
	<u>Air Conditioning System</u>		Annexure -[1A] of Price Bid format
PROJECT: NALCO DAM ANJODI		Rev 00	
Air Conditioning System :: Unit rates of Recommended Spares			
S. No	Item Description	Quantity	Unit Rate (Rs.)


ANNEXURE-2


[illegible]

ANNEXURE-3

[illegible]

TD-201 Rev No. 00	Form No.	 HYDERABAD	<p align="center">PRODUCT STANDARD</p> <p align="center">PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD</p>	ANNEXURE Rev No. 00 Page 1 of 3
<div data-bbox="175 646 263 1585" data-label="Text"> <p>COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.</p> </div> <div data-bbox="597 422 1156 468" data-label="Section-Header"> <h2 align="center">QAP GUIDELINES & FORMAT</h2> </div> <div data-bbox="776 569 976 604" data-label="Text"> <p align="center">(ANNEXURE)</p> </div> <div data-bbox="297 705 1451 779" data-label="Text"> <p>The QAP format and guidelines for filling up the format shall be used by vendor for preparation and submission of QAP after order placement.</p> </div> <div data-bbox="297 913 380 947" data-label="Section-Header"> <p>Note:</p> </div> <div data-bbox="297 980 1455 1155" data-label="List-Group"> <ol style="list-style-type: none"> 1. Typical /Indicative /Standard QAP(s) for equipment /package attached is reference document and to use by successful bidder in future for preparation and submission of QAP for BHEL /CUSTOMER approval. 2. No deviation to reference document is acceptable. </div>				

Form No.	 HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	ANNEXURE
			Rev No. 00
			Page 2 of 3
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.	<p style="text-align: center;"><u>GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN</u></p> <ol style="list-style-type: none"> QAP shall be made in landscape mode on A4 size paper as per the format enclosed. Font size shall be minimum 10. Each page of QAP shall contain the following information. <ol style="list-style-type: none"> Vendor's name & address. Customer: BHEL, Hyderabad. Project. BHEL Product Standard Number/revision number as referred in P.O. BHEL Purchase Order Number & Date. Product as per P.O. description. QAP Number (unique and shall not repeat)/revision number/date. Page number and number of pages QAP shall contain four parts / stages as follows. <ol style="list-style-type: none"> Raw materials and bought out items. In process Control / Inspection. Final assembly, Inspection & Testing. Painting, preservation & packing. Under 'Component', indicate name of the component (say casing, rotor, pressure gauge, etc). Under 'Characteristics', indicate appropriately (say chemical analysis, mechanical properties, NDT (UT,DP etc.), hydrostatic test, calibration check etc.) Under 'Class', indicate minor, major or critical depending on the importance of characteristic. Under 'Type of check', indicate appropriately (say chemical, mechanical, UT, DP etc.) Under 'Quantum of check', indicate appropriately (say 100%, 10%, sample, per melt, per heat, all pieces etc.) Under 'Reference document' and 'Acceptance norms', appropriate National & International standards, BHEL standards, approved drawing references etc. should be indicated. It is not correct to mention as "Vendor's internal standards or Vendor's standard practice etc.". If vendors' internal standards are referred, same shall be in line with BHEL Spec. indicated in the P.O. These may require review & approval by our Engineering dept. Under 'Format of record', indicate appropriately supplier's test certificate, calibration certificate, lab report, inspection report etc. Please refer 'Agency' in QAP format. Under P: Perform, W: Witness, V: Verify Indicate against each characteristic 1: (BHEL CQS/Nominated inspection agency), OR 2: (Vendor / Sub vendor) 		
	Ref. Doc		

Form No.	 HYDERABAD	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD	ANNEXURE
			Rev No. 00
			Page 3 of 3
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.	<p>Note: Performing agency is normally vendor or his sub vendor (Legend 2). Where witness points are indicated in specification, P.O., Drawing etc., for such operations, Under Witness (W) column use 1. Under 'Verify' column, use code 1.</p> <p>12. Under 'D' please put (<input type="checkbox"/> Tick) against each characteristic where vendor proposes to submit test certificate/report etc. OR as required as per BHEL Specification.</p> <p>13. Vendor's signature & stamp should be available on each page of QAP.</p> <p>14. Vendor should read the BHEL Product Standard thoroughly and QAP should be made only inline and relevant to the Specification & Approved Drawings.</p> <p>15. The following operations/characteristics/check points may be included (AS APPROPRIATE)</p> <ul style="list-style-type: none"> a) Visual check b) Dimensional check c) Mechanical and Chemical properties. d) Surface preparation before painting (by chemical cleaning, sand blasting, shot blasting etc. as the case may be.) e) Painting check for shade, Dry Film Thickness (DFT), Adhesion/ peel off test etc. f) Check for correctness for all components mounted as per General arrangement Drawing, Bill Of Materials (BOM), etc. for range, rating, make, color, size, location as per GA, quantity, label description including tag nos., annunciator facia, loose components, accessories, spares etc. g) Verification of test certificate for protection class for the enclosures. h) Mechanical functioning of switches. i) Continuity of earthing and provision of earth points. j) Colour coding of wiring, size, tightness & dressing of wiring. k) Review of test certificates of assembled items, raw materials, internal test reports etc. l) Witness of functional checks, which may include mechanical run & electrical run, H.V.test, IR measurement, Electrical and Mechanical tests etc. m) PQR, WPS, Welder Qualification Record, welding records (fit up, DP) etc. n) Material identification (for punch marks of serial numbers, Heat No, Melt No, Inspector's stamp etc.) o) Hydraulic Pressure Test, Pneumatic Pressure Test, Liquid Penetration Examination and other Non-Destructive Tests. p) Tests on Galvanised items (Visual, Hammer Test, Knife Test, Thickness, Pierce Test (Copper sulphate test), Hydrogen evaluation test, Stripping test (for Mass of Zinc coating) q) All tests as per BHEL Product Standard & approved drawings including Type tests and Routine tests on individual items and on System as a whole. r) Packing and Preservation. <p>16. QAP Format enclosed.</p> <p>17. Typical Manufacturing QAP(s) is /are attached.</p>		
	Ref. Doc		

