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broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

- 2.04.02 The mandatory spares should be supplied to the Owner at least one month before the trial run. The despatch programme is subject to approval of the Owner/Consultant after award of contract.



**TECHNICAL SPECIFICATION  
4X270 MW BHADRADRI TPS  
TECHNICAL SPECIFICATIONS  
AIR CONDITIONING SYSTEM**

**SPECIFICATION NO. PE-TS-411-553-A001**


**Section- C1-C**

**REV. 01**

**DATE: MAY 2015**

**SECTION: C1- C**

**FUNCTIONAL / PERFORMANCE / DEMONSTRATION GUARANTEE**

	<b>TECHNICAL SPECIFICATION 4X270 MW BHADRADRI TPS TECHNICAL SPECIFICATIONS AIR CONDITIONING SYSTEM</b>		<b>SPECIFICATION NO.PE-TS-411-553-A001</b>
			<b>Section- C1-C</b>
	<b>REV. 01</b>	<b>DATE: MAY 2015</b>	

## 1. TRIAL OPERATION / COMMISSIONING / COD AND HANDING OVER:

### A) Trial Operation

- i. On completion of erection of any major items along with its auxiliaries, the same shall be thoroughly inspected by the Contractor together with TSGENCO's Engineers for correctness and completeness and acceptability for Pre Commissioning Tests. Though the TSGENCO's Engineers associate themselves with such inspection, the responsibility for declaration for correctness, completeness and acceptability shall rest with the Contractor and the pre-commissioning tests shall be carried out after such declaration. The pre-commissioning tests to be performed at site as well as necessary documentation and formats for the protocols to be signed during and after the tests shall be prepared by the Contractor taking into account relevant Indian / International / Manufacturers' standards as applicable and finalized by the TSGENCO sufficiently in advance through mutual discussions. On conclusion of satisfactory pre-commissioning tests of each individual equipment, the trial operation of each unit (total 4 units) shall start consistent with parameters of the technical specifications.
- ii. The duration of trial operation shall be for 14 days during which period the unit shall run as follows:
  - a. Half to full load or any other load cycle mutually agreed to during which period the unit shall also run on economical load (90% of Full / Available Load) for 48 hours continuously.
  - b. During the above trial operation the standby auxiliary equipment shall also run for a minimum period of more than 72 hours during which period the equipment including standby equipment shall run at its rated capacity for a maximum period of 24 hrs subject to (a) above.
  - c. Full load continuous operation for seventy two (72) hours.  
Any interruption caused by the Contractor up to 24 hours will not affect the period of 14 days trial operation indicated above. In case of such interruption occurring for more than 24 hours, the above period shall be extended correspondingly. The unit is deemed to be commissioned on successful completion of the above trial operation. Upon successful completion of trial operation, a protocol shall be signed by the both parties.
- iii. A document shall be prepared on the results of trial operation. This document besides recording of the details of the various observations .during the trial run will also include the date of start and finish of the trial operation and will be signed by the representative of both the parties. The document of the trial operation shall have log sheets and all adjustments, repairs, interruptions etc., shall be recorded therein.
- iv. The readiness of the unit for the trial operation shall be intimated by written notice to TSGENCO. After receipt of such notice and a consent within 15 days from TSGENCO, if the trial operation could not be performed or could not be completed due to any reasons not attributable to the Contractor, the Contractor shall be absolved of the responsibility for the delay and the plant shall be deemed to have been taken over by the TSGENCO at the end of 60 days after the Contractor's notifications of readiness of the same. In case TSGENCO does not reply within 15 days from contractors notification of readiness of Trial Operation, the responsibility of insurance of plant and equipment shall pass on to TSGENCO.



**TECHNICAL SPECIFICATION  
4X270 MW BHADRADRI TPS  
TECHNICAL SPECIFICATIONS  
AIR CONDITIONING SYSTEM**

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**Section- C1-C**

**REV. 01**

**DATE: MAY 2015**

- v. The trial operation shall be carried out in compliance with relevant manufacturers standards and / or relevant Indian / International standards and manufacturers operation directions before starting them.
- vi. Defects which are minor in nature and do not endanger the safe operation of the plant, shall not be considered as reasons for not taking over the plant by the TSGENCO. These defects shall be listed in the above mentioned documents and shall be rectified by the Contractor in accordance with the agreement made in this respect.

**2. ACCEPTANCE TEST**

Room condition test shall consist of taking the reading of dry bulb and wet bulb temp at different locations points to be mutually decided at site in the areas which are air-conditioned by the respective system / plant. Room condition test shall be done after stabilization of the system. The dry and wet bulb temp shall be measured by measured by sling psychrometer which will have accuracy of +/-0.5% with a least count of 0.5 degC. This will be carried out for 24 hrs continuously and readings will be taken every two hours. Standby equipment should be changed over during these 24 hours. This test shall be carried out during summer between months April to June when the dry bulb temp is generally high. The format for recording the readings is as under. Relative humidity shall be determined from psychometric chart. Temperature shall be measured when the plant is working in full load and Power consumption shall also be demonstrated.

**FORMAT FOR RECORDING ROOM CONDITION TEST**

**Instrument Used & s.l. No:**

**Reading Set No:**

**Location:**

**Date:**

<u>TIME / HRS.</u>	<u>OUTSIDE CONDITION</u>		<u>INSIDE CONDITION</u>	
	<u>READING</u>	<u>READING</u>	<u>READING</u>	<u>READING</u>
	<u>DRY BULB ( DEG C )</u>	Wet bulb ( Deg C )	Dry bulb ( Deg C )	Wet bulb ( Deg C )



**TECHNICAL SPECIFICATION  
4X270 MW BHADRADRI TPS  
TECHNICAL SPECIFICATIONS  
AIR CONDITIONING SYSTEM**

**SPECIFICATION NO. PE-TS-411-553-A001**

**Section: C1-D**

**REV. 00**

**DATE: APRIL 2015**

**SECTION: C1- D**

**INSPECTION, TESTING AND QUALITY ASSURANCE**



TITLE

## AIR-CONDITIONING SYSTEM INSPECTION AND TESTING

SPECIFICATION NO. PE-TS-410-553-A001

VOLUME

SECTION - E

REV 00 DATE 11.03.2015

SHEET 1 OF 3

### 1.00.00 INSPECTION AND TESTING

#### 1.01.00 Inspection and Tests during Manufacture.

1.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

1.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

1.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

1.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.

The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.

For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.

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

1.01.06 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.

1.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.

  
Arvind


  
S A Khan


  
Praveen Kishore



TITLE

## AIR-CONDITIONING SYSTEM INSPECTION AND TESTING

SPECIFICATION NO. PE-TS-410-553-A001

VOLUME

SECTION - E

REV 00 DATE 11.03.2015

SHEET 2 OF 3

- 1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.
- 1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.
- 1.01.10 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 penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnaflex and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.
- Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.
- 1.02.00 **Performance Tests at Site**
- 1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to test on completion and commissioning of the complete system/equipment.
- 1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.
- All Statutory testing / clearance is in Bidder's scope including payment of all fees, etc. as required
- 1.04.00 **AIR CONDITIONING SYSTEM**
- AT SHOP**
- 1.04.01 Power consumption of chilled & condenser water pumps, chilling units, condensing units, air handling units, package air conditioners & cooling towers of AC system at rated duty point with respective job motors.

  
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Praveen Kishore



TITLE

## AIR-CONDITIONING SYSTEM INSPECTION AND TESTING

SPECIFICATION NO. PE-TS-410-553-A001

VOLUME

SECTION - E

REV 00 DATE 11.03.2015

SHEET 3 OF 3

1.04.02 Capacity & head of all the fans of AC system of all the areas.

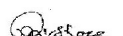
AT SITE

1.04.03 AC Plant capacity of each area and guaranteed room condition during summer and monsoon for all the Air conditioned area along with the power consumption of air conditioning units.

1.04.04 Parallel operation, vibration & noise level of all rotating equipment.

  
Arvind

  
S A Khan

  
Praveen Kishore

PROJECT :	SYSTEM :
VENDOR :	ITEM :

[illegible]


## 1. BHEL

QIP No	CAS/SQP/31	Signature	Date	Customer/Consultant	Bhel	Vendor
	Rev		Name			
Page No	1 of 1		Party			

MANUFACTURE'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 4x270 MW MANJUGURU TPS					
						Q.P. NO. :					
		ITEM : SCREW CHILLER				PACKAGE : AIR CONDITIONING					
						REV. :					
		SUB-SYSTEM : AIRCONDITIONING				CONTRACT NO. : K-27					
						CONTRACTOR : BHARAT HEAVY ELECTRICALS LTD					
						PAGE 1 OF 1					
						SUB CONTRACTOR :					
SL. No	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY		
									M	C N	
1	2	3	4	5	6	7	8	9		10	11
1	Material Test for condenser	Visual, Physical & Chemical	Major	VISUAL, MEASUREMENT, CHEMICAL & MECHANICAL	1 / BATCH	Manuf. STD./APPVD DATA SHEET	Manuf. STD./APPVD DATA SHEET	MFR. TEST CERTIFICATE	✓	P	V
2	Pressure Test for condenser	Leak proofness	Critical	PNEUMATIC / HYDRAULIC TEST	100%	---	---	---	✓	P	V
3	Material Test for evaporator	Visual, Physical & Chemical	Major	VISUAL, MEASUREMENT, CHEMICAL & MECHANICAL	1 / BATCH	Manuf. STD./APPVD DATA SHEET	Manuf. STD./APPVD DATA SHEET	MFR. TEST CERTIFICATE	✓	P	V
4	Pressure Test for evaporator	Leak Proofness	Critical	PNEUMATIC / HYDRAULIC TEST	100%	---	---	---	✓	P	V
5	Chilling Unit	Leak Proofness	Critical	N <sub>2</sub> LEAK TEST	100%	Manuf. STD.	Manuf. STD.	---	✓	P	V
6	Chilling Unit	Leak Proofness	Critical	VACUUM TEST	100%	Manuf. STD.	Manuf. STD.	---	✓	P	V
7	Complete Air Run Test for compressor	No Load Test	Major	VISUAL - AIR RUN TEST	100%	SGL3 REV-3 OF CARLYLE REQUIREMENTS	SGL3 REV-3 OF CARLYLE REQUIREMENTS	---	✓	P	V
8	Run Test	Functional Test	Critical	VISUAL	100%	Manuf. STD./APPD. DATA SHEET	Manuf. STD./APPD. DATA SHEET	---	✓	P	V
		LEGEND		FOR CUSTOMER USE				DOC NO.			
MANUFACTURER / CONTRACTOR		D : Records identified with "Tick" shall be essentially included by contractor in QP documentation.				REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY			
SIGNATURE		M : Manufacturer, C : Contractor, Customer (BHEL), Performer W : Witness V : Verification									

QAP MAY BE CHANGED DURING DETAILED ENGINEERING (MUTUALLY AGREED BETWEEN BHEL & VENDOR)

MANUFACTURING QUALITY ASSURANCE PLAN (QAP) FOR PRECISION AIR CONDITIONING															
Name of Agency :				PRECISION AIR CONDITIONING Project : 4x270 MW MANUGURU TPS				QAP NO : REV NO : R0  DATE : PAGE : 1 OF 1							
Sr No	Components & Operations	Characteristics	Class	Type of check	Quantum of check	Reference Document	Acceptance Norms	Format of Record	Agency			Remarks			
1	2	3	4	5	6	7	8	9	P	W	V	11			
1.0	Material														
1.1	Humidifier ( If Applicable )	Rating	Major	Visual	1 per lot	Factory Order / Data Sheet	as per col 7	Electrical QA report	1	-	2				
		ON/OFF check	Major	Electrical	1 per lot		as per col 7	Electrical QA report	1	-	2				
1.2	Heater ( If Applicable )	Rating	Major	Visual	1 per lot	Factory Order	as per col 7	Electrical QA report	1	-	2				
		ON/OFF check	Major	Electrical	1 per lot		as per col 7	Electrical QA report	1	-	2				
1.3	compressor	Rating	Major	Visual	1 per lot	Factory Order / Data Sheet	as per col 7	Job order sheet	1	-	2				
		Over all finish	Major	Visual	1 per lot	Data sheet	as per col 7	Mech QA report	1	-	2				
1.4	sheet metal	Measurement	Major	Visual	1 per lot	Production drawing	as per col 7	sheet metal QA report	1	-	2				
		Over all finish	Major	Visual	1 per lot	Production drawing	as per col 7	sheet metal QA report	1	-	2				
2.0	Inprocess Inspection														
2.1	Evaporator Coil	Measurement	Major	Visual	1 per lot	Production drawing	as per col 7	Supplier / Incoming insp report	1	-	2				
		Over all finish	Major	Visual	1 per lot	Production drawing	as per col 7		1	-	2				
		Holding pressure	Major	Visual	1 per lot	Production drawing	as per col 7	Pressure test QA report	1	-	2				
2.2	Condenser	Rating	Major	Visual	1 per lot	Production drawing	as per col 7	Job order sheet odu	1	-	2				
		Over all finish	Major	Visual	1 per lot	Production drawing	as per col 7	Job order sheet odu	1	-	2				
2.3	Controller	Alarm check	Major	Electrical	1 per lot	Data sheet	as per col 7	Controller alarm QA report	1	-	2				
3.0	Final Inspection														
3.1	Fan Run test	Over all finish	major	Visual	1 per lot	Factory Order / Data Sheet	Approved Data sheet/ drawing	Inspection Report	1	3.2					
		Pressure test of coil	major	Visual	1 per lot		325 PSI for 15 min	IIR	1	3.2					
		Noise	major	Mesurement	1 per lot		85 DBA at 1.5 meter	Inspection Report	1	3.2					
LEGEND															
P : PERFORMED BY															
W : WITNESS BY															
V : VERIFIED BY															
1 : Manufacturer															
2 : Sub-contractor (AC Supplier)															
3: Customer (BHEL)															
QAP MAY BE CHANGED DURING DETAILED ENGINEERING/MUTUALLY AGREED BETWEEN BHEL & VENDOR															
SUBMITTED BY															
NAME AND SIGNATURE OF THE APPROVING AUTHORITY															

