S. No	Description	TSGENCO								Consultant			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/	SE/ Civil	SE/E&M /	DE Constr.		HYD	BTPS		
D	Progress Report Monthly													
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	S	
2.	Consultant	1	1	2	2	1	1	2	1	S	1	1	Nil	
E	Test & Inspection Reports													
1.	Equipment manufacturer													
	a. Civil	1	1	1	2	1	1	1	-	11	1	1	S	
s	b. E&M	1	1	-	2	1	-	1	1	11	1	1	S	
2.	Consultant	1	1	-	2	1	-	1	1	S	-	1	-	
F	Instruction Manuals/Data Books													
1.	Equipment manufacturer													
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1	S	
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1	S	
2.	Consultant	1	1	-	10+1T	1	-	15+1T	-	S	1	1	Nil	
G	Consultant	1	1	1	8+1T	1	1	2	1	1	1	1	S	
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1	S	
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1	Nil	

S – Source, T – Transparency & Soft Copy on CD,

TSGENCO : Telangana State Power Generation Corporation Limited

Director, Projects, Hyd : Director/ Projects, TSGENCO, Vidyut Soudha, Hyderabad – 500 082

QUALITY ASSURANCE REQUIREMENTS

CONTENT

QUALITY ASSURANCE REQUIREMENTS

1.00.00 **QUALITY ASSURANCE PROGRAMME**

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

a) His organisation structure for the management and implementation of the proposed quality assurance programme.

b) Documentation control system.

c) Qualification data for Bidder's key personnel.

d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

f) Control of non-conforming items and system for corrective actions.

g) Inspection and test procedure both for manufacture and all site related works.

h) Control of calibration and testing of measuring and testing equipments.

i) System for quality audit.

j) System for indication and appraisal of inspection status.

k) System for authorising release of manufactured product to the Owner.

l) System for handling storage and delivery.

m) System for maintenance of records.

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

o) Internal standards, if referred in the quality plans shall generally be compatible with National / International standards and shall be mentioned in the quality plans. Alternatively bidder shall furnish extracts of the internal standards detailing out acceptance norm for the product / material.

2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

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

Contractor shall furnish list of Manufacturing Quality Plans of major equipments indicating proposed inspection catagorisation indicating items that will be offered for Owner’s inspection etc and the Field Quality Plans

2.02.00 Manufacturing Quality Plan for all the major equipment will detail out their respective important components, their in-process various tests/inspection & final inspection / tests, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization. The relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing are to be comprehensibly documented by Contractor.

Manufacturing Quality Plan for all major equipments/ items will be approved by owner. In these approved quality plans, Owner / Authorised representative shall identify customer hold points (CHP), test / checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work shall not proceed without consent of Owner / Authorised representative in writing. Inspection/ Test reports are to be submitted to owner as specified in final approved Manufacturing Quality Plans.

2.03.00 Field Quality Plans / Procedures for all field activities shall be submitted to

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

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

2.05.00 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/ Authorised representative for “CHP” and “W” points marked in quality plans , and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). For items which is not under owner’s inspection the contractor shall apply for despatch clearance (MDCC) from owner by submitting their internal inspection reports and quality records

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

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

2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section - IX (latest edition) or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX (latest edition) or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner / his authorised representative or owner approved Third Party Inspection Agency(TPIA). Previously qualified WPS & PQR shall be acceptable if witnessed by owner’s approved TPIA.

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

2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with LIST OF STANDARDS FOR REFERENCE as given below in this section.

The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT for the list major equipments / items identified for owner's inspection shall be properly recorded and submitted for review and approval. Other items not covered under owner's inspection, contractor shall review and approve the NDT results and such reports shall be submitted to owner in the final documentation of the items / equipments

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

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

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

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

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

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

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

3.00.00 **QUALITY ASSURANCE DOCUMENTS**

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

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

b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.

c) Non-destructive examination results /reports including radiography interpretation reports.

d) Factory tests results for testing required as per applicable codes and standards referred in the specification.

e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.

f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

   i) When some important repair work is involved to make the job acceptable.

   ii) The repair work remains part of the accepted product quality.

i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Owner’s Engineer, or his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access inside the workshops, test labs, establishments at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Owner’s Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

4.02.00 The Contractor shall give the Owner’s Engineer/ Authorized Inspector twenty one (21) days written notice for “CHP” / “W” points of any material being ready for testing by owner’ engineer / Authorized inspector. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/ Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection. If owner’s Engineer / Authorised Inspector fail to attend the inspection, next mutually convenient date for test shall be agreed with Contractor. Contractor shall, in

no case proceed with the test without owner or his authorized inspectors, unless the witnessing is officially waived and advised Contactor to proceed with the test. Contractor shall forthwith forward duly certified completed test report and a product quality certificate in six (6) copies to owner upon completion of such test.

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

4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests excluding the test completion date subject to submission of all certified documents related to the test, If the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the owner’s Engineer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract / QAP or other approved quality documents.

4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the owner’s Engineer/Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contract / QAP or other approved quality documents. Contractor and shall give facilities to the owner’s Engineer/ Inspector or to his authorised representative to accomplish testing.