INSPECTION PROCEDURE (IP) FOR MECHANICAL EQUIPMENT & STRUCTURES AT MANUFACTURERS' WORKS

Project : NALCO CGPP
Contractor's Name :
Package Description : BOILER & TURBOGENERATOR

Contract/P.O. No. :
Contract Specification Reference : NALCO CGPP-3CA01-PWR-01(R1)
IP No. & Rev. : IP-28812-M-00 Rev. 0

List-A - Test & Test Certificate Codes (Add additional Codes, if required)				List-B-Documents (Add additional Codes, if required)					
Code	Tests & Test Certificates	Code	Tests & Test Certificates	Code	Documents	Code	Documents		
1	Visual Inspection	15	Spark test for Rubber Lining	27	Manufacturer's Test Certificates for Bought Out Items	B1	Approved GA drawing	B10	Painting Certificate
2	Dimensional Checks	16	Adhesion Test	28	Painting/Galvanization Test/ Rust Preventive oil coating	B2	Information and other Reference drawings duly approved	B11	Conformity certificate
3	Fitment & Alignment	17	Performance Test (with Characteristic Curve)	29	Strip test	B3	Fabrication drawings duly approved	B12	Match marking of site joints
4	Control Assembly Check	18	No Load/Free Run Test	30	Shaft runout test	B4	Data Sheet	B13	IBR/Other Statutory Agency Certificate
5	Raw material -Physical test from NABL Lab.	19	Measurement of speed	31	Routine Test	B5	Bill of Materials		
6	Raw material-Chemical test from NABL Lab	20	Vibration,Noise & Temperature	32	Tensile, Elongation & Full thickness breaking	B6	Manufacturer's Catalogue		
7	Ultrasonic test	21	Rise Measurement	33	Fire, Electrical resistance, Drum friction test	B7	Approved Billing Schedule		
8	Magnetic Particle Test	22	Pressure Test	34	Abrasion loss & Troughability	B8	Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), Welding Operator Performance Qualification (WPC)		
9	Radiography Test	23	Leakage Test			B9	Calibration Certificate of all measuring Instruments and Gauges from NABL Lab.		
10	Dye Penetration Test	24	Load/Overload Test						
11	Hardness Test	25	Static Balancing Test						
12	Water & Dust Ingress Test	26	Dynamic Balancing Test						
13	Friction factor test		Operational & Functional Test						
14	Heat treatment/Stress Relieving								

General Note :-

- Three sets of test certificates (2 sets hard & 1 set soft) duly verified and signed by the main Contractor shall be furnished.
- IP number and revision status to be indicated by M.N.Dastur & Co, (P) Ltd.
- Drawing approval authority shall be as per contract.
- If quantity is in lot, substantial quantity shall be offered for economy of inspection.
- For Structural items average quantity shall be offered in 100 MT lot.
- Attempt shall be exercised to furnish IP for all the items if the package in single lot.
- Painting to be done after inspection as per approved Painting Specification. Shop Painting. Certificate as per format FM VIA shall be submitted.
- Vendor approved detail drawing shall be made available during inspection as required correlated with Dasturco approved GA drawing
- All measuring instruments used for our inspection and testing shall have valid calibration certificate from NABL laboratory with traceability to national/international standards.
- Pumps, Fans, Blowers and Compressors Performance test shall be conducted for one per type/model/capacity and remaining quantities shall be Mechanical Run Tested.
- All manual, pneumatic, electrical operated valves upto and 100 NB size shall be cleared based on review of documents and valve size 150 NB and above shall be witnessed.

Sl. No.	Contract/ Billing Schedule/ Item No.	Equipment / Item Description	Qty.	In-Process Inspection (Select from List-A)			Final Inspection (Select from List-A)			Acceptance Norm (Indicate applicable Standards, Methods, Procedures & Documents)	Test Certificates & Documents to be submitted by Contractor (Select from List A&B)	Remarks/Sampling Plan, if any
				M	C	D	M	C	D			
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												


Abbreviation:-

M : Manufacturer C : Contractor D : M.N.Dastur & Company (P) Ltd. P : Perform W : Witness R : Document Review

Signature of Contractor & Seal
Name:

Signature of Client & Seal
Name:

Signature of Inspection Agency & Seal
Name: M.N. Dastur & Company (P) Ltd.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 1 OF 10	

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Air Conditioning Package (Comprising of Chilling Unit, Air Handling Unit, Control System & Ducts).