<div></div>		QUALITY PLAN		CUSTOMER : BHEL		PROJECT: 4x270 MW MANUGURU TPS		SPECIFICATION :													
SL. NO.		COMPONENT/OPERATION		CHARACTERISTICS CHECK		SYSTEM		BIDDER/ VENDOR		TITLE		SPECIFICATION									
								TITLE		TITLE											
SHEET 1 OF 2		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		SECTION AGENCY		VOLUME III					
1		2		3		4		5		6		7		8		9		10		11	
1.0	ASSEMBLY	1.WORKMANSHIP		MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	MANUF'S SPEC	-DO-	3	2 -									
		2.DIMENSIONS		MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	3	2 -										
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE		MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	3	2 -										
2.0	PAINTING	1.SHADE		MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	3	2 -										
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.		MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	3	2	1	NOTE -1 & NOTE-3								
		2.OVERALL DIMENSIONS & ORIENTATION		MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	3	2	1	NOTE -1 & NOTE-3								
BHEL		PARTICULARS		BIDDER/VENDOR																	
		NAME																			
		SIGNATURE																			
		DATE																			

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MANUFACTURE'S NAME & ADDRESS				MANUFACTURING QUALITY PLAN				PROJECT : 4x270 MW MANJIGURU TPS				
				ITEM : FIRE DAMPER				PACKAGE : AIR-CONDITIONING SYSTEM				
				SUB SYSTEM : AC SYSTEM				CONTRACT NO.				
								SUB CONTRACTOR :				
SL NO	DESCRIPTION OF COMPONENTS AND OPERATION	CHARACTERISTICS	CLASS	TYPE & METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARK
1	2	3	4	5	6	7	8	9	10	11	12	
<b>A</b>	<b>RAW MATERIAL</b>											
1	DAMPER-CASING & LOUVER	BEND TEST & CHEMICAL ANALYSIS	MAJOR	LAB TEST	SAMPLE FROM LOT	IS 277-1992	IS 277-1992	TESTING LAB REPORT	V	C	N	LAB TC TO BE SUBMITTED
2	DAMPER SHAFT	CHEMICAL, MECHANICAL & DIMENSION	MAJOR	LAB TEST	SAMPLE FROM LOT	INDEPENDENT LAB TEST TREPORT	MANUFACTURING STD.	TESTING LAB REPORT	V	V	V	
3	BUSH	DIMENSIONAL	MAJOR	VISUAL/DIMENSIONAL	AS PER SAMPLING PLAN	MFR. STD	MFR. STD	INTERNAL INSP. REPORT	P	V	V	NA
4	ACUTATOR	OPRETION CHARACTERSTIC	MAJOR	FUNCTIONAL	100%	APPD. DRG. /DATA SHEET	APPD. DRG./ DATA SHEET		V	V	V	
<b>B</b>	<b>FINISHED DAMPER</b>											
1	VISUAL INSPECTION	SURFACE DEFECT	MINOR	VISUAL	100%	MANUFACTURING STD.	MANUFACTURING STD.	INTERNAL INSP. REPORT	P	V	V	10% OF DAMPER RECORDED
2	DIMENSIONAL CHECK	TAG DETAILS	DO	DO	100%	APPRVD. DRG	APPRVD. DRG	INTERNAL INSP. REPORT	P	V	V	
3	DAMPER OPERATION WITH ACTT. FUNCTIONING	MEASUREMENT	MAJOR	DIMENTIONAL	100%	APPRVD. DRG	APPRVD. DRG	DIMENSIONAL REPORT	P	W	W	SELECTED FROM LOT FOR CROSS CHECK
4	REVIEW OF QA DOCUMENT	FUNCTIONAL/PERFORMANCE	MAJOR	FUNCTIONAL	100%	APPRVD. DRG	APPRVD. DRG	INTERNAL INSP. REPORT	P	W	W	
NOTE : NO PAINTING IS REQUIRED AS THE MATERIAL IS OF GI.												
NOTE:- TEST REPORT OF FIRE TEST OF 90 MIN. FIRE RATING AS PER UL-555 1995 FORM CBRI-ROORKEE FOR SIMILAR TYPE OF FIRE DAMPER SHALL BE FURNISHED AT THE TIME OF INSPECTION ALONG WITH ONE SAMPLE FROM THE ORDERED LOT												
MANUFACTURER/ SUB CONTRACTOR/				LEGEND								
				D-RECORDS IDENTIFIED "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT								
				M-MANUFACTURE								
				C-SUB CONTRACTOR								
				N-CUSTOMER (BHEL)								
				P-PERFORMANCE								
				W-WITNESS								
				V-VERIFICATION								
CONTRACTOR-SIGNATURE				REVIEWED BY				NAME & SIGN OF APPROVING AUTHORITY				
				CUSTOMER USE				DOC NO.:				
GAP MAY BE CHANGED DURING DETAILED ENGINEERING (MUTUALLY AGREED BETWEEN BHEL & VENDOR)												

 Arvind  
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 Praveen Kishore

<b>Manufacturer's Name &amp; Address</b>		<h1 style="text-align: center;">Manufacturing Quality Assurance Plan</h1>								
						<b>Project Name</b> PLC SYSTEM FOR AIR CONDITIONING SYSTEM, 4x270 MW MANUGURU TPS		<b>Prepared By</b>		Signature
								<b>Checked By</b>		Signature
								<b>Approved By</b>		Signature
<b>Contract No.:</b>			<b>Rev No.</b>	<b>Date</b>	<b>Page No</b>	<b>Material Code</b>				
<b>Item Name</b>	PLC SYSTEM FOR AC PLANT		<b>QP No.</b>							

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									M	C	N	
1.0	Materials /Components											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	P	P	V	
1.2	Power Supply/Packs.	Physical Inspection Physical Damages Dimensions	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	P	P	V	
1.3	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection <ul style="list-style-type: none"> <li>Identification Labels</li> <li>Physical Damages</li> <li>Quantity</li> <li>Spare Capacity</li> </ul>	MA	Visual	100%	Product Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	P	P	V	





Arvind  
 S A Khan  
 Praveen Kishore

Legend:

\* : Record Identified with “v” shall be essentially included by the Contractor in QA Documentation    M : Manufacturer  
 C : Sub Contractor /Contractor Nominated Inspecting Agency    N : BHEL    Indicate “p” i.e. PERFORM, “w” i.e. WITNESS and “v” i.e. VERIFICATION

Item Name		PLC SYSTEM FOR AC PLANT (4x270 MW MANUGURU TPS)		QP No.		Rev No.		Date		Page No		Material Code	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
1.4	Touchscreen Panel PC, Printer, OS, Engineering software in the form of CD and license.	Physical Inspection Identification Labels, <b>Tech. Specification</b> Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	P	P	V		

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Legend:  
\* : Record Identified with "v" shall be essentially included by the Contractor in QA Documentation M : Manufacturer  
C : Sub Contractor /Contractor Nominated Inspecting Agency N :BHEL Indicate "p" i.e. PERFORM, "W" i.e. WITNESS and "V" i.e. VERIFICATION






Arvind  
S A Khan  
Praveen Kishore

Legend:

\* : Record Identified with “v” shall be essentially included by the Contractor in QA Documentation
M : Manufacturer
C : Sub Contractor /Contractor Nominated Inspecting Agency
N : BHEL
Indicate “p” i.e. PERFORM, “W” i.e. WITNESS and “V” i.e. VERIFICATION

Item Name	PLC SYSTEM FOR AC PLANT (4x270 MW MANUGURU TPS)	QP No.	Rev No.	Date	Page No	Material Code
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									M	C	N	
2.0	Assembly											
2.1	Functional Test for HMI/OWS devices	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	P	P/V	P/V	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking.	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram	Test Certification	BHEL Quality Inspection Report.	P	W	V	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	P	P/V	P/V	

 Arvind  
 S A Khan  
 Praveen Kishore

Legend:

\* : Record Identified with “v” shall be essentially included by the Contractor in QA Documentation      M : Manufacturer  
 C : Sub Contractor /Contractor Nominated Inspecting Agency      N : BHEL      Indicate “p” i.e. PERFORM, “W” i.e. WITNESS and “V” i.e. VERIFICATION

Item Name	PLC SYSTEM FOR AC PLANT (4x270 MW MANUGURU TPS)	QP No.	Rev No.	Date	Page No	Material Code
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									M	C	N	
3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	P	W	W	
3.2	Processor Verification	Processor configuration, Powering up, standby operation ( as applicable)	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	P	W	W	
3.3	I/O Rack Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	P	W	W	
3.4	Communication System Verification	Redundancy operation of Communication System	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	P	W	W	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	P	W	W	
3.6	Software Verification	(i) Sample Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	P	W	W	
3.7	Power Supply Module Verification	Electrical Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	P	W	W	

Note: All materials of construction shall be as per Specification /Approved Drawings /Approved Data Sheets by BHEL as and where applicable. QAP MAY BE CHANGED DURING DETAILED ENGINEERING (BETWEEN BHEL & SUB VENDOR)

Legend:

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C : Sub Contractor /Contractor Nominated Inspecting Agency N : BHEL Indicate “p” i.e. PERFORM, “W” i.e. WITNESS and “v” i.e. VERIFICATION



**TECHNICAL SPECIFICATION  
4X270 MW BHADRADRI TPS  
TECHNICAL SPECIFICATIONS  
AIR CONDITIONING SYSTEM**

**SPECIFICATION NO. PE-TS-411-553-A001**

**Section: C1-E**

**REV. 00**

**DATE: APRIL 2015**

**SECTION: C1-E**  
**PAINTING SPECIFICATIONS**

**TECHNICAL SPECIFICATION**  
**FOR**  
**PROTECTIVE LINING 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 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : 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 on 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.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

### **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.
- 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 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 to Sa 2-1/2 Swiss Standard 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.
- 4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

**4.03.00 Painting**

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
  - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
  - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
  - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
  - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss 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.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a huge pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

The no. of coats and DFT specified above is minimum. However to achieve above specified DFT, no of coats can be increased as per paint manufacture's recommendation.

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 2000 micron including primer coat.

- 4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :
- a) 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.
  - b) 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.
  - c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.
- 4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :
- a) 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.
  - b) 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.
  - c) Total thickness of primer and paint should not be less than 500 microns.
- 4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.
- 4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

The no. of coats and DFT specified above is minimum. However to achieve above specified DFT, no of coats can be increased as per paint manufacture's recommendation.

4.03.09 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 / 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 atleast 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 that 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 atleast 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  $\pm 20\%$  and as per SSPC PA 2.

#### **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.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- $$\text{Testing Voltage } V = 7900 \sqrt{T} \pm 10 \text{ percent where } T \text{ is the average coating thickness in mm.}$$
- 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.

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 handwheel 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/cm<sup>2</sup> required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm<sup>2</sup> 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.