4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating proposed schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

LIST OF STANDARDS FOR REFERENCE

a) International Standards Organisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers(ASME)

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission Publications.

t) Power Test Code for Steam Turbines (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS)

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Emission regulation of Central Pollution Control Board (CPCB).

gg) Pollution Control regulations of Dept. of Environment, Govt. of India

hh) Central Board of Irrigation and Power (CBIP) Publications

ANNEXURE-I
FORMAT OF QUALITY ASSURANCE PROGRAMME

VENDOR'S LOGO , NAME & ADDRESS	MANUFACTURING QUALITY ASSURANCE PLAN	DOC NO:	XXXXX-CAL-QAP-M-0001				
	-	REV NO :	0	1	2	3	4
	ITEM :	DATE :					

CLIENT :		LOCATION :	
PROJECT :		REFERENCE PURCHASE ORDER NO. & DT :	
VENDOR :		REFERENCE APPROVED DATA SHEET :	
SUB VENDOR :		REFERENCE APPROVED DRAWING. NO. :	

ABBREVIATIONS :

QAP - QUALITY ASSURANCE PLAN,
CR - CRITICAL,
MA - MAJOR,
MI - MINOR
SPEC - SPECIFICATION,
TC - TEST CERTIFICATES
P - PERFORM
w - WITNESS
V - VERIFY
CHP - CUSTOMER HOLD POINT

MATL - MATERIAL,
APP - APPROVED,
DWG - DRAWING,
SUPL - SUPPLIER,
PROC - PROCEDURE

AGENCY :

1 - PROJECT AUTHORITY
2 - SUPPLIER
3 - SUB-SUPPLIER
4 - MANUFACTURER
5 - THIRD PARTY INSPECTION AGENCY

GENERAL REMARKS

1 THE ITEMS WHICH ARE FALLING UNDER ANY STATUTORY AUTHORITY'S (LIKE I.B.R. ETC.) SCOPE SHALL BE SUBJECTED TO THAT STATUTORY AUTHORITY'S INSPECTION CLEARENCE.

NOTES:

1. EXACT MATERIAL / PROCESS / INSPECTION / TESTS FOLLOWED BY THE MANUFACTURER SHALL BE SPECIFIED
2. EXACT REFERENCE DOCUMENT/ACCEPTANCE STANDARD SHALL BE SPECIFIED
3. IN CASE SPECIFIED ACCEPTANCE STANDARD / NORMS IS OTHER THAN NATIONAL / INTERNATIONAL STANDARDS
. STANDARD / COPY OF THE ACCEPTANCE NORMS FOLLOWED BY THE MANUFACTURER SHALL BE SUBMITTED FOR REVIEW RECORD
4 FINAL INSPECTION DOSSIER SHALL BE PREPARED BY MANUFACTURER & SHALL BE ENDORSED BY INSPECTIONTION AGENCY

	Prepared by			Checked by			Approved By		
Revision	R0	R1	R2	R0	R1	R2	R0	R1	R2
DATE									

VENDOR'S LOGO, NAME & ADDRESS	ITEM :	DOC NO:			
		REV NO :	R0	R1	R2
		DATE :			

SL NO.	DESCRIPTION	CHECKS			CATEGORY	REF DOCS	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
		TYPE	METHOD	QUANTUM					P	W	V	
1	2	3	4	5	6	7	8	9	12	13	14	15
1.00												

Notes:

Prepared by				Checked by			Approved By		
Revision	R0	R1	R2	R0	R1	R2	R0	R1	R2
DATE									

ANNEXURE-II

FIELD WELDING SCHEDULE

PROJECT	:	FWS NO	:
CONTRACTOR	:	REV NO.	:
PACKAGE	:	FIELD WELDING CODE	:
SYSTEM	:	PAGE NO.	:

Sl No.	Drawing No. for Weld Locations & Identi-fication mark	Descrip-tion of parts to be welded	Material specifica-tion	Dimen-sions	Pro-cess of Weld-ing	Type of Weld	Electrode Filler Specifica-tion	WPS No.	Minimum Pre-heat Tempera-ture	Heat Treat-ment Tempe-rature [Holding Time in secs]	NDT Method Quantu m	NDT Speci-fication Number	Accep-tance Norm Ref.	Re-marks

The Field Welding Schedule should be submitted for :

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

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

CONTENT

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

1.00.00 **TOOLS & TACKLE**

The Contractor shall supply with the equipment one complete set of special tools and tackle as required for the erection, assembly, dismantling & maintenance of the equipment. These special tools will also include special material handling equipment, jigs & fixtures for maintenance and calibration/ readjustment, checking & measurement aids etc. A list of such tools & tackle shall be submitted by the Bidder along with the offer. Detailed description of each tools/tackle, its function along with the equipment/part for which it is meant for and the price of each tools/tackle shall also be indicated in the offer. These tools & tackle shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 **SPARES**

2.01.00 **General**

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with dessicator packs as necessary.

2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be despatched before the despatch of the associated main equipment.

2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30 years after commissioning of the plant.

2.02.00 **Recommended Spares**

2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalised after mutual discussion.

2.03.00 **Start-up Commissioning Spares**

2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.

2.03.02 The Contractor shall submit a complete BBU list inclusive of recommended, mandatory, initial start-up and commissioning spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.

2.04.00 **Mandatory Spare Parts**

2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.

Since the components involved can not be foreseen at the bidding stage, only

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.

SUB SECTION: C2- B

FUNCTIONAL / PERFROMANCE / DEMOSTARTION GUARANTEE

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.

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:

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

SUB SECTION: C2- B

INSPECTION, TESTING AND QUALITY ASSURANCE

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.

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 magnuflux 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

1.04.00AIR 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.

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.