2.0 REFERENCE DOCUMENTS

PO/ PR/ Standards referred therein/ Job specifications/Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
1.0	Procedure						
1.1	Functional/ Performance test, Hydrostatic/ Leak Test, Heat Treatment, NDT and other applicable procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS/ PQR/ WPQ for Equipments, Piping & Ducting	Documented Procedures	100%	Procedure Documents	-	H	R-Existing W-New
1.3	Categorization Plan for Bought Out Items	Documented Inspection Category	100%	Categorization Plan	-	H	H
2.0	Inspection at Works - Chilling Unit						
2.1	Refrigeration System - Vapour Compression System (as applicable) - Material/ Bought Outs						

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

**TYPICAL MANUFACTURING QUALITY PLAN**

MQP. NO.:

PROJECT ENGINEERING & SYSTEMS
DIVISION BHEL,
RC PURAM, HYD-502032PROJECT:
PACKAGE: AC SYSTEM
BHEL TECH SPEC:


REV NO:

DATE:

PAGE 2 OF 10


SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
2.1.1	Refrigerant Compressor & Motor (as applicable)	Compressor: Model/ Type, Physical & Chemical properties for parts, Dynamic Balancing, Leak Test, Performance characteristics (as applicable), Mechanical Run Test Motor: Type & Routine testing	100%	Manufacturer Test Certificate/ Inspection Reports	H	As per Note - 1	As per Note - 1
2.1.2	Heat Exchangers like Refrigerant Condenser, Shell & Tube Economizer, Evaporator, Oil Cooler, High Pressure Absorber Chiller (as applicable)	Physical & Chemical properties for pressure parts, Tube to Tubesheet Mock up & Expansion check, Visual, Dimensions, Hydrostatic test	100%	Manufacturer Test Certificate/ Inspection Reports	H	As per Note - 1	As per Note - 1
2.1.3	Vessels like Refrigerant Receiver, Compressor Knock-Out Drum, Oil Separator, Flash Vessel, Oil Recovery Vessel, Oil Reservoir/ Sump, Oil Filters (as applicable)	Physical & Chemical properties for parts, Visual, Dimensions, Hydrostatic test	100%	Manufacturer Test Certificate/ Inspection Reports	H	As per Note - 1	As per Note - 1
2.1.4	Fan/ Blower & drive motor for Condenser/ Evaporator (as applicable)	Fan/ Blower: Model, Physical & Chemical properties for parts, Dynamic Balancing, Leak Test, Performance, Mechanical Run Test, Motor: Type & Routine testing	100%	Manufacturer Test Certificate/ Inspection Reports	H	As per Note - 1	As per Note - 1

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 3 OF 10	


SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
2.1.5	Oil Pump Set Assembly (as applicable)	Pump: Model, Physical & Chemical properties for parts, Dynamic balancing (as applicable), Leak Test, Performance characteristic, Mechanical Run Test Motor: Type/ Routine testing	100%	Manufacturer Test Certificate/ Inspection Reports	H	As per Note - 1	As per Note - 1
2.1.6	Piping items viz. Valves, Pressure Safety Valves, Strainers, Pipes, Flanges, Fittings, Fasteners & Gaskets (as applicable)	Physical & Chemical properties for parts, Hydrostatic test, Functional Test (as applicable)	100%	Manufacturer Test Certificate	H	As per Note - 1	As per Note - 1
2.1.7	Miscellaneous items viz. Compressor Couplings, Base Frame for Skid, V Belt, Pulleys Insulation (Cold & Hot) & Structural Materials (as applicable)	Visual, Dimension, Dynamic Balancing of Coupling	100%	Manufacturer Test Certificate	H	As per Note - 1	As per Note - 1
2.2	Refrigeration System - Vapour Absorption System (as applicable) - Materials/ Bought Outs						

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 4 OF 10	


SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
2.2.1	Plates, Pipes/ Tubes, Valves, Pump (Hydraulic/ Vacuum),	Pump: Model/ Type, Physical & Chemical properties for parts, Dynamic Balancing, Performance Characteristics, Mechanical Run Test Other items: Physical & Chemical properties, Hydrostatic test (for pipes)	100%	Manufacturer Test Certificate/Inspection Reports	H	As per Note - 1	As per Note - 1
2.2.2	Expansion Tank, Cooling Tower (as applicable)	Tank: Physical & Chemical properties for parts, Visual, Dimensions, Hydrostatic test Cooling Tower: Performance characteristics for Fan, Type/ Routine testing of Motor, Functional cum Mechanical Run Test, Physical & Chemical properties for parts	100%	Manufacturer Test Certificate/ Inspection Reports	H	As per Note - 1	As per Note - 1