#### **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.



**4X270 MW BHADRADRI TPS**  
ELECTRICAL SPECIFICATION  
**AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-411-553-A001

VOLUME II B

SECTION C2

REV. 00

DATE: APRIL 2015

**SECTION: C2**  
**ELECTRICAL SPECIFICATION**

**TELANGANA STATE POWER GENERATION  
CORPORATION LIMITED**

**4 X 270 MW BHADRADRI TPS**

**AIR CONDITIONING SYSTEM**

**TECHNICAL SPECIFICATION  
(ELECTRICAL PORTION)**

  
Arvind

  
SA Khan

  
Pritesh Khatore



TITLE :  
**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
AC  
4X270MW BHADRADRI TPS**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION : **C**

REV NO. : **00** DATE :

SHEET : 1 OF 2

**1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for Condensate Polishing Unit
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

**2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:**

Refer “Electrical Scope between BHEL and Vendor”.

**3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

**4.0 List of enclosures :**

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.
- c) Datasheets & quality plan for motors.

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TITLE :  
**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
AC  
4X270MW BHADRADRI TPS**

SPECIFICATION NO.  
VOLUME NO. : **II-B**  
SECTION : **C**  
REV NO. : **00** DATE :  
SHEET : 2 OF 2

- d) Electrical Load data format (Annexure –II)
- e) BHEL cable listing format (Annexure –III)
- f) Electrical mandatory spares (Annexure IV)

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	<b>TITLE :</b> <b>GENERAL TECHNICAL REQUIREMENTS</b>  <b>FOR</b>  <b>LV MOTORS</b>	<b>SPECIFICATION NO.</b>
		<b>VOLUME NO. : II-B</b>
		<b>SECTION : D</b>
		<b>REV NO. : 00 DATE : 18.12.14</b>
		<b>SHEET : 1 OF 1</b>

**GENERAL TECHNICAL REQUIREMENTS**

**FOR**


**LV MOTORS**

**4 X 270 MW BHADRADRI TPS**

  
Arvind

  
SA Khan

  
Pritesh Khatore

	TITLE :	SPECIFICATION NO.
	GENERAL TECHNICAL REQUIREMENTS	
	FOR	VOLUME NO. : II-B
	LV MOTORS	SECTION : D
		REV NO. : 00 DATE : 18.12.14
		SHEET : 1 OF 4

1.0

INTENT OF SPECIFICATION

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

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

2.0

CODES AND STANDARDS

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

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

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

3.0

DESIGN REQUIREMENTS

3.1

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

3.2

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

3.3

Starting Requirements

3.3.1


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


3.3.2


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





	TITLE : <b>GENERAL TECHNICAL REQUIREMENTS</b>  <b>FOR</b>  <b>LV MOTORS</b>	SPECIFICATION NO.
		VOLUME NO. : <b>II-B</b>
		SECTION : <b>D</b>
		REV NO. : <b>00</b> DATE : 18.12.14
		SHEET : 2 OF 4
<p>The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.</p> <p>3.3.3 The following frequency of starts shall apply</p> <ul style="list-style-type: none"> <li>i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.</li> <li>ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)</li> <li>iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor</li> </ul> <p>3.4 <b>Running Requirements</b></p> <p>3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.</p> <p>3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.</p> <p>3.5 <b>Stress During bus Transfer</b></p> <p>3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.</p> <p>3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.</p> <p>3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.</p> <p>3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.</p> <p>4.0 <b>CONSTRUCTIONAL FEATURES</b></p> <p>4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy</p> <p>4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.</p> <p>Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled</p> <p>4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.</p>		

	TITLE : <b>GENERAL TECHNICAL REQUIREMENTS</b>  <b>FOR</b>  <b>LV MOTORS</b>	SPECIFICATION NO.
		VOLUME NO. : <b>II-B</b>
		SECTION : <b>D</b>
		REV NO. : <b>00</b> DATE : 18.12.14
		SHEET : 3 OF 4
4.4. 4.5. 4.6. 4.7. 4.7.1 4.7.2 4.7.3 4.7.4 4.7.5 4.7.6 4.7.7 4.7.8 4.7.9 4.8. 4.9. 4.9.1	<p>Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.</p> <p>Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.</p> <p>In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.</p> <p><b>Terminals and Terminal Boxes</b></p> <p>Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.</p> <p>Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.</p> <p>Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.</p> <p>Connections shall be such that when the supply leads R, Y &amp; B are connected to motor terminals A B &amp; C or U, V &amp; W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or V W &amp; V respectively.</p> <p>Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.</p> <p>Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.</p> <p>Degree of protection for terminal boxes shall be IP 55 as per IS 4691.</p> <p>Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.</p> <p>Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.</p> <p>Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.</p> <p>Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.</p> <p><b>General</b></p> <p>Motors provided for similar drives shall be interchangeable.</p>	

	TITLE : <b>GENERAL TECHNICAL REQUIREMENTS</b>  <b>FOR</b>  <b>LV MOTORS</b>	SPECIFICATION NO.  VOLUME NO. : <b>II-B</b> SECTION : <b>D</b> REV NO. : <b>00</b> DATE : 18.12.14 SHEET : 4 OF 4
<p>4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.</p> <p>4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.</p> <p>4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.</p> <p>4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.</p> <p>4.9.6 Name plate with all particulars as per IS: 325 shall be provided</p> <p>4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.</p> <p><b>5.0 INSPECTION AND TESTING</b></p> <p>5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.</p> <p>5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.</p> <p>5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.</p> <p>5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.</p> <p><b>6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT</b></p> <p>a) OGA drawing showing the position of terminal boxes, earthing connections etc.</p> <p>b) Arrangement drawing of terminal boxes.</p> <p>c) Characteristic curves:  <i>(To be given for motor above 55 kW unless otherwise specified in Data Sheet).</i></p> <p>i) Current vs. time at rated voltage and minimum starting voltage.</p> <p>ii) Speed vs. time at rated voltage and minimum starting voltage.</p> <p>iii) Torque vs. speed at rated voltage and minimum voltage.          For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.</p> <p>iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.</p>		

## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

## PACKAGE: AC SYSTEM

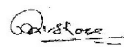
## SCOPE OF VENDOR: SUPPLY, ERECTION &amp; COMMISSIONING OF VENDOR'S EQUIPMENT

## PROJECT: 4X270 MW BHADRADRI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) &	BHEL	BHEL	Refer note no. 4 for electronic earthing


  
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## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

## PACKAGE: AC SYSTEM

## SCOPE OF VENDOR: SUPPLY, ERECTION &amp; COMMISSIONING OF VENDOR'S EQUIPMENT

## PROJECT: 4X270 MW BHADRADRI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	lightning protection			
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

**NOTES:**

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: AC SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT


PROJECT: 4X270 MW BHADRADRI TPS

3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

  
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	TITLE	<div>LV MOTORS</div> <div>DATA SHEET-A</div> <div>4 X 270 MW BHADRADRI TPS</div>	SPECIFICATION NO.	
			VOLUME	II B
			SECTION	D
			REV. NO.	DATE 18.12.14
			SHEET 1	OF 2

1.0	Design ambient temperature	:	50 °C	
2.0	Maximum acceptable kW rating of LV motor	:	160KW *	
3.0	Installation (Indoors/ Outdoors)	:	As required	
4.0	Details of supply system			
	a)	Rated voltage (with variation)	:	415V ± 10%
	b)	Rated frequency (with variation)	:	50 Hz + 3 % to - 5%
	c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
	d)	System fault level at rated voltage	:	50 kA for 1 sec
	e)	Short time rating for terminal boxes		
		o 110 kW and above (Breaker Controlled)	:	50 KA for 0.20 sec..
		o Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
	f)	LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to class B.	
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	(a) 85% below 110KW (b) 80% from 110KW to 160KW (c) 85% above 160KW to 1000KW (d) 80% from 1001 KW to 4000KW (e) 75% > 4000KW	
7.0	Power cables data	:	Shall be given during detailed engg.	
8.0	Earth Conductor Size & Material	:	As per attached Datasheet of Earthing.	
9.0	Space heater supply	:	240 V, 1ϕ, 50 Hz (for motors above 30 Kw)	
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW	
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	As per IS 12615*
12.0	Flame-proof motor			
	a)	Enclosure suitable (As per IS: 2148)	:	As per requirement
	b)	Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
13.0	Makes	:	BHEL/ Customer approval	
14.0	Paint shade	:	Shall be given during detailed engg	
15.0	Degree Of protection for motor/ terminal box	:	IP 54/ IP 55	



TITLE

**LV MOTORS****DATA SHEET-A****4 X 270 MW BHADRADRI TPS**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. DATE 18.12.14

SHEET 1 OF 2

\* Continuous duty LT motors up to 160 KW Output rating (at 50 deg.C ambient temperature), shall be High efficiency (IE2) as per IEC: 60034-30/ IS:12615

**16.0 TESTING****16.1 Type Tests**

For LT Motors above 55kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

**16.2 Routine Tests**

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

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	TITLE	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 1 OF 2

**MOTOR**  
**DATA SHEET - C**

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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	TITLE	SPECIFICATION NO.		
	MOTOR  DATA SHEET - C	VOLUME		II B
		SECTION D		
		REV NO.00 DATE		
		SHEET	2	OF

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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QUALITY PLAN			CUSTOMER :		PROJECT TITLE		SPECIFICATION :					
							NUMBER :		TITLE			
							NUMBER :		TITLE			
SHEET 1 OF 9			BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007_REV-03		SPECIFICATION :					
COMPONENT/OPERATION			SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III			
SL. NO.	3	4	5	6	7	8	9	10	11	REMARKS		
CHARACTERISTIC CHECK			CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V
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	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSP.EC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	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	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
			BIDDER'S/VENDORS COMPANY SEAL									

<div></div>		CUSTOMER :		PROJECT		SPECIFICATION :											
QUALITY PLAN		BIDDER/ VENDOR		TITLE		NUMBER :											
		SYSTEM		QUALITY PLAN		SPECIFICATION :											
SHEET 2 OF 9		CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		SECTION AGENCY		VOLUME III REMARKS	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	3	4	5	6	7	8	9	10	11	P	W	V			
1	2	3															
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-		3	-	-				VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED	
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC		3	-	2					
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUF'R'S DRG.	LOG BOOK		3	-	2					
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUF'R'S SPEC. BHEL SPEC.	-DO-		3	2	1				FOR DIA OF 55 MM & ABOVE	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUF'R'S DRG. SPEC.	MANUF'R'S DRG. SPEC.	-DO-		3	-	2					
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-		3	-	2					
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUF'R'S DRG./ SPEC.	MANUF'R'S DRG. / SPEC.	-DO-		3	-	2					
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT		3	-	2					
BHEL		PARTICULARS	BIDDER/VENDOR														
		NAME															
		SIGNATURE															
		DATE															
		BIDDER'S/VENDORS COMPANY SEAL															

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<div><div>भारतीय विद्युत निगम</div><div></div></div>		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :						
QUALITY PLAN		BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION : TITLE						
SHEET 3 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		VOLUME III						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION			REMARKS
									AGENCY	P	W	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
		1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
1.8	SHEET STAMPING (PUNCHED)	2. DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUF'S DRG. .	MANUF'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	MANUF'S SPEC./ RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2. ELECT. PROP. & MECH. PROP	MA	ELECT. & MECH. TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	
BHEL		PARTICULARS		BIDDER/VENDOR								
		NAME										
		SIGNATURE										
		DATE										
BIDDER'S/VENDORS COMPANY SEAL												

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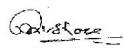
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<div></div>		CUSTOMER :		PROJECT		SPECIFICATION :							
QUALITY PLAN		BIDDER/ VENDOR		TITLE		NUMBER :							
SHEET 4 OF 9		SYSTEM		EXTENT OF CHECK		TITLE							
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF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

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


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<div></div>			CUSTOMER :		PROJECT		SPECIFICATION :						
QUALITY PLAN			BIDDER/ VENDOR		TITLE		NUMBER :						
COMPONENT/OPERATION			SYSTEM		QUALITY PLAN		SPECIFICATION :						
SHEET 8 OF 9					ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		TITLE						
SL. NO.	2	3	4	5	6	7	8	9	SECTION			VOLUME III	
		CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	P	W	V	REMARKS
1	TESTS												
3.0		1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3.VIBRATION & NOISE LEVEL 4.OVERALL DIMENSIONS AND ORIENTATION 5.DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1		* NOTE - 1
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>\$</sup>	1		<sup>\$</sup> NOTE - 2
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 <sup>\$</sup>	1		<sup>\$</sup> NOTE - 2
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-		
			MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1		TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>\$</sup>	1		<sup>\$</sup> NOTE - 2
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 <sup>\$</sup>	1		<sup>\$</sup> NOTE - 2
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 <sup>\$</sup>	1		<sup>\$</sup> NOTE - 2
			MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1		TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 <sup>\$</sup>	1		SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY <sup>\$</sup> NOTE - 2
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE										
					BIDDER'S/VENDORS COMPANY SEAL								