BHARAT HEAVY ELECTRICALS LIMITED

CORPORATE QUALITY ASSURANCE

PROJECT: **SYSTEM :**

VENDOR : **ITEM :**

SL NO	COMPONENT /OPERATION OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYPE /METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

Legend: **1. BHEL** **2. Vendor** **3. Sub-Vendor**

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

भेल BHEL		MANUFACTURE'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : 4x270 MW MANUGURU TPS					
							QP. NO. :						
				ITEM : SCREW CHILLER				PACKAGE : AIR CONDITIONING					
							REV. :						
								CONTRACT NO. : 411					
				SUB-SYSTEM : AIRCONDITIONING			DATE :	CONTRACTOR : BHARAT HEAVY ELECTRICALS LTD					
							PAGE 1 OF 1	SUB CONTRACTOR :					
										AGENCY			
SL. No	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D	M	C	N	REMARKS
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	V	
2	Pressure Test for condenser	Leak proofness	Critical	PNEUMATIC / HYDRAULIC TEST	100%	---do---	---do---	---do---	√	P	V	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	V	
4	Pressure Test for evaporator	Leak Proofness	Critical	PNEUMATIC / HYDRAULIC TEST	100%	---do---	---do---	---do---	√	P	V	V	
5	Chilling Unit	Leak Proofness	Critical	N_2 LEAK TEST	100%	Manuf. STD.	Manuf. STD.	---do---	√	P	V	V	
6	Chilling Unit	Leak Proofness	Critical	VACUUM TEST	100%	Manuf. STD.	Manuf. STD.	---do---	√	P	V	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	---do---	√	P	V	V	
8	Run Test	Functional Test	Critical	VISUAL	100%	Manuf. STD./APPD. DATA SHEET	Manuf. STD./APPD. DATA SHEET	---do---	√	P	V	V	

		LEGEND	FOR CUSTOMER USE	DOC NO.
MANUFACTURER /	CONTRACTOR	D : Records identified with "Tick" shall be essentially included by contractor in QP documentation. M : Manufacturer, C : Contractor, N : Customer (BHEL), P : Performer W : Witness V : Verification	REVIEWED BY	NAME & SIGN OF APPROVING AUTHRITY
SIGNATURE				

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

MANUFACTURING QUALITY ASSURANCE PLAN (QAP) FOR PRECISION AIR CONDITIONING

	Name of Agency : Category : Bought out Item	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
									P	W	V	
1	2	3	4	5	6	7	8	9	10			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	Mesurment	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)

SUBMITTED BY

NAME AND SIGNATURE OF THE APPROVING AUTHORITY

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

	QUALITY PLAN		CUSTOMER : BHEL			PROJECT: 4x270 MW MANUGURU TPS TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			STND QUALITY PLAN FOR MOTOR PACKAGE: AIR-CONDITIONING SYSTEM			SPECIFICATION TITLE			
	SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
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	-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						BIDDER'S/VENDORS COMPANY SEAL			

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

	QUALITY PLAN		CUSTOMER : BHEL			PROJECT: 4x270 MW MANUGURU TPS TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			STND QUALITY PLAN FOR MOTOR PACKAGE: AIR-CONDITIONING SYSTEM			SPECIFICATION : TITLE :			
		SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	3	2	1	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL .

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. CUSTOMER (BHEL)
2. SUB-CONTRACTOR
3. MOTOR MANUFACTURER

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

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

MANUFACTURE'S NAME & ADDRESS

MANUFACTURING QUALITY PLAN
ITEM : FIRE DAMPER
SUB SYSTEM : AC SYSTEM

PROJECT : 4x270 MW MANUGURU TPS
PACKAGE : AIR-CONDITIONING 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
									D	M	C	N	
1	2	3	4	5	6	7	8	9			10		11
A	**RAW MATERIAL**												
1	DAMPER-CASING & LOUVER	BEND TEST & CHEMICAL ANALYSIS	MAJOR	LAB TEST	SAMPLE FROM LOT	IS 277-1992	IS 277-1992	TESTING LAB REPORT	√	V	V	V	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	**FINISHED DAMPER**												
1	VISUAL INSPECTION	SURFACE DEFECT	MINOR	VISUAL	100%	MANUFACTURING STD.	MANUFACTURING STD.	INTERNAL INSP. REPORT	√	P	V	V	10% OF DAMPER RECORDED
		TAG DETAILS	DO	DO	100%	APPRVD. DRG	APPRVD. DRG	INTERNAL INSP. REPORT	√	P	V	V	
2	DIMENSIONAL CHECK	MEASUREMENT	MAJOR	DIMENTIONAL	100%	APPRVD. DRG	APPRVD. DRG	DIMENSIONAL REPORT	√	P	W	W	SELECTED FROM LOT FOR CROSS CHECK
3	DAMPER OPERATION WITH ACTT. FUNCTIONING	FUNCTIONAL/PERFORMANCE	MAJOR	FUNCTIONAL	100%	APPRVD. DRG	APPRVD. DRG	INTERNAL INSP. REPORT	√	P	W	W	
4	REVIEW OF QA DOCUMENT					APPRD. QAP	APPRD. QAP				V	V	CHP

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/

CONTRACTOR-SIGNATURE

LEGEND

D-RECORDS IDENTIFIED "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTION

M-MANUFACTURE
C-SUB CONTRACTOR
N-CUSTOMER (BHEL)
P-PERFORMANCE
W-WITNESS
V-VERIFICATION

CUSTOMER USE

REVIEWED BY

DOC NO.:

NAME & SIGN OF APPROVING AUTHORITY

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

	Manufacturer's Name & Address	Manufacturing Quality Assurance Plan						
		Project Name	PLC SYSTEM FOR AIR CONDITIONING SYSTEM, 4x270 MW MANUGURU TPS				Prepared By	Signature
							Checked By	Signature
Contract No.:							Approved By	Signature
Item Name	PLC SYSTEM FOR AC PLANT	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
									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 • Identification Labels • Physical Damages • Quantity • Spare Capacity	MA	Visual	100%	Product Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	P	P	V	