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 5 OF 10	


SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
2.3	Instrumentation Items like Local Control Panel, PLC, Transmitters (Pressure, Diff. Pressure, Temperature, Level), Pressure Gauges, Temperature Gauges, Level Gauges, Thermo Wells, Temperature Elements, Control Wiring & Junction Boxes, Control Valves, Solenoid Valves, Orifice Plates, Cable Trays, Instrument Tubing/ Fittings/ Valves (as applicable)	Panel: HV/ IR, Logic Check, BOM verification Other Instruments/ items: Calibration & applicable statutory certificates, Leak testing, Functional test (as applicable)	100%	Manufacturer Test Certificate/ Inspection Reports	H	As per Note - 1	As per Note - 1
2.4	Pre-Fabricated Interconnecting Piping at shop	NDT (RT for Butt welded joint & MPT/ DPT for Socket weld joint), Heat Treatment & Helium/ Pneumatic/ Hydrostatic Test	As per Spec.	Inspection Report	H	W	RW
2.5	Complete Refrigeration Package assembly	Visual, Dimensions, Completeness as per Piping & Instrument Drawing & Performance test (Type tests as per applicable standards, as applicable), Helium Spray/ Shroud Test (For Vapor Absorption Chillers)	100%	Test Report	H	H	H

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 6 OF 10	


SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
3.0	Inspection at Works - Air Handling Unit						
3.1	Plates, Filters (Fine/Chemical), Dampers etc	Physical & Chemical properties, Size, Quantity	100%	Manufacturer's Test Certificate/ Inspection Report	H	As per Note - 1	As per Note - 1
3.2	Heating Unit (Electric Heater)	Model/ Type, Visual, Dimensions, Electrical Characteristics, Statutory approvals	100%	Manufacturer's Test Certificate/ Inspection Report	H	As per Note - 1	As per Note - 1
3.3	Humidifier/ De-humidifier Unit	Physical & Chemical properties for parts, Leak Testing, Spay pattern (for nozzles)	100%	Manufacturer's Test Certificate/ Inspection Report	H	As per Note - 1	As per Note - 1
3.4	Fan/ Blower & Drive motor	Fan/ Blower: Model/ Type, Physical & Chemical properties for parts, Dynamic Balancing, Leak Test, Performance, Mechanical Run Test	100%	Manufacturer's Test Certificate/ Inspection Report	H	As per Note - 1	As per Note - 1
		Motor: Type & Routine testing					
3.5	Complete Air Handling Unit	Visual, Dimensions, Completeness as per Piping & Instrument Drawing, Mechanical Run Test	As per Spec	Inspection Report	-	H	H
4.0	Inspection at works - Air Distribution Ducting/ Diffuser/ Grills						
4.1	Sheets/ Dampers/ Louvers/ Insulation/ Cladding	Physical & Chemical properties, Visual, Dimensions, Size, Quantity	100%	Manufacturer's Test Certificate/ Inspection Report	H	R	R

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 7 OF 10	


SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
4.2	Blower & Drive motor	Fan/ Blower: Model/ Type, Physical & Chemical properties for parts, Dynamic Balancing, Leak Test, Performance, Mechanical Run Test Motor: Type & Routine testing	100%	Manufacturer's Test Certificate/ Inspection Report	H	W	R
5.0	Final Inspection of Package (At Site)						
5.1	Inspection of welds & Pressure Testing	Fit up/ NDT/ Heat Treatments	As per spec.	Inspection Report	-	H	Note - 4
5.2	Installation of items/ units	Installation of units as per layout/ location/ Insulation	100%	Inspection Report	-	H	Note - 4
5.3	Balancing of Air Distribution system	Verification of air quantities across various air terminals	100%	Inspection Report	-	H	Note - 4
5.4	Inspection of Electrical circuits/ installation	Verification of circuits & installations	100%	Inspection Report	-	H	Note - 4
5.5	Performance Run test	Performance guarantee run test for 72 hours	100%	Inspection Report	-	H	Note - 4
5.6	Spares (Mandatory, Commissioning, Operational), Special Tools & Tackles (as applicable)	Verification for quantity	100%	Inspection Reports	-	H	Note - 4

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 8 OF 10	

SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
6.0	Painting						
6.1	Surface Preparation & Painting of all Carbon Steel Parts and Pickling & Passivation for Stainless Steel Parts	Visual Inspection for Workmanship/ Paint Shade/ Painting DFT/ Adhesion/ Holiday Check (as applicable)	100%	Inspection Report	-	H	W/R
7.0	Documentation & IC						
7.1	Submission of Certificates (as applicable)	<ul style="list-style-type: none"> Certificate of Statutory testing agency for suitability of area classification Certificate of Statutory approval authority like PESO (as applicable) Valid BIS License (as applicable) Degree of protection certificate (as applicable) 	Each Model	Certificates from Statutory Bodies	R	R	R
7.2	Documentation & Inspection Certificate (IC)	Issue of IC	100%	Inspection Certificate	-	H	H
7.3	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Manufacturer data book		H	H

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 9 OF 10	

NOTES (As applicable):


- 1a. For Non NACE & Non Hydrogen service, following items shall be procured with EN 10204 type 3.1 certification.