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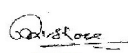
		<b>QUALITY PLAN</b>		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :	
				BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007_REV-03		SPECIFICATION : TITLE	
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		VOLUME III	
				CAT.		REFERENCE DOCUMENT		REMARKS	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	SECTION	
1	2	3	4	5	6	7	8	9	10
11									
<p>NOTES:</p> <p>1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.</p> <p>2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.</p> <p>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.</p> <p>4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p>									
<p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER</p> <p>2. VENDOR (MOTOR MANUFACTURER)</p> <p>3. SUB-VENDOR (RAW MATERIAL/COMPONENT'S SUPPLIER)</p> <p>P. PERFORM</p> <p>W. WITNESS</p> <p>V. VERIFY</p>									
<p><b>BHEL</b></p>									
<p>PARTICULARS</p>									
<p>NAME</p>									
<p>SIGNATURE</p>									
<p>DATE</p>									
<p>BIDDER'S/VENDORS COMPANY SEAL</p>									



	QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :				
			BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION : TITLE :				
	SHEET 2 OF 2		SYSTEM CAT.		ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION AGENCY		VOLUME III		
	COMPONENT/OPERATION CHARACTERISTICS CHECK		EXTENT OF CHECK		ACCEPTANCE NORM		FORMAT OF RECORD		REMARKS		
SL. NO.	2	3	4	5	6	7	8	9	P	W	V
1		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-
<p>NOTES:</p> <p>1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER</p> <p>2. VENDOR (MOTOR MANUFACTURER)</p> <p>3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM</p> <p>W. WITNESS</p> <p>V. VERIFY</p>											
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
BIDDER'S/VENDORS COMPANY SEAL											

  
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## ANNEXURE III

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**Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.**

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT\_CAB\_SCH\_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
  - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
  - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
  - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
  - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
  - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

**(A) SYSTEM VOLTAGE CODES:**

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V  
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

**(B) CABLE VOLTAGE CODES:**

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)  
C = 3.3KV (Power cables)  
D = 1.1KV (LV & DC system power & control cables)  
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES  
T = TOUGH RUBBER SHEATH  
U = OVERALL SCREENED  
V = PAIRED OVERALL SCREENED  
W = PAIRED INDIVIDUAL SCREENED  
Y = COMPENSATING CABLES  
I = PRE-FABRICATED CABLES  
Z = JELLY FILLED CABLES



**4X270 MW BHADRADRI TPS**  
C & I PORTION SPECIFICATION  
AIR CONDITIONING SYSTEM

SPECIFICATION No: PE-TS-411-553-A001

VOLUME II B

SECTION C3

REV. 00

DATE: APRIL 2015

**SECTION-C3**  
**C&I SPECIFICATION**



Technical specification for  
**AIR CONDITIONING SYSTEM**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015


SHEET

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# C&I TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM

	<p>Technical specification for <b>AIR CONDITIONING SYSTEM</b></p> <p><b>4 X 270 MW BHADRADRI TPS</b></p>	SPEC NO.: <b>PE-TS-411-145-I</b>	
		VOLUME	
		SECTION	
		REV. NO.	00
		DATE : 19.03.2015	
SHEET 2 OF 2			

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Technical specification for  
**AIR CONDITIONING SYSTEM**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION **C**

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DATE : 19.03.2015

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# SPECIFIC TECHNICAL REQUIREMENT



**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING SYSTEM  
4X270 MW BHADRADRI TPS**

SPECIFICATION NO.

VOLUME **II-B**

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1. **Complete** Control & Instrumentation for Air Conditioning System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder.
2. A common PLC based control system cum Annunciation panel with solid state annunciation windows along with product integrated microprocessor panel for the chilling unit shall be provided for AC and ventilation system by the AC system vendor.
3. The Ventilation system shall be controlled from the common AC system PLC panel. Vendor to ensure necessary provision and hardware requirement in its PLC panel for the Ventilation system. The list of drives/motors/fans/pumps etc., Input/ output lists for ventilation system to be hooked up to the PLC panel and other necessary inputs shall be furnished by the Ventilation system vendor.
4. Bidder to include Field instrumentation along with necessary fittings, accessories and valve manifold etc. and Field Junction Box (JB's), in his scope of supply. Each instrument/ equipment shall have a unique KKS Tag no. Field instrument specification and Data Sheet are given elsewhere in this specification. Bidder to provide local control panel wherever required.
5. All fields cabling for instruments/motor/pump/blower to JB is in bidder's scope and details are given elsewhere in the specification. The field I/O s should be grouped together in JB's suitably and a common trunk cable shall be taken to the panel. Cable between JB to PLC shall be provided by BHEL as free issue as per 'Electrical scope split sheet' in Electrical portion of the specification whereas cable schedule, cable interconnection details and wiring diagram for the same shall be in bidders' scope.
6. Cable schedule, cable interconnection details and wiring diagram where one end equipment and/or both end equipments are in bidder scope shall be provided by the bidder.
7. Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware/racks as per instrument installation diagram shall be in bidder's scope.
8. All manual valves at pump discharge shall be provided with Open and Close Limit Switches.
9. PLC control system as defined in the enclosed specification and Data Sheets shall be in bidder scope. The PLC system shall comprise of (i) PLC based



**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING SYSTEM  
4X270 MW BHADRADRI TPS**

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local panel (ii) UPS Power supply (iii) Operator interface in the form of CRT, keyboard and OWS along with required furniture.

10. PLC shall have the facility to synchronize its time with BHEL plant master clock system using IRIG-B signals. Necessary Hardware (IRIG-B port) for same at PLC end to be provided by bidder. The cable connecting PLC and plant master clock system shall be in BHEL scope.
11. PLC shall be connected to DCS through serial link with OPC Compliant for monitoring/Control. For details, please refer PLC Configuration Diagram.
12. All furniture (tables, chairs etc.) required for PLC operator HMI shall be in bidder's scope. Chairs shall be capable of being adjusted for height and position of backrest. The chairs shall be mounted on five castors, shall swivel and shall have arm rests'. One table and chair shall be provided for each operator station and separate table for each printer.
13. The requirements given below are to be read in conjunction with detailed Technical specification enclosed.
14. For instrument and control cable scope of supply, refer 'Electrical scope split sheet' in Electrical portion of the specification.
15. Bidder shall provide at least 20% or minimum two numbers, whichever are higher, spare channels as hot on rail spares in each configured I / O modules. In addition to this 10% or minimum one number, whichever is higher, extra assigned complete spare I / O modules mounted on rails in sub racks as hot on rail spare for each category of installed I / O modules shall also be provided. Spare modules shall be distributed over each controller group. Spare channel and modules shall be fully wired up to termination cabinets.
16. Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.
17. Supplied system shall provide critical group alarms for both AC and ventilation system to be hardwired to plant DCS.
18. Provision for input fire signal from fire alarm system to be ensured in the PLC panel for opening/ closing of the motor operated fire dampers.
19. Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.



**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING SYSTEM  
4X270 MW BHADRADRI TPS**

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20. Provision for earthing of the panel to be provided by vendor.
21. Vendor to submit GA drawing of control panel indicating layout of instruments, construction details, wiring diagram, class of protection for enclosure, paint type, paint color, thickness and material of enclosure sheet, control scheme during detailed engineering.
22. Layout & space requirement of panel to be specified during detailed engineering.
23. All bidirectional drives (Motor Operated Valves, MOVs) are integral starter type. Typical Hook Up diagram of all types of drives is attached for use(subject to Customer approval).
24. Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, Cable Interconnections details for Complete System shall be in Bidders' scope.
25. 415 V AC/ 240 V AC (3 Phase, 3 Wire) supply shall be provided by BHEL at a single point as per 'Electrical scope split sheet' in Electrical portion of the specification. Further distribution to various instruments/Equipment shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. Any power supply other than the above, if required for any instrument/equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope.
26. Bidder to provide all control panels, system cabinets, termination & relay cabinets complete with all accessories, wiring and all mounting and erection hardware including junction boxes, canopies, structural steel as required. All instruments/drives shall be terminated on Junction Boxes/Panel in Bidder scope of supply. 20% Spare terminals shall be provided on Junction Boxes.
27. Bidder to delegate/depute their person/experts as per owner/consultant requirements.
28. The make of all the items shall be from approved sub-vendor list.
29. The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.



**SPECIFIC TECHNICAL REQUIREMENT FOR  
AIR CONDITIONING SYSTEM  
4X270 MW BHADRADRI TPS**

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30. Bidder shall provide the signal exchange, to Plant DCS in BHEL prescribed format to be furnished during detailed engineering.

**NOTES:**

1. All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage.
2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

    
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Technical specification for  
**CONTROL & INSTRUMENTATION**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.


00

DATE : 19.03.2015

SHEET

OF

# PLC SPECIFICATION

	<b>TITLE:</b> <b>SPECIFICATION FOR</b> <b>PROGRAMMABLE LOGIC</b> <b>CONTROLLER SYSTEM</b>	SPECIFICATION NO. PES-145-36	
		VOLUME <b>II-B</b>	
		SECTION <b>D</b>	
		REV. NO. 03	DATE: 18.03.2014
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## 1. SCOPE

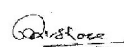
This specification covers the Design, Manufacture, Assembly, Inspection and Testing at manufacturer's works, proper packing and delivery to site, erection & commissioning, site acceptance test of the PLC Control & Monitoring System comprising PLC Control panel/Remote I/O panel (housing Processors, I/O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


## 2. GENERAL

- 2.1. The offered PLC shall be of Industrial Grade and from Original Equipment manufacturer (OEM).
- 2.2. The PLC shall perform protection logic, interlock and sequential control functions such as binary logic operation, set/reset operation, timers, counters, logic blocks, math functions, input quality checking engineering unit conversion, Boolean functions & PID control (Analog logic function) etc.
- 2.3. The system shall be redundant in processor, power supply and communication interfaces unless otherwise specified. The control of all drives and equipment shall be effected through the keyboard/mouse / panel mounted push button / control switches as per Data sheets-A&B. The system shall include self-diagnostic features not limited to the following:-
  - Memory Faults, both PROM and EPROM
  - Processor Faults
  - Communication Faults
  - I/O interface or address faults
  - Voltage signal discrepancy on input and output
  - Power supply faults
  - Output loop check
  - Channel level diagnostics such as fault monitoring, contact bounce filtering etc.
  - Failure of main or I/O processor
- 2.4. The system shall have facility for connecting to Main Plant's Distributed control system (DCS) using hardware/software interface for two-way transfer of signals.
- 2.5. The mimic shall be displayed on the OWS screen and may also be provided on the control desk/panel (as per Datasheet).
- 2.6. In case OWS is provided, HMI functions like trends, curves, bar charts, historical storage of data, logs and reports etc. shall be provided in addition to Plant schematics. The necessary catalogue / literature elaborating the features of HMI shall be supplied along with the bid.
- 2.7. It shall be possible to use the same OWS as programming station.
- 2.8. The PLC system shall be sized to meet process/system requirements as per the approved P&IDs and Control write-up.
- 2.9. The PLC system shall be designed to ensure that no single device failure should result in failure of any other device.


  
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S.A. Khan


  
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- 2.10. Signal multiplication where required shall be done in PLC. Use of relays for multiplication of contacts (for control, monitoring and alarm) is not acceptable. The control/ monitoring components on the control panel/ desk shall be driven through I/O modules.
- 2.11. Bidder shall provide all software on CDs along with required software licenses .The original CDs of installed operating & application software shall be maintained by bidder. Software modification and up gradation (as & when required) shall also be covered under the vendor scope without any cost implication.
- 2.12. PLC programming console shall be provided with industry proven antivirus software with perpetual license (free version not acceptable).

### 3. TECHNICAL REQUIREMENTS

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

#### 3.1. CODES AND STANDARDS

- 3.1.1. The equipment covered under this specification shall meet the requirements of latest edition of all applicable codes and standards like ANSI, NEMA, IEEE, IEC, NEC & IS.
- 3.1.2. PLC shall conform to IEC: 61131
- 3.1.3. The offered PLC shall comply with safety standards as per Data sheet-A&B.


#### 3.2. CONTROL PANEL

- 3.2.1. PLC control panel shall be freestanding type with provision for mimic display, push-button stations, control switches, indicating lamps, metering instruments like Indicators, ammeters etc. and facia windows for critical alarms.

