED DRG. NO LEAKAGE	✓ ✓	3 3 3	1,2 1,2 1,2				
C	FINAL INSPECTION AT ATLAS COPCO 4.1 INDIA	DIMENSIONAL APPERANCE & MECH. RUN TEST OF COMPLETE DRYER & LEAKAGE TEST WITH SOAP SOLUTION	MAJOR	MECH. RUN TEST VISUAL	100%	ACIL MFG. STD	SMOOTH OPERATION NO LEAKAGE	✓	3 3	1,2 1,2				
D	PACKING & DISPATCH 5.1 PACKING SHIPPING	CHECK DOC. PACKING	MAJOR	VERIFICATION	1 / BATCH	ACIL PACKING PROCEDURE	AS PER PACKING PROCEDURE		3	1,2				
E	REVIEW OF QA DOCS									1,2				
MANUFACTURER SUBCONTRACTOR		CONTRACTOR		LEGEND :										
				* RECORDS IDENTIFIED WITH ✓ SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.										
				** 3 - MANUFACTURER / SUBCONTRACTOR										
				2 - WBPDCI / Nominated 1A, 1 - BHEL										
				INDICATE "P" PERFORM "W" WITNESS & "V" VERIFICATION AS APPROPRIATE										

Note : - 1. All material of construction shall be as per Specifications / Approved Drawings / Approved Datasheet by WBPDCI / DCPL as and where applicable. Drawing / Documents which are not under the approval of WBPDCI / DCPL must be approved by BHEL.



CUSTOMER:	THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.(WBPDCL) 1X860MW,SAGARDIGHI THERMAL POWER EXTENSION PROJECT (UNIT #5)		
CONSULTANT:	DEVELOPMENT CONSULTANTS PRIVATE LIMITED KOLKATA		
JOB NO.	445	DEPT	CODE
STATUS	CONTRACT	NAME	SIGN
DISTRIBUTION	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT Noida		
TO	NO.	REV.	DATE
REV.	DATE	ALT	CHD
TITLE			
SYSTEM ARCHITECHTURE FOR COMPRESSED AIR SYSTEM			
DRAWING NO.			
SHEET 01			
DATE			

266568/2021/PS-PEM-MAX

SECTION-6 Guaranteed Power Consumption For Compressed Air System				Doc No:	PE-TS-445-555-A001	
				Rev No:	0	
				Date of issue	Mar. 20	
NAME OF PROJECT:		KAHALGAON TPS – FGD				
NAME OF PACKAGE:		COMPRESSED AIR SYSTEM				
TECHNICAL SPECIFICATION:		PE-TS-481-555-A001				
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	Standby			
		A	B			
1	Instrument Air Compressors (Oil free Screw type) of capacity 36 NM3/min.	1	0	to be filled by bidder	0.67	to be filled by bidder
2	Service Air Compressors (Oil free Screw type) of capacity 36 NM3/min.	1	0	to be filled by bidder	0.33	to be filled by bidder
3	HOC Air Dyrer of capacity 36 NM3/min.	2	0	to be filled by bidder	0.5	to be filled by bidder
					TOTAL	to be filled by bidder
Note :						
1	Estimated Power Consumption Figure for the compressed air system (For Working Drives Only) considered is 306.5 KW .					
2	Bidders Guaranteed power consumption at motor input terminal at rated duty of Air Compressor considering motor efficiency as confirmed by motor OEM including Air Drying Plant (Heater and Blowers, as applicable) as furnished in guranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.					
3	The price quoted by the bidder shall be loaded @ INR 4,62,000 /- for every additional KW increase in consumption from the base figure indicated at Note no. 1.0 above.					
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (base figure of auxiliary power consumption or the GPC quoted by bidder, whichever is higher) on actual performance testing at the manufacturing works / site, penalty INR 4,62,000 /- per KW increase in power consumption figure shall be levied.					
Particulars of bidder / authorised representative						
Name	Designation	Signature	Date	Date	Company Seal	