Legend:

: Record Identified with "√" 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
									M	C	N	
1.4	Touchscreen Panel PC, Printer, OS, Engineering software in the form of CD and license.	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.	P	P	V	

Legend:

: Record Identified with "√" 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
									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	

Legend:

: Record Identified with "√" 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
									M	C	N	
3.0	Factory Acceptance Test (FAT)											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	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:

: Record Identified with "√" 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

SECTION: I

SUB-SECTION: C 2C

CUSTOMER SPECIFICATIONS

PAINTING SPECIFICATIONS

Revised Painting specification

Paint Reference Scheme	Surface Preparation Grade / Surface Profile	Primer Coat			Intermediate Coat			Finish Coat			Total DFT in microns
		Premier Paint	No. of Coats	DFT in Microns	Intermediate Paint	No. of Coats	DFT in Microns	Finish Paint (See Note)	No. of Coats	DFT in Microns	
Various type of equipment/ valve, etc. (Temp. up to 90°C)	Degreasing and Mech. Cleaning with wire brushing/hand tool (Sa1/St2/St3 as applicable)	Red Oxide Zinc Phosphate (alkyd Medium)	2	35 per coat				Synthetic enamel (alkyd med.) as per IS:2932	2	35 per coat	140
LP Piping/ structural/ Vessels, etc. (Temp. upto 90°)	- do -	Red Oxide Zinc Phosphate (alkyd Medium)	2	35 per coat				Synthetic enamel (alkyd med.) as per IS:2932	2	35 per coat	140
Equipment with (Temp. upto 250°)	- do -	Heat resistant Al – paint	2	20 per coat	- NA	-	-	Heat resistant Al – paint	2	20 per coat	80
Elect. / Control Panels, etc.	Seven tank process	Red Oxide Zinc Phosphate (alkyd Medium)	2	35 per coat				Synthetic enamel (alkyd med.) as per IS:2932	2	35 per coat	140

Notes

1. Surface preparation shown above is as per Swedish Standards SIS 05-5900. Degreasing will be as per Standard SSPC-SP1.

2. In case of insulated surfaces, only primer coats shall be applied.

3. Gun metal/SS items with piping and G.I. pipes will not be painted. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.

4. All instruments shall be painted as per manufacturer standard practice.

5. All structural steel items shall be painted at site. Piping shall go with primer coating & finish paint shall be applied at site. Equipment shall be finish painted at shop.

6. Method of painting application shall be as per paint manufacturer's recommendation.

7. Paint makes - Asian Paints/Berger Paints/Shalimar Paints / Goodlass Nerolac / Addison Paints / Grand Paints / Bombay Paints / Jenson & Nicholson / CDC Carboline / Jotun / Hemple / Akzonoble.

SECTION: I

SUB-SECTION: C-3

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

TELANGANA STATE POWER GENERATION CORPORATION LIMITED

4 X 270 MW BHADRADRI TPS

AIR CONDITIONING SYSTEM

TECHNICAL SPECIFICATION (ELECTRICAL PORTION)

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) Erection and Commissioning spares.
e) Erection & Maintenance tools & tackles.
f) Electrical load requirement for AC system
g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
h) 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
i) 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.
j) Motor shall meet minimum requirement of motor specification.

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 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

a) A copy of this sheet "Electrical equipment Specification for AIR CONDITIONING SYSTEM" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) Electrical load requirement

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.
d) Electrical Load data format (Annexure –II)
e) Cable listing format (Annexure III)

SL.NO.	PARAMETERS	REQUIREMENTS
1	CODE ANS STANDARDS	IS-325, IS-12615, IEC-60034
2	SERVICE CONDITIONS	Hot, Humid and Tropical Atmosphere highly polluted.
3	TYPE AND RATING	General purpose, Constant speed, Squirrel cage, Three/Single phase, Induction type, Continuous duty, motor name-plate rating at 50°C shall have at least 15% margin
4	EFFICIENCY CLASS	IE3 (As per latest BIS notification)
5	RUNNING REQUIREMENT	(a) Motor shall run continuously at rated output over the entire range of 415V±10% voltage and 50Hz+3% to -5% frequency variations. (b) The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. (c) The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
6	STARTING CURRENT	(a) Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed 600% subject to IS tolerance of plus 20%. (b) The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage. (c) Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals. (d) Two hot starts in succession with motor initially at normal running temperature. (e) The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.
7	LOCKED ROTOR WITHSTAND TIME	(a) Under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time at minimum permissible voltage of 80% rated voltage. (b) Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
8	ENCLOSURE	All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
9	COOLING	The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air-cooled IC 611(CACA).
10	WINDING AND INSULATION	(a) All insulated winding shall be of copper. (b) Class F insulation but limited to class B temperature rise. (c) Windings shall be impregnated to make them non-hygroscopic and oil resistant.
11	TROPICAL PROTECTION	(a) All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion. (b) All fittings and hardwares shall be corrosion resistant.

12	SPACE HEATERS	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.
13	BEARINGS	(a) Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs. (b) Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. (c) Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area. (d) Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement. (e) Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
14	MOTOR TERMINAL BOX	(a) Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation. (b) Terminal box shall be capable of being turned 360 Deg. in steps of 90 degree for LV motors unless otherwise approved. (c) The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. (d) Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame (e) The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor. (f) The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec. (g) Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used. (h) Degree of protection for terminal boxes shall be IP 55 as per IS 4691. (i) 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. (j) Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
15	MINIMUM PHASE TO PHASE & PHASE TO EARTH CLEARANCE FOR 415V	25 mm
16	GROUNDING	(a) The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer to accommodate Flat ground conductor (as defined in Datasheet A). (b) The cable terminal box shall have a separate grounding pad.
17	RATING PLATE	In addition to the minimum information required by IS, the following information shall be shown on motor rating plate : (a) Temperature rise in Deg.C under rated condition and method of measurement. (b) Degree of protection.