- 3.2.2. The salient features of construction shall be:

Sheet material: Cold rolled sheet steel  
 Frame thickness: Not less than 3.0mm  
 Enclosure thickness: Not less than 2.5 mm for load bearing sections (mounted with instruments) and not less than 1.6 mm for others  
 Gland plate thickness: 3.0mm  
 Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

- 3.2.3. Each panel shall be identified by a name plate, which shall be of non-rusting metal or three ply lamicold, with engraved lettering.

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- 3.2.4. Vendor shall indicate earthing details along with bid.
- 3.2.5. 25 x 6 mm Copper ground bus to be provided for each panel.
- 3.2.6. 240V AC single phase, thermostatically controlled space heaters shall be provided. Each free standing panel shall have a door switch operated fluorescent lamp and a 240V AC plug point.
- 3.2.7. Painting treatment shall be as per IS: 6005. Two coats of lead oxide primer shall be followed by powder coating. Paint shade shall be as specified in the "Data sheet for PLC system"-Data Sheet-A&B. Project specific paint shade, if applicable, shall be followed.
- 3.2.8. Panel internal wiring shall be as per NEC and NEMA standard.
- 3.2.9. TB points in terminal block shall be cage clamp type/screw type.
- 3.2.10. The annunciation system shall be facia window type, driven by the PLC. Audible alarm, Acknowledge, Reset and lamp test facility shall be provided as per ISA sequence – S18.1, M.

### 3.3. PROCESSORS

- 3.3.1. The microprocessors shall be 32 bit, and Hot redundant.
- 3.3.2. Hot redundancy: PLC shall be provided with two processors (Main processing unit and memories) one for normal operation and one as hot standby. In case of failure of working processor, there shall be an appropriate alarm and simultaneously the hot standby processor shall take over the complete operation automatically. This transfer from main processor to standby processor shall be bump less and shall not cause any disturbance whatsoever. In the event of both processors failing, the system shall revert to fail safe mode. It shall be possible to keep any of the processor as master and other as standby.
- 3.3.3. An authorized forcing facility shall be provided for changing the status of inputs and outputs, timers and flags to facilitate fault finding and other testing requirements.
- 3.3.4. The standby processor shall be updated automatically in line with the changes made in the working processor.
- 3.3.5. In the event of any replacement of the processor, synchronization of the replaced processor shall be automatic upon live insertion.
- 3.3.6. The cycle time for input scanning, execution of logics, overheads and output scan shall not exceed 120 m sec.
- 3.3.7. The processor & memory shall be loaded up to 50% at normal conditions and maximum up to 60% under worst loading conditions.
- 3.3.8. The memories shall be field expandable. Memory capacity shall be sufficient for complete system operation and have a capability for at least 20% expansion in future.
- 3.3.9. Memory shall be non-volatile, preferably EEPROM type. However, in case volatile memory is provided, battery backup shall be provided for a minimum of three months to keep the stored program intact. Battery drain indication shall be provided at least 1 week before the battery gets drained and same shall be annunciated in OWS.



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### 3.4. INPUT / OUTPUT Modules

3.4.1. Input/output card assignments shall be modular i.e. no single card shall be assigned with more than one drive of a particular sub-system. The maximum number of channels per I/O module shall be as follows.

- Analog Input Module: 8
- Analog Output Module: 8
- Binary Input Module: 16
- Binary Output Module: 16
- Analog Input/output combined: 16
- Binary Input/output combined: 32

3.4.2. On line module replacement (hot swappable): All modules cards shall have quick disconnect terminations allowing for card replacement without disconnection of external wiring and without switching off the power supply.

3.4.3. Each I/O shall be protected against the reversal of polarity of the power voltage to I/O.

3.4.4. 10% spare capacity shall be ensured in each card channel assignment. Overall minimum 20% spare channels shall be provided.

3.4.5. Output command to MCC/Switchgear shall be through coupling relays, whose mounting location shall be as per "Data sheet A & B for PLC System". In case coupling relays are located in PLC Panel, the same shall be in PLC vendor's scope of supply.

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

### 3.5. DATA BUS/ I/O BUS

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

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



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### 3.6. OPERATOR WORK STATION (OWS)

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

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

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

3.6.4 Specification of OWS

#### (a) CPU

- |                           |  |
|---------------------------|--|
| 1. Processor              | 32 Bit or better                                       |
| 2. Main Memory            | Min. 1 GB and expandable to at least 4 GB              |
| 3. Hard drive             | Min 40 GB  |
| 4. Floppy drive           | 3.5", 1.44 MB  |
| 5. Removable bulk storage | DVD (R/RW)   |
| 6. Graphic memory         | Min. 16 MB   |
| 7. Auto controller        | 16 bit or better                                       |
| 8. Operating system       | Window XP or better                                    |
| 9. Communication ports    | 2 serial, 1 parallel, 8 Nos. USB, Dual 100 MB Ethernet |
| 10. Expansion slot        | 3 Nos. or more   |

#### (b) Monitor

- |                         |   |
|-------------------------|---|
| 1. Type                 | LCD colour monitor (TFT based)                                  |
| 2. Screen diagonal      | 22" (approx.) flat  |
| 3. Display              | XGA or better   |
| 4. Degree of Protection | IP-30   |
| 5. External controls    | Brightness, Contrast, Horizontal/vertical amplification & shift |
| 6. Power supply         | 240 VAC, 50 Hz, 1 phase   |
| 7. Version              | Industrial grade  |

#### (c) Keyboard & Mouse

- |                    |   |
|--------------------|---|
| 1. Type            | Flat spill membrane or positive depression type ASCII |
| 2. Life expectancy | 50 Million cycles per key                             |
| 3. Version         | Industrial  |
| 4. Mouse           | Optical   |


### 3.7. PRINTER

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

  
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### 3.8. COMMUNICATION WITH PLANT DCS/ THIRD PARTY SYSTEM

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

### 3.9. POWER SUPPLY Scheme

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

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

### 4.1. For Approval:

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







TITLE:

# **SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM**

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- Power distribution scheme.
- Block logic diagrams/ Ladder diagram mimic.
- Annunciation list.
- PLC control room layout drawing.
- List of soft signal exchange with Plant DCS.
- List of mandatory spares.
- UPS load calculation details.
- Quality plan
- FAT
- Data Sheet-C
- CRT display
- Power supply scheme for PLC system, HMI & peripherals, Remote I/O etc.

## **4.2. For Information:**

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

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


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

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

  
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## 6. TESTING AND INSPECTION

- 6.1. The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.
- 6.2. BHEL's standard Quality Plan for PLC is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.
- 6.3. The complete PLC system, including all instrument and devices shall be subjected to standard factory tests (i.e. Type Tests and Routine Tests) as per relevant IS, NEMA, IEEE, IEC.
- 6.4. Factory Acceptance Test-FAT (Functional Tests) shall be performed prior to shipment and Owner/Purchaser shall be notified 15 days before the schedules dates of the test.
- 6.5. The certificates for following type tests, as per IEC Standard, shall be submitted: -
  - Surge protection test as per IEC-225-4
  - Dry heat test as per IEC-68-2-2
  - Damp Heat test as per IEC-68-2-3
  - Vibration Heat test as per IEC-68-2-6
  - Electrostatic discharge test as per IEC-801-2 or equivalent
  - Radio frequency Immunity test as per IEC-801-6 or equivalent
  - Electromagnetic Immunity test as per IEC-801-3 or equivalent

## 7. SPARES AND CONSUMABLES

### 7.1. Commissioning Spares and consumables

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

### 7.2. Mandatory Spares

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

### 7.3. Recommended Spares


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

### 7.4. Special Tools & Tackles

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

### 7.5. Spares, Service support

Bidder shall provide availability of spares and service support for minimum 15 years after guarantee period.

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## 8. MARKING AND PACKING

### 8.1. Marking:

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

### 8.2. Packing:

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

## 9. PERFORMANCE AND GUARANTEE

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

## 10. APPLICABLE DATA SHEET FORMS

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

- Data Sheet A & B for PLC system - PE-DC-999-145-I036-1
- Data Sheet C for PLC system - PE-DC-999-145-I036-2



Technical specification for  
**CONTROL & INSTRUMENTATION**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

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OF

# PLC DATA SHEET

	<b>DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING &amp; VENTILATION SYSTEM</b>		SPECIFICATION NO.: PE-TS-411-	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 19.03.2015
			SHEET 1	OF 2
Data Sheet No.: PES-145-36-DS1-0				
<b>Data Sheet A&amp;B</b>				
DATA SHEET – A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B FOR PLC SYSTEM (TO BE FILLED BY BIDDER)	
<b>GENERAL</b>	PROJECT	4X270 MW BHADRADRI TPS		
	SERVICE	AIR CONDITIONING & VENTILATION SYSTEM		
	QUANTITY	<input type="checkbox"/> UNITISED <input checked="" type="checkbox"/> COMMON		
	LOCATION	<input checked="" type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input checked="" type="checkbox"/> AC <input type="checkbox"/> NON-AC*		
<b>PLC EQUIPMENT</b>	MAKE / MODEL NO.	BIDDER TO INDICATE		
	<b>PROCESSOR</b>	REDUNDANT WITH HOT STANDBY		
	DATA BUS (HMI)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC		
	DATA BUS (I/O - CPU)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC		
	DATA BUS (REMOTE I/O - CPU)	<input type="checkbox"/> COPPER WIRE <input type="checkbox"/> FIBRE OPTIC		
	FIELD CONTACTS INTERROGATION VOLTAGE	<input checked="" type="checkbox"/> 24 V DC <input type="checkbox"/> 48 V DC <input type="checkbox"/> 110 V AC		
	LOCATION OF COUPLING RELAYS	<input checked="" type="checkbox"/> MCC <input type="checkbox"/> PLC PANEL		
	DESKTOP OWS QUANTITY	<input type="checkbox"/> ONE <input type="checkbox"/> TWO <input type="checkbox"/> _____ <input checked="" type="checkbox"/> DESKTOP VERSION <input type="checkbox"/> SERVER VERSION <input type="checkbox"/> WORK STATION VERSION REQUIREMENT OF OWS IN CCR <input type="checkbox"/> YES <input type="checkbox"/> NO QUANTITY _____		OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	DESKTOP MONITOR TYPE	<input type="checkbox"/> 19" <input checked="" type="checkbox"/> 24"      TFT/CRT MONITOR <input type="checkbox"/> GIU <input type="checkbox"/> OTHERS		
	PRINTER	INKJET <input type="checkbox"/> A3__NOS <input type="checkbox"/> A4__NOS LASER B/W <input type="checkbox"/> A3__NOS <input type="checkbox"/> A4__NOS COLOR INKJET <input type="checkbox"/> A3__NOS <input type="checkbox"/> A4__NOS COLOR LASER <input checked="" type="checkbox"/> A3_1_NOS <input type="checkbox"/> A4__NOS		
PROGRAMMING / CONFIGURATION FACILITY	A) <input type="checkbox"/> HAND HELD <input type="checkbox"/> LAPTOP B) ENGINEERING SOFTWARE <input type="checkbox"/> ONE OWS <input type="checkbox"/> ALL OWS <input type="checkbox"/> LAPTOP		OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.	
SAFETY STANDARD	<input type="checkbox"/> SIL-3 <input type="checkbox"/> SIL-2 <input checked="" type="checkbox"/> NIL			
	COMPUTER FURNITURE	BOQ <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO INDUSTRIAL GRADE <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> START UP & COMMISSIONING		
<b>SPARE LIST</b>	SPARE LIST	<input checked="" type="checkbox"/> MANDATORY SPARE <input type="checkbox"/> RECOMMENDED		
	SPARE LIST ATTACHED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
<b>REDUNDANCY</b>	CPU	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	POWER SUPPLY	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	COMMUNICATION	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	I/O CARD	<input type="checkbox"/> YES <input type="checkbox"/> NO		
	OTHER ELECTRONICS	<input type="checkbox"/> YES <input type="checkbox"/> NO		As per vendor practice