Items	Dimensions	Material
Seamless Pipes	Size upto 12"	Carbon Steel
Seamless Fittings	Size upto 14" and Socket welded fittings of all sizes	Carbon Steel
Flanges	Size upto 24" - 300 ANSI Class & Socket Welded Flanges of all rating.	Carbon Steel
Valves	Size upto 12" - 300 ANSI Class & All Forged Valves with socket welded ends upto 1500 ANSI Class (Other than Jacketed Valves)	Carbon Steel
Fasteners	All sizes	All material except Fasteners as per ASTM A453
Gaskets	All sizes	All material
Motor	Upto 55KW	For safe area
Catalogued Item	Electrical/ Mechanical Items	For safe area

- 1b. All other materials which are not covered in 1a and categorized as 'A' or 'B' shall be procured with EN 10204 type 3.2 certification.
2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable (unless otherwise agreed upon).
3. Acceptance Norms for all the activities shall be as per PO/ PR/ STANDARDS referred therein/ Job Specification /Approved Documents.
4. Site activities covered under 5.0 shall be witnessed by : Construction Inspection or TPIA, as the case may be.
-
5. This Standard MQP should be read along with specification (Latest revision as per PO), approved drawings & approved datasheet (as applicable).
6. Drawing/datasheet shall prevail over quality plan for contradiction if any.
7. Any project/customer specific requirements which shall be notified have to be fulfilled by the vendor at the time of execution of order.

Abbreviations: -

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

	TYPICAL MANUFACTURING QUALITY PLAN		MQP. NO.:	
	PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RC PURAM, HYD-502032	PROJECT: PACKAGE: AC SYSTEM BHEL TECH SPEC:	REV NO:	DATE:
			PAGE 10 OF 10	

MTC	-	Material Test certificate	TC	-	Test Certificate
IR	-	Inspection Report	ITR	-	Internal Test Report
NDE	-	Non Destructive Examination	IGC	-	Inter Granular Corrosion

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.

M.N. DASTUR & COMPANY (P) LTD.
INSPECTION DIVISION

FM-IV/Rev. 22

List of Dasturco Inspection Centres

1.	EAST	M.N. Dastur & Company (P) Ltd. P-17 Mission Row Extension Kolkata 700 013 Attn.: Mr. A. K. Dutta	FAX : 033 2225 1422/2225-7101 PHONE : 033 2225 5420 (10 lines) Extn 2225 0500 (10 lines) 719 E-Mail : inspection.kol@dastur.com & Arun.Dt@dastur.com
2.	WEST	M.N. Dastur & Company (P) Ltd. “Engineering Centre” 9 Mathew Road Mumbai 400 004 Attn.: Mr. G.S. Kulkarni	FAX : 022 2363 0906 PHONE : 022 2363 2880 (4 Lines) 2363 2901 (5 Lines) E-Mail : inspection.mum@dastur.com kulkarni.gs@dastur.com
3.	SOUTH	M.N. Dastur & Company (P) Ltd. “Engineering Centre” 480, Anna Salai, Nandanam Chennai 600 035 Attn.: Mr. V.M. Subramanian	FAX : 044 2434 3712 PHONE : 044 2434 2206/2303/2002 2434 2348/2340 E-Mail : inspection.chn@dastur.com subramanian.vm@dastur.com
4.	NORTH	M.N. Dastur & Company (P) Ltd. 232B, Okhla Industrial Estate, Phase-III First Floor New Delhi – 110 020 Attn.: Mr. K. S. Duggal	FAX : 011 2632 5863 PHONE : 011 2632 6838/6323 E-Mail : Inspection.Del@dastur.com Kanwaljeet.D@dastur.com

Geographical jurisdiction of Inspection Centres:

EAST :	West Bengal, Odisha, Jharkhand, Bihar, Chhattisgarh, Tripura, Meghalaya, Assam, Sikkim, Arunachal Pradesh, Nagaland, Mizoram, Manipur
WEST :	Maharashtra, Gujarat, Goa, Diu, Daman, Dadra Nagar Haveli
SOUTH :	Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, Kerala, Pondicherry
NORTH :	Delhi, Uttar Pradesh, Haryana, Madhya Pradesh, Himachal Pradesh, Punjab, Rajasthan, Uttarakhand, J&K

**M.N. DASTUR & COMPANY (P) LTD.
INSPECTION DIVISION**

Form: FM-V Rev. 01

Inspection Call Format

Contractor's Inspection Call No.

Dated -

A. General Information:

Project		Client	
Package		Order No. on Contractor	
Contact Persons with mobile & email ID	Contractor: Manufacturer:	Place of Insp. with full address and landmark	
Proposed date of insp.		Estimated duration of Insp.	
Manufacturer's off day		Order no. on Manufacturer	

B. Items Offered:

Item/BS No.	Item Description	Quantity *		
		Ordered	Offered now	Accepted earlier

* In case of lot, break up of lot shall be furnished from duly approved document/drawing.

C. Document Enclosed (1 set hard copy & 1 soft copy) for ready reference:

Document	Letter ref. of Dastur	Document No. & Rev.	Approval status
IP/ QAP			
Drawings/ Data-sheet			

D. Test Certificate (TC) Enclosed as per IP(3 sets hard copy & 1 soft copy):

TC No.	TC Description	TC No.	TC Description

Sign, Name & Designation
For CONTRACTOR

Note:

1. Use Annexure wherever space is inadequate
2. Manufacturing/Fabrication drawings duly approved by designer of Contractor/ Vendor shall be made available to Dastur during physical inspection or for document review wherever applicable.
3. It will be the sole responsibility of the Contractor to indicate correct Billing Schedule (BS) No. and Item Description. For any error on this account by Contractor, Dastur will not be liable to issue any amendment.