		(c) Bearing identification no. and recommended lubricant.
18	DRAIN PLUG	Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.
19	LIFTING PROVISIONS	Motor weighing 20 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.
20	PAINTING	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 subject to Customer's approval during detailed engineering.
21	TESTS	All motors shall be subjected to Type tests & routine tests as per IS: 325 and approved quality plan.
22	DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT	DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: AIR CONDITIONING SYSTEM
PROJECT: 4 X270 MW BHADRADRI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC /240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage. 2. 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) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: AIR CONDITIONING SYSTEM
PROJECT: 4 X270 MW BHADRADRI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
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.
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.

DATA SHEET A

SL.NO.	PARAMETERS	4X270MW BHADRADRI
1	Design ambient temperature	50 ^{o}C
2	Maximum acceptable kW rating of LV motor	160KW *
3	Installation (Indoors/ Outdoors)	As required
4	Degree Of protection for motor/ terminal box	IP 54/ IP 55
5	Type of Cooling	TEFC/CACA/TETV
6	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	
i)	110 kW and above (Breaker Controlled)	50 KA for 0.25 sec..
ii)	Below 110 Kw (Contactor Controlled)	50 KA protected by HRC fuse
f)	LV System grounding	Solidly
7	Class of insulation	Class 'F', with temp rise limited to class B.
8	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
9	Power cables data	Shall be given during detailed engg.
10	Earth Conductor Size & Material	415 V motors : Above 90 kW - 50 x 6 Galvanised MS Flat 415 V motors : Above 30 upto 90 kW - 35 x 6 Galvanised MS Flat 415 V motors : Above 2.2 upto 90 kW - 25 x 3 Galvanised MS Flat 415 V motors : Upto 2.2 kW - 8SWG GI/GS Wire
11	Space heater supply	240 V, 1¢, 50 Hz (for motors above 30 Kw)
12	Rating up to which Single phase motor	Acceptable below 0.20 kW
13	Locked rotor current Limit as percentage of FLC	As per IS 12615*
14	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
15	Makes	BHEL/ Customer approval
16	Paint shade	Shall be given during detailed engg
17	TESTING	All motors shall be subjected to Type tests & routine tests as per IS: 325 and approved quality plan.
18	Energy efficient motors	* Continuous duty LT motors up to 160 KW Output rating (at 50 deg.C ambient temperature), shall be premium efficiency (IE3) as per IEC: 60034-30/ IS:12615.

	TITLE	SPECIFICATION NO.
	MOTOR	VOLUME II B
	DATA SHEET - C	SECTION
		REV NO. 00 DATE
		SHEET 1 OF 2

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

NAME OF VENDOR					
			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

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

NAME OF VENDOR					
				REV.	
NAME	SIGNATURE	DATE	SEAL		

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 1 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
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-	INSPEC. 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	RELEVENT 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	RELEVENT 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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
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-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'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	MANUFR'S DRG./ SPEC.	MANUFR'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			

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
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	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* 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

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 4 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	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 MANUF'S 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	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S 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%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	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	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	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

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
	SHEET 6 OF 9	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
		SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 7 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 8 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	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
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	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
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	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
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 9 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
		SHEET 1 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
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	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	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	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	2	1	-	NOTE -1 & NOTE-3
	BHEL		**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01	SPECIFICATION : TITLE :
	SHEET 2 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 55KW (LV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ANNEXURE-II																		

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

	LOAD DATA (ELECTRICAL)	JOB NO.	401	ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	4X 270 MW MANUGURU TPS	NAME		DATA FILLED UP ON
		SYSTEM	AIR CONDITIONING SYSTEM	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO

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

(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

SECTION: I

SUB-SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)

C&I TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM

Table of Contents

SPECIFIC TECHNICAL REQUIREMENT

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 JBs 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

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.

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.

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.

PLC SPECIFICATION

	TITLE:	SPECIFICATION NO. PES-145-36	
BHEL	**SPECIFICATION FOR PROGRAMMABLE LOGIC CONTROLLER SYSTEM**	VOLUME **II-B**	
		SECTION **D**	
		REV. NO. 03	DATE: 18.03.2014
		SHEET 1	OF 11

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.

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.

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.

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.

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.

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.

- 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.

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.

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-IIB 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

Additional technical specification of PLC like Remote I/O, Ethernet Specification, UPS signal IO List etc.

Remote I/O

Remote I/O panels shall be provided with pushbuttons, indicating lamps and hardwired annunciation system for local control/ operations.

Ethernet Specification

Networking (LAN) components:

Networking (LAN) components including switches, Firewall, fibre optics cable, other cable as required, jack panel with wire manager, patch cord, coupler, rack with all accessories, connectors, port, etc. shall be supplied.

A) The Industrial graded, IEC 61850-3 Std compliant, Managed Ethernet
Switches shall meet following minimum requirements:

i) 48 X Gigabit Ethernet Port

ii) 24 or 48 x 10/100/1000 Base TX ports (STP)

iii) SNMP, RMON, VOIP, VLAN, Multi link Trunk support

iv) Broadcast/multicast storm control

v) Supervisor Engine redundancy capability

vi) Redundant Power Supply

vii) Extra expansion slots for future up gradation.

viii) Integrated Security features (IPS, ACL, Firewall)

ix) 10 GB module support for future upgradeability

Expandability/stackability through a dedicated high speed expansion port.