	<b>DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING &amp; VENTILATION SYSTEM</b>		SPECIFICATION NO.: PE-TS-411-	
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Data Sheet No.: PES-145-36-DS1-0				
<b>Data Sheet A&amp;B</b>				
DATA SHEET – A FOR PLC SYSTEM (TO BE FILLED BY PURCHASER)			DATA SHEET – B FOR PLC SYSTEM (TO BE FILLED BY BIDDER)	
<b>No. of CHANNELS PER CARD</b>	ANALOG INPUT	<input checked="" type="checkbox"/> 8 NOs <input type="checkbox"/> 16 NOs		
	ANALOG OUTPUT	<input checked="" type="checkbox"/> 8 NOs <input type="checkbox"/> 16 NOs		
	BINARY INPUT	<input checked="" type="checkbox"/> 16 NOs <input type="checkbox"/> 32 NOs		
	BINARY OUTPUT	<input checked="" type="checkbox"/> 16 NOs <input type="checkbox"/> 32 NOs		
	RTD**	4 NOs		
	THERMOCOUPLE**	8 NOs		
	ELECTRONIC CARD ISOLATION	<input type="checkbox"/> GALVANIC <input type="checkbox"/> OPTICAL <input type="checkbox"/> OTHER		
<b>PANEL</b>	QUANTITY	BIDDER TO INDICATE		
	CLASS OF PROTECTION(Refer Location of PLC)	<input checked="" type="checkbox"/> IP-42		
	REMOTE I/O PANEL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO AC REQUIREMENT <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	COLOUR#	RAL 7032		
	BACK-UP DESK	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
	MIMIC	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO IF YES, THEN <input type="checkbox"/> PANEL MOUNTED GUI <input type="checkbox"/> ACRYLIC		
	CONTROL HARDWARE	<input type="checkbox"/> PB <input type="checkbox"/> INDICATORS <input checked="" type="checkbox"/> FACIAS 25 Nos. <input type="checkbox"/> OTHERS		
	CONFORMAL COATING	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
<b>COMMUNICATION WITH OTHER SYSTEM</b>	HARDWIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	PURPOSE	<input type="checkbox"/> CONTROL <input checked="" type="checkbox"/> MONITORING		
	MEDIUM	<input type="checkbox"/> UTP <input checked="" type="checkbox"/> FIBRE OPTIC <input type="checkbox"/> OTHERS		
	TIME SYNCHRONIZATION SIGNAL FORMAT	<input type="checkbox"/> PULSE <input type="checkbox"/> RS-485 <input checked="" type="checkbox"/> IRIG-B <input type="checkbox"/> NTP		
	SOFTLINK	<input type="checkbox"/> MODBUS <input checked="" type="checkbox"/> OPC IF MODBUS THEN <input type="checkbox"/> RS-485 <input type="checkbox"/> ETHERNET		
	SERIAL LINK	COMMUNICATION PORT TYPE _____		
<b>POWER SUPPLY INPUT FEEDER</b>	PLC PANEL	BIDDER TO INDICATE LOAD DATA		
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA		
<b>POWER SUPPLY</b>	SOURCE \$\$	<input checked="" type="checkbox"/> UPS (INDUSTRIAL GRADE) <input type="checkbox"/> 24V DC CHARGER		
	BATTERY TYPE	<input type="checkbox"/> Ni-Cd <input checked="" type="checkbox"/> LEAD ACID <input type="checkbox"/> OTHERS		
	BACK-UP TIME	<input type="checkbox"/> 30 MINS <input checked="" type="checkbox"/> 60 MINS <input type="checkbox"/> OTHERS		
	BATTERY CONFIGURATION	<input type="checkbox"/> 1X100% <input checked="" type="checkbox"/> 2X100% <input type="checkbox"/> 2X50%		As per MAX philosophy
<b>CUSTOMER TRAINING</b>	TRAINING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	NO OF DAYS	3 DAYS		
	LOCATION	<input type="checkbox"/> VENDOR'S WORK <input type="checkbox"/> PROJECT SITE <input type="checkbox"/> OTHERS		

\*IF THE LOCATION IS INDOOR, KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.

\*\*SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.

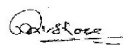
# PROJECT SPECIFIC PAINT SHADES, IF APPLICABLE TO BE USED.


\$\$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

	<b>DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING &amp; VENTILATION SYSTEM</b>		SPECIFICATION NO.:	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 21.03.2014
			SHEET 1	OF 2
Data Sheet No.: PES-145-36-DS2-0				
DATA SHEET – C				
GENERAL	PROJECT			
	SERVICE			
	QUANTITY			
	LOCATION			
PLC EQUIPMENT	MAKE / MODEL NO.			
	PROCESSOR			
	DATA BUS (HMI)			
	DATA BUS (I/O - CPU)			
	DATA BUS (REMOTE I/O - CPU)			
	FIELD CONTACTS INTERROGATION VOLTAGE			
	LOCATION OF COUPLING RELAYS			
	DESKTOP OWS QUANTITY			
	DESKTOP MONITOR TYPE			
	PRINTER			
	PROGRAMMING / CONFIGURATION FACILITY			
	SAFETY STANDARD			
		COMPUTER FURNITURE		
SPARE LIST	SPARE LIST			
	SPARE LIST ATTACHED			
REDUNDANCY	CPU			
	POWER SUPPLY			
	COMMUNICATION			
	I/O CARD			
	OTHER ELECTRONICS			
No. of CHANNELS PER CARD	ANALOG INPUT			
	ANALOG OUTPUT			
	BINARY INPUT			
	BINARY OUTPUT			
	RTD**			
	THERMOCOUPLE**			
	ELECTRONIC CARD ISOLATION			
PANEL	QUANTITY			
	CLASS OF PROTECTION(Refer Location of PLC)			
	REMOTE I/O PANEL			
	COLOUR#			
	BACK-UP DESK			
	MIMIC			


  
Arvind


  
SA Khan


  
Pritesh Kishore

	<b>DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING &amp; VENTILATION SYSTEM</b>		SPECIFICATION NO.:	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 21.03.2014
			SHEET 2	OF 2
Data Sheet No.: PES-145-36-DS2-0				
DATA SHEET – C				
	CONTROL HARDWARE			
	CONFORMAL COATING			
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED			
	PURPOSE			
	MEDIUM			
	TIME SYNCHRONIZATION SIGNAL FORMAT			
	SOFTLINK			
	SERIAL LINK			
POWER SUPPLY INPUT FEEDER	PLC PANEL			
	REMOTE I/O PANEL			
POWER SUPPLY	SOURCE \$\$			
	BATTERY TYPE			
	BACK-UP TIME			
	BATTERY CONFIGURATION			
CUSTOMER TRAINING	TRAINING			
	NO OF DAYS			
	LOCATION			

\*IF THE LOCATION IS INDOOR,KINDLY SPECIFY IF PLC PANEL IS PLACED IN AC OR NON-AC ENVIRONMENT.

\*\*SHALL NOT BE APPLICABLE IF TEMPERATURE TRANSMITTERS ARE ENVISAGED.

# PROJECT SPECIFIC PAINT SHADES, IF APPLICABLE TO BE USED.

\$\$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.



Technical specification for  
**CONTROL & INSTRUMENTATION**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

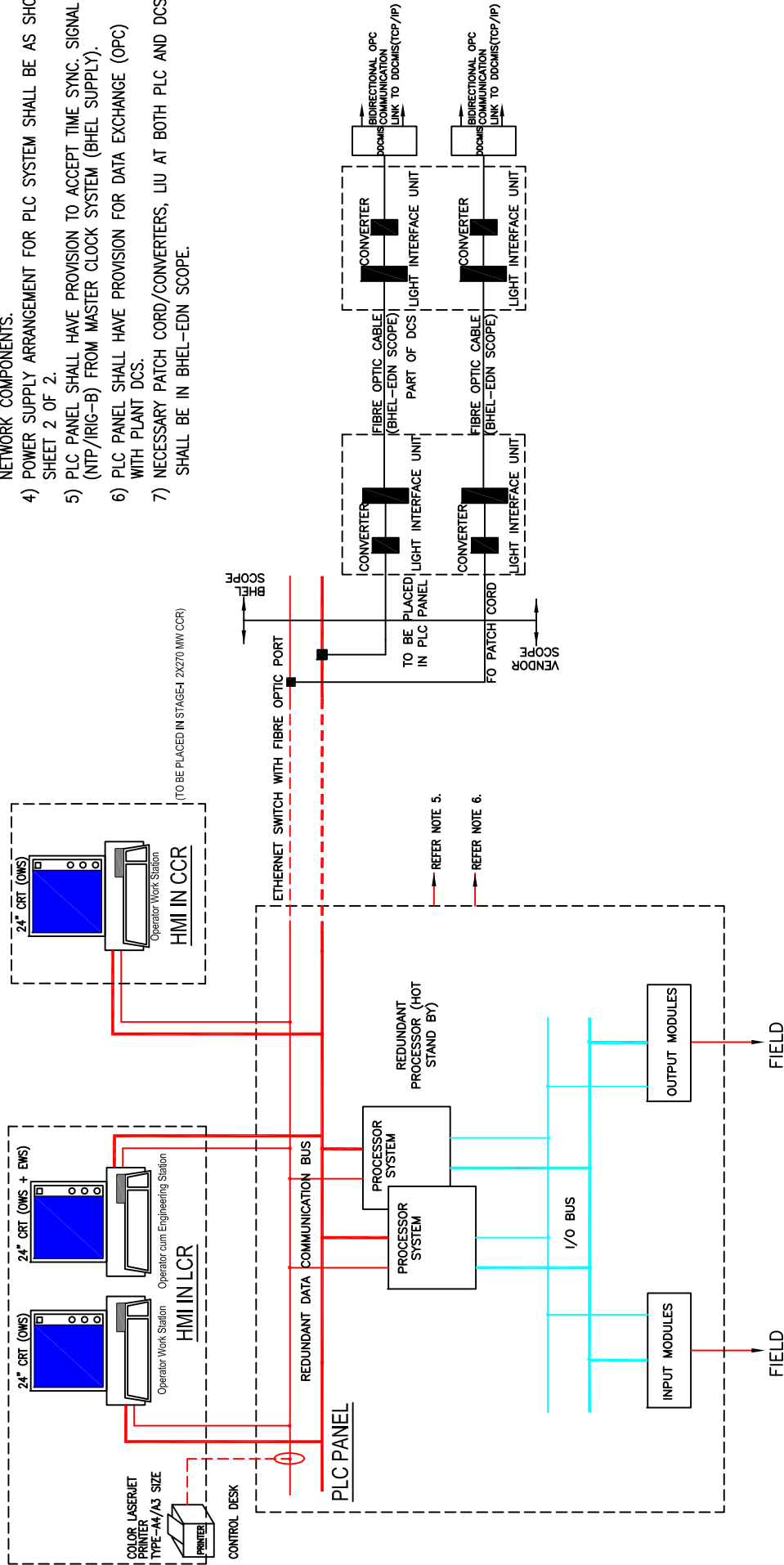
SHEET

OF

# PLC CONFIGURATION

**NOTES:**

- 1) TABLE TOP OWS/EWS SHALL BE 24" OR AVAILABLE INDUSTRY STANDARD.
- 2) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, POWER SUPPLY AND COMMUNICATION SYSTEM.
- 3) UPS POWER SUPPLY SHALL BE USED FOR PLC PANEL(S), OWS/EWS AND NETWORK COMPONENTS.
- 4) POWER SUPPLY ARRANGEMENT FOR PLC SYSTEM SHALL BE AS SHOWN ON SHEET 2 OF 2.
- 5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM (BHEL SUPPLY).
- 6) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (OPC) WITH PLANT DCS.
- 7) NECESSARY PATCH CORD/CONVERTERS, LIU AT BOTH PLC AND DCS END SHALL BE IN BHEL-EDN SCOPE.



**LEGEND: -**

- PLC - PROGRAMMABLE LOGIC CONTROLLER
- DCS - DISTRIBUTED CONTROL SYSTEM
- UPS - UNINTERRUPTED POWER SUPPLY
- OWS/EWS - OPERATOR WORK STATION/ ENGINEERING WORK STATION
- HMI - HUMAN MACHINE INTERFACE
- NTP - NETWORK TIME PROTOCOL
- OPC - OLE PROCESS CONTROL
- MCCB - MOULDED CASE CIRCUIT BREAKER
- MCB - MINATURE CIRCUIT BREAKER
- LCR - LOCAL CONTROL ROOM
- CCR - COMMON CONTROL ROOM

PROJECT:	4X270 MW BHADRADRI TPS			DRG.NO.	PE-DM-411-145-1900
				DATE	21.03.2015
TITLE:	PLC CONFIGURATION AC/VENTILATION			REV.NO.	00
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Technical specification for  
**CONTROL & INSTRUMENTATION**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

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00

DATE : 19.03.2015

SHEET

OF


# PLC Quality Plan

STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER										QUALITY PLAN NO.: PE-QP-999-145-1036											
<div><div><div><div><div></div><div>PEM :: C&amp;I</div></div><div><div><div></div><div>BHEL</div></div></div></div><div></div></div></div>										VOLUME IIB		SECTION D		REV. NO. 01		DATE: 24.08.2007		SHEET 1		OF 8	
										Acceptance Norms		Format of Records		Agency \$			Remarks				
														P	W	V					
										Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents					
1.0	Materials /Components																				
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1										
.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1										
.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1										
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection <ul style="list-style-type: none"><li>Identification Labels</li><li>Physical Damages</li><li>Quantity</li><li>Spare Capacity</li></ul>	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1										

LEGEND: \* CR - Critical characteristics  
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 PROGRAMMABLE LOGIC CONTROLLER										QUALITY PLAN NO.: PE-QP-999-145-1036			
												VOLUME IIB			
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												REV. NO. 01 DATE: 24.08.2007			
												SHEET 2 OF 8			
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	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1				

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  S A Khan
  Pritesh Khatore

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

 <b>STANDARD QUALITY PLAN</b> <b>FOR</b> <b>PROGRAMMABLE LOGIC CONTROLLER</b>		QUALITY PLAN NO.: <b>PE-QP-999-145-1036</b>										
		VOLUME <b>IIB</b>										
		SECTION <b>D</b>										
		REV. NO. <b>01</b> DATE: 24.08.2007										
		SHEET <b>3</b> OF <b>8</b>										
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	

2.0	Assembly											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

LEGEND:

\* CR

- Critical characteristics

MA

- Major characteristics

MI

- Minor characteristics

\$

P

- Agency Performing the Test.