Page No.: 1 of

Contractor-

I	Place of Inspection & Insp. date						
II	Cont. No./P.O/LOI/LOA & Date on M/s.						
III	Contractor's Call Ref. No. & Date						
IV	Insp. File ref. no. for call & date						
V		VI			VII		VIII
Eqpt/ Item No.	B.Sch. No.	Description of Items			Relevant approved/Cleared Drawings No.		Quantity Inspected
IX	Test & Measuring Instruments used & its calibration details			<i>(In Case of more than two instruments, use form FM-VIB)</i>			
X	Sampling Plan (if any) * ✓ Tick			XI	Documents collected during visit, if any		
	A	B	100%				
XII	Observations :						
* A: Sampling as agreed in IP is followed. B: IS:2500 (Part I) – latest revision, General Inspection Level - II of Table I and Single Sampling Plan as well as AQL (0.1%) as per Table - II-A was followed							

Inspection Agency
M.N. Dastur & Co. (P) Ltd.

M.N. DASTUR & COMPANY (P) LTD.

JOINT INSPECTION REPORT
(Continuation Sheet)

Page No.: 2 of

JIR No. & date :

[illegible]

Manufacturer
Name

Main Contractor
Name:

Inspection Agency
M.N. Dastur & Co. (P) Ltd.

SHOP PAINTING CERTIFICATE

Equipment/ : Item	Qty:	Project:
Painting Certificate No. and date:		Drg. No.

Surface Preparation and Painting has been done as per Painting System (System No.) of General Specification No. for Painting applicable for the Project.

Details of Painting are as follows:

<u>Surface Preparations</u>						
Required:						
Observed:						

<u>Inside Painting :</u>						
Coat Detail	Paint Detail	Paint Shades Adopted	No. of Coat	Detail/Coat in Microns		Total DFT (in Micron)
				Required	Observed	
Primer						
Coat						
Intermediate						
Coat						
Finish						
Coat						

Outside Painting :

Coat Detail	Paint Detail	Paint Shades Adopted	No. of Coat	Detail/Coat in Microns		Total DFT (in Micron)
				Required	Observed	
Primer						
Coat						
Intermediate						
Coat						
Finish						
Coat						

Signature of Manufacturer

Signature of Contractor

	JIR No. and Dt.					
<u>TEST INSTRUMENT CALIBRATION DETAILS</u>						
Sl. No.	INSTRUMENT	SL.NO/ ID NO.	MAKE	RANGE	NABL Accredited Lab Y/N	VALIDITY

MANUFACTURER

CONTRACTOR

DASTURCO

M.N. DASTUR & COMPANY (P) LTD.
INSPECTION DIVISION

INSPECTION CERTIFICATE

Inspection category: Physical Inspection/ Document review

Certificate No.

Date:

Issuing Office :

Client:
Package No, & Description:
Contractor:
Ref. Inspection Call No. and date
Manufacturer & Place of Inspection:

Project:			
Order No.& dt. on Contractor:			
Date(s) of Inspection:			
JIR Ref. for Physical Inspection:			
Test reports verified (put tick)			
MTC	Dimension	Performance	Routine
Pressure	Acceptance	No load/Run	Others

The following items of equipment are released on the basis of review of test certificates / physical inspection and witness of tests as applicable as per approved QAP/IP. This is subject to further inspection by the Purchaser or his representative/s who may consider it fit prior to, or, after dispatch:

Item/BS No.	Description of Items	Quantity			
		Ordered	Offered	Accepted	Cumulative

Remarks: 1.
2.
3.

Drawing Nos. with Rev.: 1. 2. 3. Copy to:- 1. Client – 1 copy 2. Contractor- 2 copies 3. Site Office – 1 copy 4. Project Manager – 1 copy	5. Insp Kol – 1 copy 6. 7.
---	----------------------------------

Reviewed/Inspected by:

Name & Designation

Certificate released by:

For M.N. DASTUR & COMPANY (P) LTD.

(Signature)

Name & Designation:

(put stamp)

Note:

- This Inspection Certificate (IC) does not absolve the responsibility of the contractor / manufacturer from their contractual obligations nor shall it preclude subsequent rejection / replacement / rectification if found not meeting the specifications and shall not accrue any responsibility, to the inspection agency signing this document in any way at any time after dispatch from the manufacturer's works / premises.
- Quantity indicated above may defer from billing schedule quantity due to engineering requirements.
- This IC is released upon receipt of compliance of comments on documents and/or compliance of Joint Inspection Report observations. Refer "Remarks" above for reference of such compliances and concessions / re-approval granted, if any, against deviations by Designer / Client.

Inspected & accepted items / Samples Punched/Stamped thus:	
--	--

Continued in Sheet No.

Inspection Certificate No. and date –

Item/BS No.	Description of Items	Quantity			
		Ordered	Offered	Accepted	Cumulative

Certificate released by:
For M.N. DASTUR & COMPANY (P) LTD.