Routable, remotely manageable, configurable.

One intelligent SNMP manageable mini-UPS for 30 minutes backup shall be provided with all accessories and software.

B) Secondary switches shall have the following features:

i) 24 or 48 X 10/100/1000 Base TX ports (STP)
ii) 2 or 4 X Gigabit Ethernet Port
iii) SNMP, RMON, VOIP, VLAN, Multi link Trunk support.
iv) Support for stacking with high throughput
v) Broadcast/multicast storm control

C) The Firewall shall meet following minimum requirements:

Firewall appliance shall facilitate multi-vendor, multi-application environment and shall support third-party products on open alliance. It shallsupport Active-Active configuration.

i) The firewall shall contain following features:
- a) Stateful inspection of packets.
- b) NAT functionality, including dynamic and static NAT translations
- c) Latest version of SNMP

ii) The firewall must send log information to a separate log server via an encrypted connection. Firewall logging must not impact firewall performance.

iii) Remote network access to the firewall shall only be possible through the administration interface.

iv) The firewall administration station must be capable of pushing firewall security policies and configurations to individual or multiple firewalls through a secure, encrypted connection to the firewall administration interfaces.

v) Graphical User Interface (GUI) and a Command Line Interface (CLI) for making changes to the firewall rules set shall be provided. (Access to the firewalls via the GUI or the CLI must be through an secure encrypted channel).

vi) Any changes or commands issued by an authenticated user shall be logged to a database configured on any of the machines in the LAN. The administration station must allow for a hierarchical architecture for rules set administration and viewing of firewall configurations Management.

vii) The firewall must not support any unencrypted means of access to the firewall.

viii) It shall Monitors ALL network traffic-traffic at Firewalls (Internet and external networks), in the DMZ and detect known threat through deep packet inspection.

ix) Detects unknown threats via anomaly scanning.

x) Detect unknown threats via behavior pattern to protect from zero day attacks.

xi) Keeps up-to-date on new threats and vulnerabilities.

D) Intrusion Detection System (IDS) and Intrusion Prevention System (IPS)
Features:

In order to inspect all inbound and outbound network activity and identify suspicious patterns that may indicate a network or system attack from someone attempting to break into or compromise a system on the Station LAN Network, the recommended IDS/IPS shall contain the following combined features. Any feature can be selected depending on whether it is to be configured as IPS or IDS.

i) Able to analyze, detect and report on security related events.

ii) Able to inspect traffic and to drop malicious traffic based on the configuration of security policy.

iii) Able to inspect the content of network packets for unique sequences/signatures.

iv) Able to detect and prevent known types of attacks such as worm or Trojan infections and hacks.

v) Able to prevent denial of service (DOS) and Distributed Denial of Service attacks.

vi) Able to prevent abnormal behaviors by monitoring and learning normal network behaviors.

vii) Keeps up-to-date on new threats and vulnerabilities.

viii) Shall provide user friendly interface to queries and reports on threats and event data so that security administrators can gain a better understanding of their ability to protect their network.

ix) Shall provide detailed activity logs for auditing.

x) Able to detect known threats via deep-packet inspection.

xi) Able to defect unknown threats via anomaly scanning.

xii) Able to detect unknown threats via behavior pattern to protect from zero day attacks.

UPS signal IO List

The following minimum hardwire/software signal shall be provided between UPS and PLC. These analog & digital signals shall be updated in HMI MIMICS.

a. Main I/P 1, 2 alternate I/P voltage, currents.

b. After line transformer -1&2 voltages

c. DC O/P VOLTAGE, current and battery charging , discharging currents,

d. Inverter o/p voltage, current.

e. Static switch main I/P, alternate i/p voltage.

f. SCVS O/P VOLTAGE, CURRENT, HZ

g. UPS-1 & 2 –KVA, KW o/ps

h. ACDB -1&2 VOLTAGE, CURRENT

i. UPS-1,2 –POWER FACTOR

PLC DATA SHEET

BHEL	**DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM**	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

Data Sheet A&B

	DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**		DATA SHEET – B FOR PLC SYSTEM **(TO BE FILLED BY BIDDER)**
GENERAL	PROJECT	4X270 MW BHADRADRI TPS	
	SERVICE	AIR CONDITIONING & VENTILATION SYSTEM	
	QUANTITY	☐ UNITISED ■ COMMON	
	LOCATION	■ INDOOR ☐ OUTDOOR ■ AC ☐ NON-AC*	
PLC EQUIPMENT	MAKE / MODEL NO.	BIDDER TO INDICATE	
	PROCESSOR	REDUNDANT WITH HOT STANDBY	
	DATA BUS (HMI)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	DATA BUS (REMOTE I/O - CPU)	☐ COPPER WIRE ☐ FIBRE OPTIC	
	FIELD CONTACTS INTERROGATION VOLTAGE	■ 24 V DC ☐ 48 V DC ☐ 110 V AC	
	LOCATION OF COUPLING RELAYS	■ MCC ☐ PLC PANEL	
	DESKTOP OWS QUANTITY	☐ ONE ☐ TWO ☐ _____ ■ DESKTOP VERSION ☐ SERVER VERSION ☐ WORK STATION VERSION REQUIREMENT OF OWS IN CCR ☐ YES ☐ NO QUANTITY_____	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	DESKTOP MONITOR TYPE	☐ 19" ■ 24" TFT/CRT MONITOR ☐ GIU ☐ OTHERS	
	PRINTER	INKJET ☐ A3___NOS ☐ A4___NOS LASER B/W ☐ A3___NOS ☐ A4___NOS COLOR INKJET ☐ A3 __NOS ☐ A4___NOS COLOR LASER ■ A3_1_NOS ☐ A4___NOS	
	PROGRAMMING / CONFIGURATION FACILITY	A) ☐ HAND HELD ☐ LAPTOP B) ENGINEERING SOFTWARE ☐ ONE OWS ☐ ALL OWS ☐ LAPTOP	OWS, EWS and LVS shall be as per PLC Configuration diagram attached elsewhere in the specification.
	SAFETY STANDARD	☐ SIL-3 ☐ SIL-2 ■ NIL	
	COMPUTER FURNITURE	BOQ ■ YES ☐ NO INDUSTRIAL GRADE ■ YES ☐ NO	
SPARE LIST	SPARE LIST	☐ START UP & COMMISSIONING ■ MANDATORY SPARE ☐ RECOMMENDED	
	SPARE LIST ATTACHED	■ YES ☐ NO	
REDUNDANCY	CPU	■ YES ☐ NO	
	POWER SUPPLY	■ YES ☐ NO	
	COMMUNICATION	■ YES ☐ NO	
	I/O CARD	☐ YES ☐ NO	
	OTHER ELECTRONICS	☐ YES ☐ NO	**As per vendor practice**

	DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM	SPECIFICATION NO.: PE-TS-411-	
		VOLUME II B	
		SECTION D	
		REV. NO. 00	DATE: 19.03.2015
		SHEET 2 OF 2	

Data Sheet No.: PES-145-36-DS1-0

Data Sheet A&B

		DATA SHEET – A FOR PLC SYSTEM **(TO BE FILLED BY PURCHASER)**	DATA SHEET – B FOR PLC SYSTEM **(TO BE FILLED BY BIDDER)**
No. of CHANNELS PER CARD	ANALOG INPUT	■ 8 NOs ☐ 16 NOs	
	ANALOG OUTPUT	■ 8 NOs ☐ 16 NOs	
	BINARY INPUT	■ 16 NOs ☐ 32 NOs	
	BINARY OUTPUT	■ 16 NOs ☐ 32 NOs	
	RTD**	4 NOs	
	THERMOCOUPLE**	8 NOs	
	ELECTRONIC CARD ISOLATION	☐ GALVANIC ☐ OPTICAL ☐ OTHER	
PANEL	QUANTITY	BIDDER TO INDICATE	
	CLASS OF PROTECTION(Refer Location of PLC)	■ IP-42	
	REMOTE I/O PANEL	■ YES ☐ NO AC REQUIREMENT ■ YES ☐ NO	
	COLOUR#	RAL 7032	
	BACK-UP DESK	☐ YES ■ NO	
	MIMIC	☐ YES ■ NO IF YES,THEN ☐ PANEL MOUNTED GUI ☐ ACRYLIC	
	CONTROL HARDWARE	☐ PB ☐ INDICATORS ■ FACIAS 25 Nos. ☐ OTHERS	
	CONFORMAL COATING	☐ YES ■ NO	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	■ YES ☐ NO	
	PURPOSE	☐ CONTROL ■ MONITORING	
	MEDIUM	☐ UTP ■ FIBRE OPTIC ☐ OTHERS	
	TIME SYNCRONIZATION SIGNAL FORMAT	☐ PULSE ☐ RS-485 ■ IRIG-B ☐ NTP	
	SOFTLINK	☐ MODBUS ■ OPC IF MODBUS THEN ☐ RS-485 ☐ ETHERNET	
	SERIAL LINK	COMMUNICATION PORT TYPE _____	
POWER SUPPLY INPUT FEEDER	PLC PANEL	BIDDER TO INDICATE LOAD DATA	
	REMOTE I/O PANEL	BIDDER TO INDICATE LOAD DATA	
POWER SUPPLY	SOURCE $$	■ UPS (INDUSTRIAL GRADE) ☐ 24V DC CHARGER	
	BATTERY TYPE	☐ Ni-Cd ■ LEAD ACID ☐ OTHERS	
	BACK-UP TIME	☐ 30 MINS ■ 60 MINS ☐ OTHERS	
	BATTERY CONFIGURATION	☐ 1X100% ■ 2X100% ☐ 2X50%	As per MAX philosophy
CUSTOMER TRAINING	TRAINING	■ REQUIRED ☐ NOT REQUIRED	
	NO OF DAYS	3 DAYS	
	LOCATION	☐ VENDOR'S WORK ☐ PROJECT SITE ☐ 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 SPECIFICPAINT SHADES, IF APPLICABLE TO BE USED.
$$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

BHEL	**DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM**	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	

BHEL	**DATA SHEET FOR PLC SYSTEM FOR AIR CONDITIONING & VENTILATION SYSTEM**	SPECIFICATION NO.:
		VOLUME II B
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		REV. NO. 03 / DATE: 21.03.2014
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Data Sheet No.: **PES-145-36-DS2-0**

DATA SHEET – C

	CONTROL HARDWARE	
	CONFORMAL COATING	
COMMUNICATION WITH OTHER SYSTEM	HARDWIRED	
	PURPOSE	
	MEDIUM	
	TIME SYNCRONIZATION 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 SPECIFICPAINT SHADES, IF APPLICABLE TO BE USED.
$$ CHECK & REPLACE WITH MAIN UPS SLD IF POWER SUPPLY IS NOT APPROVED BY CUSTOMER.

PLC CONFIGURATION

4. Soft link shall be provided for communication between plant DCS and PLC system. Soft link shall be redundant and OPC compliant over fibre optic link.