W

- Agency Witnessing the Test.

V

- Agency Verifying the Test.

1


- BHEL

2

- Vendor

3

- Sub-vendor

 <b>STANDARD QUALITY PLAN</b> <b>FOR</b> <b>PROGRAMMABLE LOGIC CONTROLLER</b>		QUALITY PLAN NO.: <b>PE-QP-999-145-1036</b>										
		VOLUME <b>IIB</b>										
		SECTION <b>D</b>										
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		SHEET <b>4</b> OF <b>8</b>										
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	

3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	

LEGEND: *	CR	- Critical characteristics	1	- BHEL
	MA	- Major characteristics	2	- Vendor
	MI	- Minor characteristics	3	- Sub-vendor

**STANDARD QUALITY PLAN  
FOR  
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: <b>PE-QP-999-145-I036</b>			
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**FACTORY ACCEPTANCE TEST (FAT) PROCEDURE**

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

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

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

**APPLICABLE TEST PROCEDURE:**

**1. Input/Output Functional Verification.**

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

**2. Processor Verification**

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

  
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**STANDARD QUALITY PLAN  
FOR  
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: <b>PE-QP-999-145-I036</b> ____			
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ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

**3. Power Supply Module Verification**

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

**4. Communication System Verification**

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

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

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

**5. Diagnostic Verification**

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

# STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.:	PE-QP-999-145-I036
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## 6. Control Panel /Desk Verification

- PLC driven annunciation system should be checked by alarm signal simulation.
- Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

## 7. Software Verification

- Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- Engineering features:-
  - Online changing of parameters, set points.
  - Online modification in Control Logic Diagrams.
  - Online configuration of Graphics, Trends, Logs, HSR.
- HMI features:-  
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

## 8. Burn in Elevated Temperature test

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

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

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

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



Technical specification for  
**CONTROL & INSTRUMENTATION**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 19.03.2015

SHEET

OF

# ACTUATOR SPECIFICATION

**VOLUME: V-A**

**SECTION-III**

**TECHNICAL SPECIFICATION  
FOR  
ELECTRIC MOTOR ACTUATORS**

**1.00.00 SCOPE**

- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.

**2.00.00 STANDARDS**

- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS -9334
- ii) IS-325

**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 general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

**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 15 minutes, 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 operation before valve load is encountered and imparts 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, 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. Degree of protection of enclosure for motor actuator shall be IP-65.
- 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.

6.02.00 **Motor**

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor 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 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 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 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.
- 6.03.04 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 de-energize automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 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. All wiring shall be done with 1100 V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 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 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 **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.

9.00.00 **DRAWINGS, DATA & MANUALS**

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **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. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A : Technical Specifications for Electrical Equipment & Accessories.

**ANNEXURE-A**

**DESIGN DATA**

**1.0 AUXILIARY POWER SUPPLY**

S	upply	Description	Consumer
	L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed	u Motors above 0.2kW pto less than 175kW.
		Fault level 50 kA symm. for 1 sec.	
	(ii)	240V AC/415V AC	Motors upto 0.2kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	o Lighting, Space heat- ing , A.C supply for Contr- l & protective devices.
	D.C. Supply	220V, 2W, unearthed	& D.C. alarm, control protective devices
		Fault level 25* kA. for 1 sec.	

\* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

**2.0 RANGE OF VARIATION**

A.C. Supply :

V	oltage	:	± 10%
	Frequency	:	+3% to -5%.
	Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242
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Technical specification for  
**CONTROL & INSTRUMENTATION**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.


00

DATE : 19.03.2015




SHEET


OF

# Actuator Data Sheet

	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>		SPECIFICATION NO.: PE-SS-411-145-I007	
			VOLUME	
			SECTION	
			REV. NO. 00	DATE: 14.11.14
			SHEET 1	OF 3
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	


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<b>GENERAL*</b>	* PROJECT	4X270 MW BHADRADRI TPS	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	<input checked="" type="checkbox"/> ON / OFF <input checked="" type="checkbox"/> INCHING (AS REQUIRED)	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
<b>CONSTRUCTION AND SIZING</b>	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING(REGULATING) SERVICE 150 STARTS/HR MINIMUM	
<b>HANDWHEEL</b>	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED	
	TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
<b>ELECTRIC ACTUATOR</b>	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT.	
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11	
	COLOUR SHADE	<input checked="" type="checkbox"/> BLUE (RAL 5012) ENAMEL <input type="checkbox"/> .....	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED INTERNALLY	
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 65 <input checked="" type="checkbox"/> IP 67 <input type="checkbox"/> FLAME PROOF <input type="checkbox"/> IP 55, TOTALLY ENCL, SELF VENTILATED.	
	@ INSULATION CLASS	<input type="checkbox"/> CLASS-B <input checked="" type="checkbox"/> CLASS-F (TEMP. RISE LIMITED TO CLASS B)	
	@ WINDING TEMP PROTECTION	   PHASE)	

	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>	SPECIFICATION NO.: PE-SS-411-145-I007	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE: 14.11.14
		SHEET 2	OF 3
<b>Data Sheet A &amp; B</b>			
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

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	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
<b>INTEGRAL STARTER</b>	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS	
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)	
	STEP DOWN CONT. TRANSFORMER	<input checked="" type="checkbox"/> REQUIRED	
	OPEN / CLOSE PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STOP PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INDICATING LAMPS	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	LOCAL REMOTE S/S	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
		INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)
<b>INTERPOSING RELAY</b> (Applicable for integral Starter)	INTERPOSING RELAYS	REQUIRED	
	INTERPOSING RELAY (QUANTITY)	<input type="checkbox"/> 2 NOS. <input checked="" type="checkbox"/> 3 NOS.	
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC	
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX	
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms	
<b>TORQUE SWITCH</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	
<b>LIMIT SWITCH</b>	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN : INT : CLOSE	<input checked="" type="checkbox"/> 1 No <input type="checkbox"/> 2 Nos.	2 Nos. (ADJ.) <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>	SPECIFICATION NO.: PE-SS-411-145-I007	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE: 14.11.14
		SHEET 3	OF 3
<b>Data Sheet A &amp; B</b>			
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

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<b>POSITION TRANSMITTER</b>	POSITION TRANSMITTER (For inching duty)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	<input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....		
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA		
	ACCURACY	$\pm 1\%$ FS		
<b>SPACE HEATER</b>	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY			
	@ RATING	415v, 3PH, AC FOR RATING > 0.2KW; SINGLE PHASE FOR RATING < 0.2KW		
<b>TERMINAL BOX</b>	MOTOR TERMINAL BOX	REQUIRED		
	ACTUATOR TERMINAL BOX	REQUIRED		
	ENCL CLASS MTR T.B. / ACTUATOR T.B.	@ <input checked="" type="checkbox"/> IP 67 @ <input type="checkbox"/> .....	<input checked="" type="checkbox"/> IP67 <input type="checkbox"/> .....	
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET(9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> <input type="checkbox"/> 2 NOS. <input type="checkbox"/> .....		
<b>CABLE GLANDS</b>	@ POWER CABLE GLAND	SIZE:--DURING DETAIL ENGINEERING		
	@ SPACE HEATER CABLE GLAND	SIZE: 2C x 2.5 sq. mm		
	OTHER CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PX0.5 SQMM - ONE CABLE GLAND OF OD SIZE 20 MM. INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PX0.5 SQMM AND 2ND 2PX0.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.		
	OTHER CONTROL CABLE GLANDS-2			
<b>WEIGHT</b>	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.

**NOTES:**

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

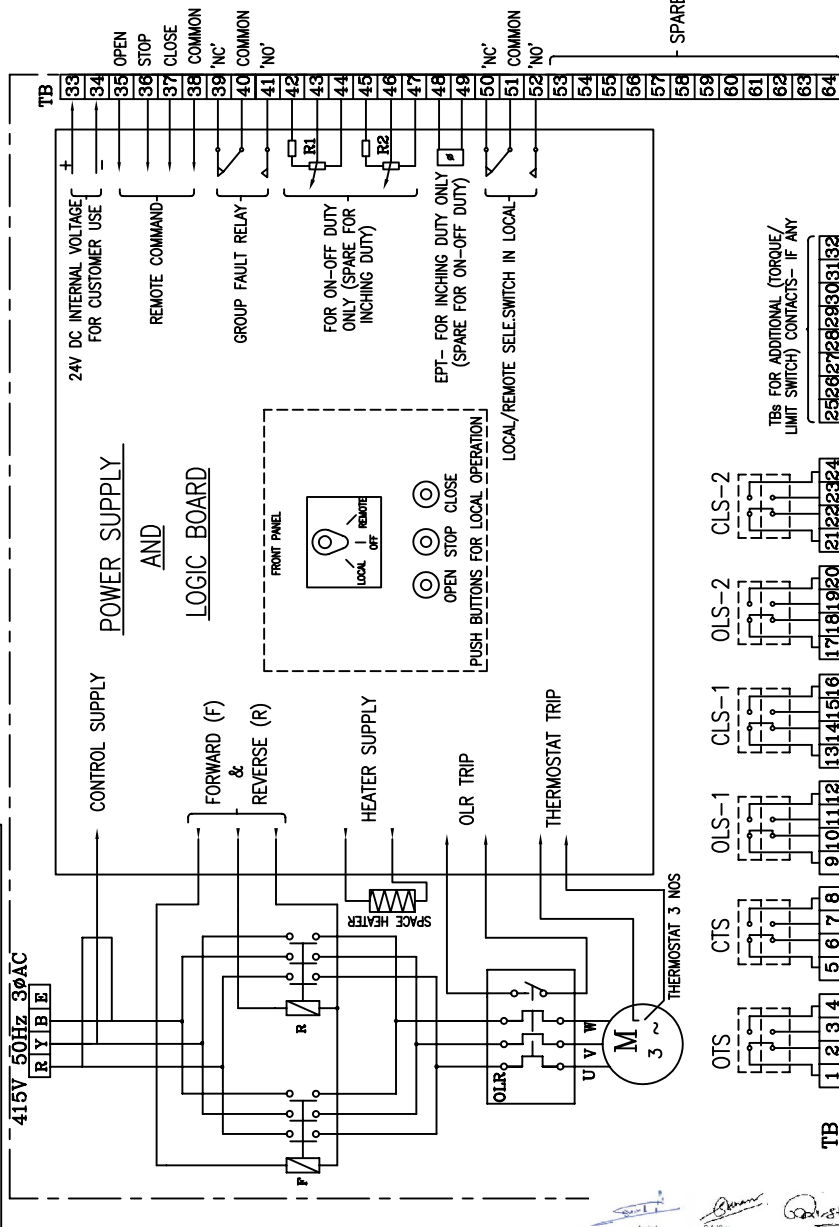
NOTES\* = TO BE FILLED BY MPL (LEAD AGENCY), @ = TO BE FILLED BY ES





Arvind      SA Khan      Pritesh Kishore

DRAWING NO. 2227-CSIM-A-E



SWITCH TERMINALS FOR CUSTOMER USE

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

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	
SWITCH NO.	TERMINAL NO.	FULL OPEN
	INTERMEDIATE	b FULL CLOSE

INDICATES CONTACT CLOSED  
INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

VALVES	OPEN			CLOSE	
	MAIN	BACK UP	MAIN	BACK UP	
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS	
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#	
# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT					
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)					

SPARE

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

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)	
BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPPALLI-620014.		DRN N.P.ESWAR	SIGN N.P
365-121		CHD D.DINAKARAN	DATE 07.10.04
DEPT VL		APPD K.ARUNACHALAM	NO. OF ITEMS
CODE	SCALE	WEIGHT (KG)	REFERENCE INFORMATION
TITLE WIRING DIAGRAM (TERMINAL PLAN)		CARD CODE U 01	DRAWING NO. 3-V-MISC-24227
FOR ACTUATOR WITH INTEGRAL STARTER		REV 0	
		Page no. 44 of 130	



Technical specification for  
**CONTROL & INSTRUMENTATION**

**4 X 270 MW BHADRADRI TPS**

SPEC NO.: **PE-TS-411-145-I**

VOLUME

SECTION

REV. NO.