(Signature)

Name & Designation:

(put stamp)

ANNEXURE-5

VENDOR'S NAME & ADDRESS:			MANUFACTURING QUALITY PLAN						QP. NO.:					
			CUSTOMER: BHEL, HYDERABAD – 32.			BHEL P.O.NO.:			REV NO:		DATE:			
			PROJECT:			P.O.DATE:								
			PRODUCT:			BHEL SPEC:			REV:		PAGE 1 OF 1			
SL NO	COMPONENTS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY			REMARKS	
										P	W	V		
1.0	RAW MATERIALS & BOUGHT OUT ITEMS													
2.0	INPROCESS INSPECTION													
3.0	FINAL INSPECTION & TESTING													
4.0	PRESERVATION & PACKING													

VENDOR TO NOTE: THIS FORMAT IS IN MICROSOFT WORD. HEADER & FOOTER SHALL BE AVAILABLE IN EACH PAGE OF QP. QP SHALL BE IN LANDSCAPE & A4 SIZE ONLY. FONT SIZE SHALL BE MIN 10. VENDOR SHALL SIGN & STAMP IN EACH PAGE OF QP. LOI REF. & DATE ARE NOT ACCEPTABLE. P.O.NO. & DATE SHALL BE INDICATED. QP NO. SHOULD BE UNIQUE AND SHALL NOT REPEAT. ALL THE TESTS / CHECKS INDICATED IN THE BHEL SPEC. SHALL BE INDICATED IN THE QP.

LEGEND: P: PERFORM, W: WITNESS, V: VERIFICATION. INDICATE 1 FOR BHEL CQS (OR BHEL NOMINATED INSPECTION AGENCY) & 2 FOR VENDOR/SUB VENDOR AS APPROPRIATE AGAINST EACH COMPONENT /CHARACTERISTIC UNDER P, W & V COLUMNS. * FOR ITEMS MARKED ✓ (TICK) IN COLUMN 'D', TEST CERTIFICATES SHALL BE SUBMITTED TO BHEL FOR RECORDS.	PREPARED BY	APPROVED BY	APPROVED BY
	VENDOR'S SIGNATURE & STAMP	BHEL QA SIGNATURE & STAMP	CUSTOMER'S SIGNATURE & STAMP



SECTION - I

GENERAL

1.0 INTRODUCTION

1.1 National Aluminum Company Limited (NALCO), a Government of India Undertaking and a Navaratna Company owns and operates a large integrated Mines-Alumina-Aluminum Complex in India. It has multi-locational operations as follows:

- a) Mines & Alumina Refinery Damanjodi, Odisha.
- b) Aluminium Smelter Angul, Odisha.
- c) Captive Power Plant Angul, Odisha.
- d) Port Handling Facilities Visakhapatnam, Andhra Pradesh (for Alumina Export & Caustic Soda Import)

The original plant at Damanjodi was commissioned in 1987. The 1st phase expansion of the integrated complex was started in 1997 and completed in 2002. The implementation of 2nd phase expansion of the integrated complex completed in 2011, along with the expansion of Smelter and Power Plant.

Further, Bauxite Mines & 4th stream of Alumina Refinery has been upgraded through debottlenecking to augment their capacities.

In the initial plant of Alumina Refinery, there were 2 streams. During 1st & 2nd phase expansion, 3rd & 4th stream have been added. Capacity of 4th stream is now being up-graded through debottlenecking. There is a co-generation Steam & Power Plant with the following facilities

- 4 Nos of 200 TPH steam generators
- 1 No of 250 TPH steam generator
- 4 Nos of 18.5 MW capacity back pressure steam turbogenerators
- 1 No. of 19.5 MW capacity back pressure steam turbogenerator



Section-I- General (cont'd)

As a part of NALCO's growth plan, it is planned to set up of one more Stream (5th Stream) in its Alumina Refinery under 3rd Phase Expansion at Damanjodi with Stream capacity of 1.0 MTPA and processing technology will be based on medium pressure digestion.

To meet the above objective, it is planned to add one number Pulverised coal (PC) fired Steam generator of 300 TPH capacity and one number Condensing cum Extraction TG of 18.5 MW capacity in third phase expansion of existing Steam and Power Plant (SPP) at Damanjodi in Odisha.

1.2 This specification covers the design, engineering manufacture, assembly, testing, packing, supply, transportation to site, unloading, storage at site, erection, start-up, commissioning and performance guarantee tests for 300 tph pulverised coal fired Steam generator (boiler), 18.5 MW turbogenerator, SOx & NOx control system along with their associated auxiliaries, ancillary facilities, pipework, electrics & instrumentation as specified.

1.3 All items of equipment shall be complete in all respects and any equipment not covered in this specification but essential for proper installation, operation and maintenance shall be included in the offer and the reasons for such inclusion shall be clearly stated.

1.4 The design, manufacture and installation of Boiler shall be strictly in accordance with Indian Boiler Regulations (IBR). The list of standards generally applicable is enclosed as Annexure-1. The specification shall be studied thoroughly regarding the workability of the plant and equipment and the tenderer shall take full responsibility for the guaranteed operation of the Boiler, TG, FGD and associated auxiliary equipment as regards to output, performance, reliable and safe working of facilities indicated in the specification.

1.5 Where found necessary, the Purchaser reserves the right of selecting the manufacturers of mechanical, electrical equipment, instruments and controls and any other specialized items in the interest of standardization, and the successful tenderer shall agree to supply equipment of the particular make, if so required.

1.6 List of approved sub-vendors for major items is given in Annexure-2. However, the tenderer shall submit a list of sub-vendors for all the equipment to be procured by him as "boughtout" items for Purchaser's review/approval and this should also be based on Annexure-2. The successful tenderer shall agree to



Section-I- General (cont'd)

procure the boughtout items from the sub-vendors approved by the Purchaser. No new parties will be considered for inclusion after order placement.