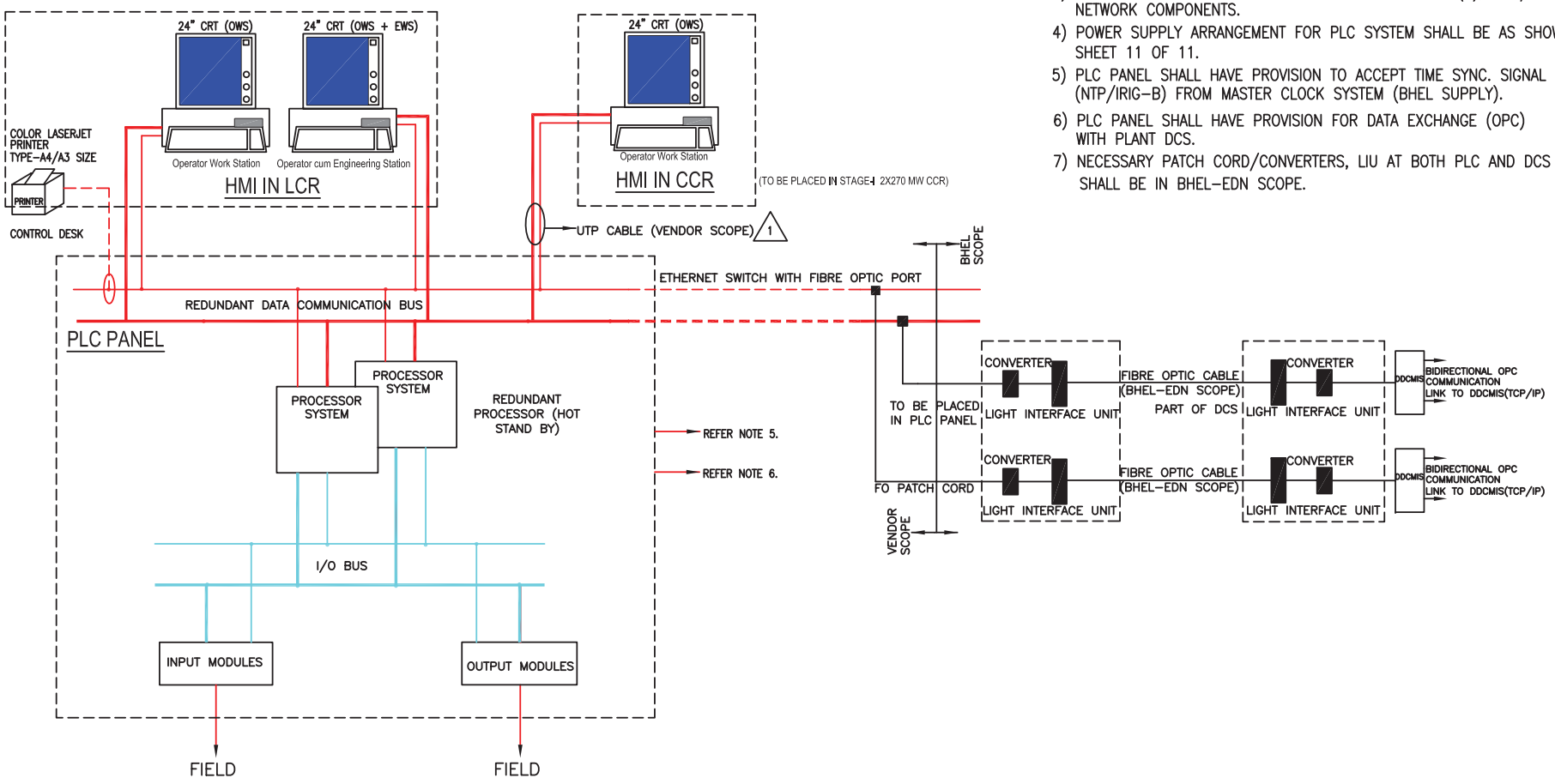
5. All PLC based system shall be time synchronized with plant Master clock system using IRIG-B signals.

6. PLC based control system shall be powered through dedicated UPS except for PLC/RIO/RPU placed in the TG building. The UPS configuration shall be as per page 11 of 11.

~~7. The operating philosophy, interlock & protection for each package shall be provided separately in design memoranda / detailed write-up of the respective package~~.

8. Wherever DCS is mentioned, it shall be read as DCS/DDCMIS.

CONTROL PHILOSOPHY FOR MECHANICAL AUXILIARY PACKAGES FOR 4 X 270 MW BHADRADRI PROJECT															REV 02
Sl. No.	System / Package	PER UNIT /COMMON	Control System Scope	Control System		Operation from		Type of interface with main plant DCS		Communication			Time Sync Format	HMI REQUIREMENT	Remarks
				Type	Location	Local	Remote (CCR)	Link	Purpose	Cable Type	Redundant (Y/N)	Protocol			
1	AC SYSTEM & VENTILLATION	COMMON	VENDOR	PLC (COMMON FOR AC & Ventilation System)	NEAR AC PLANT ROOM	Y	N	SOFT	MONITORING	FO	Y	OPC	IRIG-B	1OWS+ 1EOWS in local control room, 1 OWS in main CCR i.e. in Stage-I(2 X270 MW) CCR	REFER SHEET 5 OF 11



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 11 OF 11.
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 – MINIATURE CIRCUIT BREAKER
LCR – LOCAL CONTROL ROOM
CCR – COMMON CONTROL ROOM

Maharatna Company

PROJECT:	4X270 MW BHADRADRI TPS	DRG.NO. PE-DM-411-145-I900
		DATE 01.07.2015
TITLE:	PLC CONFIGURATION AC/VENTILATION	REV.NO. 02
		SHT 5 OF 11