00

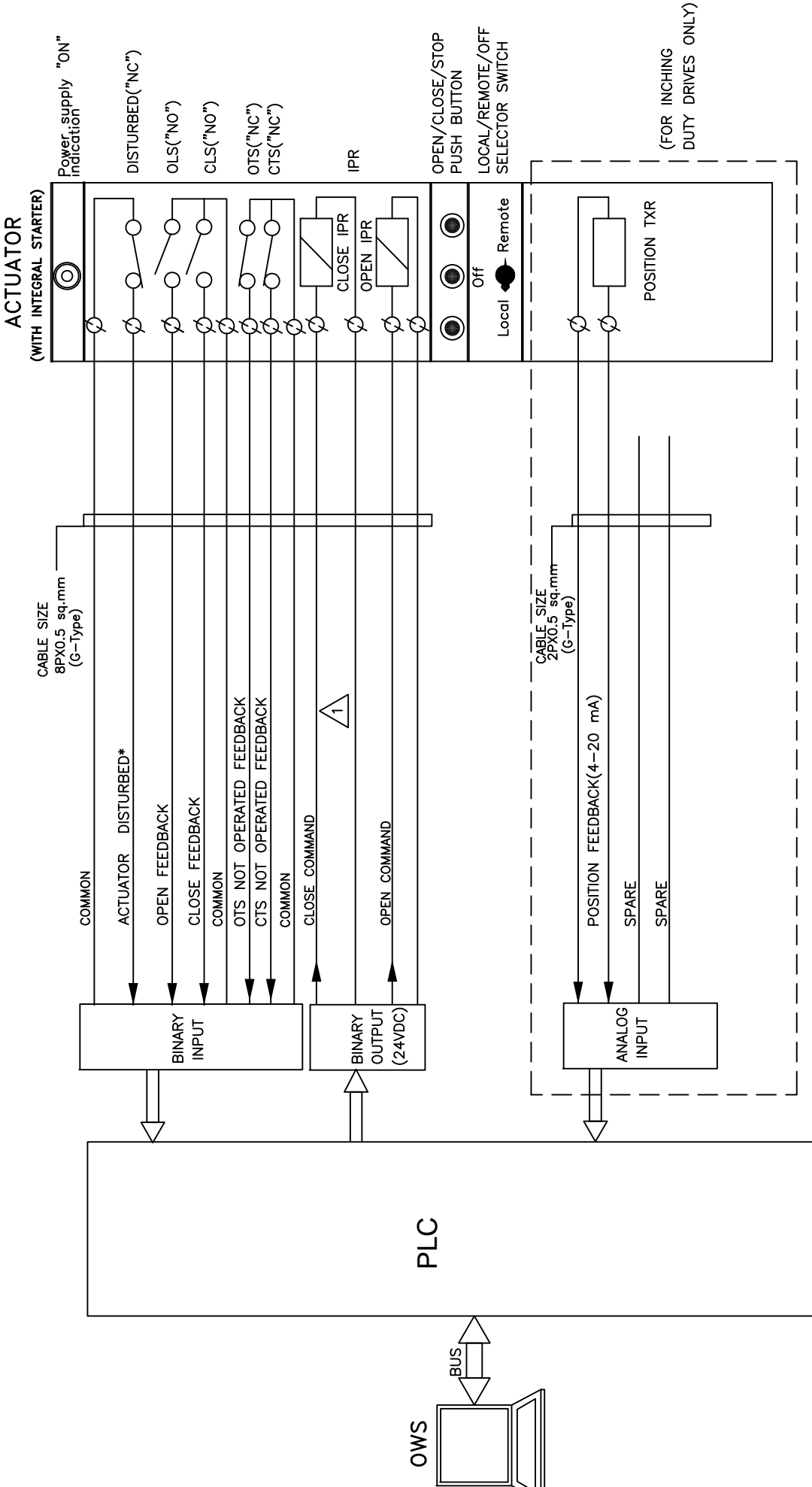
DATE : 19.03.2015

SHEET

OF

# Drive Control Philosophy

PLC INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

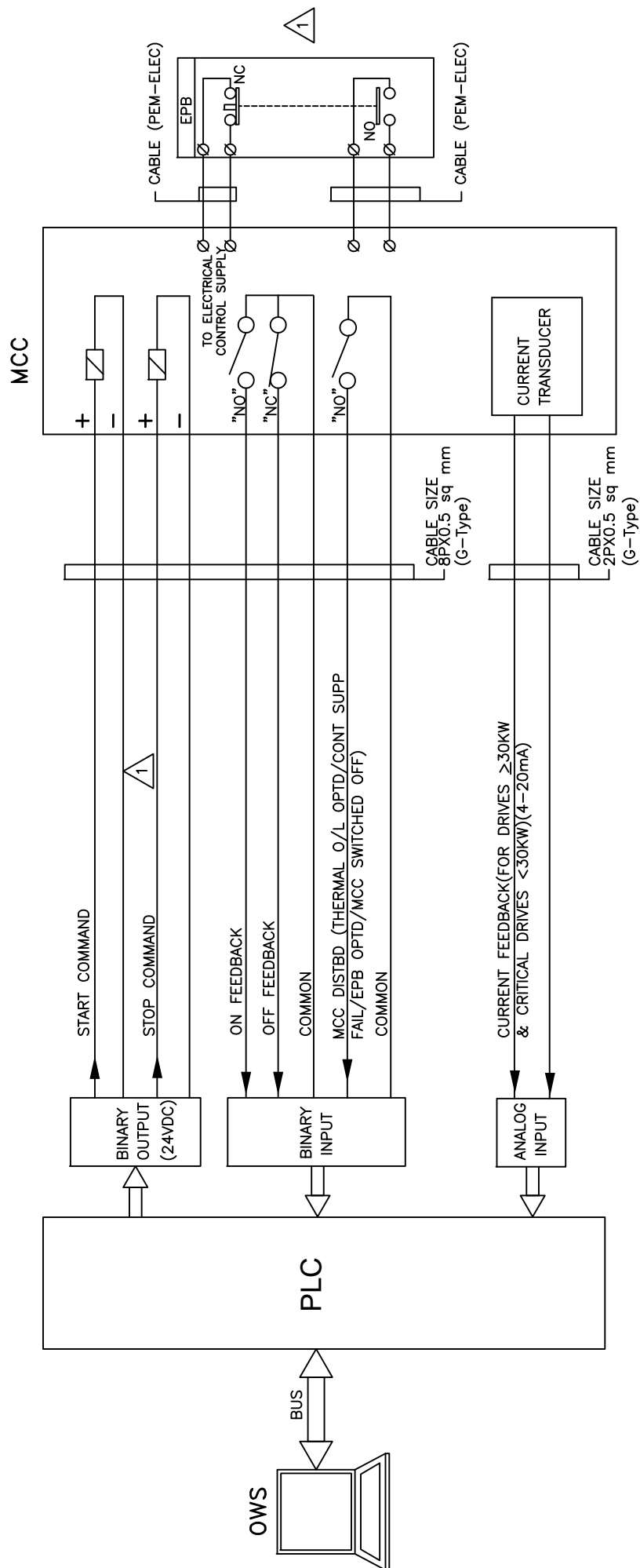



NOTE:

- \* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
- Loss of control supply/ Motor thermostat trip/
- Thermal over load/
- Local/Off/Remote Sel. switch in local or off mode/
- Stop PB optd.

	PROJECT: 4 X 270 MW BHADRADRI TPS			DRG.NO.	PE-DM-411-145-1002
	TITLE PLC INTERFACE FOR BIDIRECTIONAL DRIVE			DATE	06.02.2015
				REV.NO.	01
				SHT	7 Page 46 of 130

# PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE

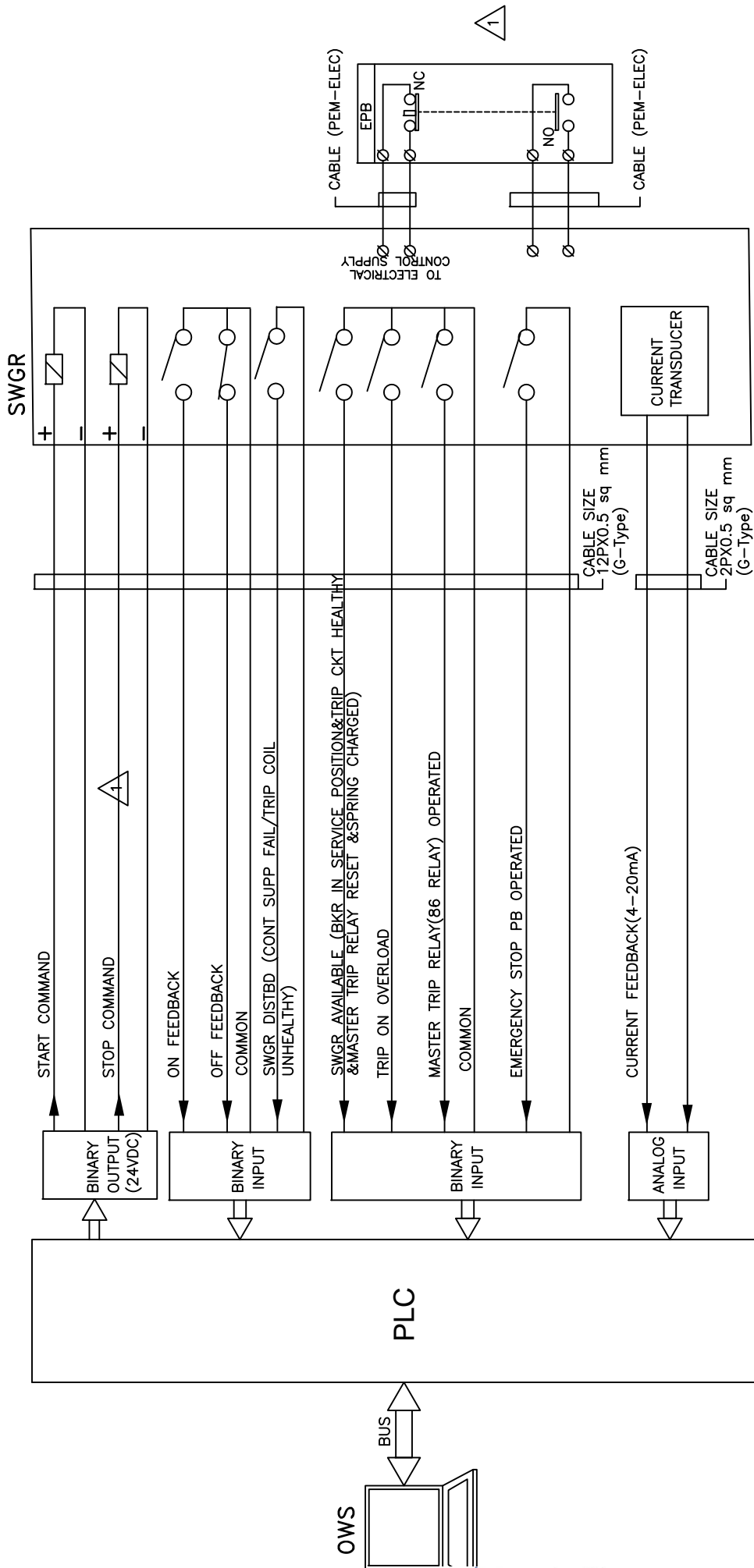


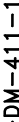
	PROJECT: 4 X 270 MW BHADRADRI TPS		DRG.NO. PE-DM-411-145-I002
	TITLE PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE		DATE 06.02.2015
			REV.NO. 01
			SHT 8 Page 47 of 130

S:

TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

# PLC INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



	PROJECT: 4 X 270 MW BHADRADRI TPS			DRG.NO.	PE-DM-411-145-I002
	TITLE			DATE	06.02.2015
				REV.NO.	01
	UNIDIRECTIONAL HT DRIVE			SHT	19 OF 49
				Page no. 11 of 130	