1.7 Under the turnkey execution of Contract, the successful Tenderer shall execute the whole and every part of work in a qualified workmanship manner and shall handover the equipment to the Purchaser in full satisfactory working condition, after commissioning and testing. In course of discharge of this obligation under the terms of the Contract, successful Tenderer shall provide/perform all services without any additional cost to the Purchaser.

1.8 The Tenderer shall visit the plant and study the proposed location for the power plant and also other related facilities before submitting his offer. All the relevant existing data/drawings necessary to be required for preparation of the offer and engineering shall be arranged by the tenderer.

2.0 SITE CONDITION

2.1 Location

The project site is located in Damanjodi village, Semiliguda block, Koraput district in Odisha state.

2.2 Site Climatic Condition

The climatic conditions pertaining to the site are given below:

- | | | |
|----|--|---|
| 1. | Maximum dry bulb temperature, °C | : 46.6 |
| 2. | Minimum dry bulb temperature, °C | : 3 |
| 3. | Ambient temperature for boiler PG Test, °C | : 35 (Correction curve up to maximum temperature of 46.6 °C shall be provided before PG test) |
| 4. | Maximum relative humidity, % | : 89 |
| 5. | Minimum relative humidity, % | : 50 |



Section-I- General (cont'd)

- | | | |
|-----|--|--|
| 6. | Relative humidity for design and performance, % | : 60 |
| 7. | (i) Maximum rainfall in a day, mm | : 354 |
| | (ii) Maximum hourly rainfall, mm | : 80 |
| 8. | Annual rainfall, mm | : 1430 (10 years average 2008 to 2017) |
| 9. | Design wind velocity (as per IS:875, Part-3, 2015), m/sec. | : 50 |
| 10. | Predominant wind direction | : Predominantly in Southwest direction |
| 11. | Average altitude from mean seal level, m | : 910 |

2.3 Susceptibility to earthquake

The plant site is situated in a region falling under Zone -II as defined in IS: 1893 – Part-I (year 2016).

2.4 Railway Station

The nearest Railway Station is Damanjodi Railway station at a distance of about 6 km towards west from refinery Site.

2.5 Roads

The site is situated at a distance of 10km from South west of NH-26.

2.6 Sea Port

Visakhapatnam port on the Bay of Bengal is at a distance of 200 km from site.

2.7 Air Port

The nearest commercial airport is Visakhapatnam international airport, Vishakhapatnam, Andhra Pradesh at a distance of 200 km from site.



ANNEXURE – 2-B

LIST OF PREFERRED VENDORS FOR UTILITIES

Sl. No.	Item	List of Vendors
1.	Pipes	: TATA/BST/JINDAL/ /MAHARASHTRA SEAMLESS LTD/SAIL
2.	Pipe Fittings	: N.L. HAZRA / SHYAM ENGG/M.S. FITTINGS / DEE DEVELOPMENT /TRUE FORGE/ TEEKAY TUBE /CHARGESON/VIVIAL FORGE PVT. LTD/ TUBE BEND /PROJECT TOOLING / ENGINEERING SERVICES
3.	Traps & Strainers	: UNI KLINGER/ESCO/FORBES MARSHAL/ PENNANT
4.	Insulation	: LLOYDS INSULATION/ROCKWOOL INDIA/ JAYASHREE INSULATORS
5.	Expansion Joints (Metallics & Non- Metallics)	: METALLIC EXPANSION JOINTS – FLUIDYNE/LONESTAR / METALLIC BELLOWS/B.D ENGINEERS/ C.L ENGINEERS. NON-METALLIC EXPANSION JOINTS – KELD/ FLEXCON / CORI ENGINEERS PVT. LTD.
6.	Gaskets	: CHAMPION/IGP/REINZ/TALBROS/ /UNIKLLNGER
7.	Hoses Including Rubber Steel Cladding	: HYDROCRIMP/SENIOR INDIA/BENGAL INDUSTRIES/ PAREKH BROTHERS
8.	Gate, Globe & Check Valves	
i.	Valve Rating #800 And Above	: BHEL/AUDCO/FISHER XOMOX SANMAR



Annexure-2-B (cont'd)

Sl. No.	Item	List of Vendors
ii.	Valve Rating Below #800	: BHEL/AUDCO/KSB/FOURESS/ /FISHER XOMOX
9.	Ball Valves	
i.	Cast Iron	: AUDCO/FOURESS/REYNOLDS/ VALTECH INDUSTRIES
ii.	Cast Carbon Steel	: AUDCO/BDK/FOURESS/VIRGO/ FISHER-XOMOX SANMAR/ /REYNOLDS
iii.	Forged Steel	: AUDCO/FOURESS/VIRGO/ REYNOLDS
10.	Butterfly Valves	
i.	Cast Iron	: AUDCO/FOURESS/INTER VALVE (INDIA)/KSB
ii.	Cast Carbon Steel	: AUDCO/FOURESS/INTERVALVE/ HI-TECH BUTTERFLY VALVES/ FLUID CONTROL EQUIPMENT
iii.	Forged Steel	: AUDCO/BDK/FOURESS/ INTERVALVE/HI-TECH BUTTERFLY VALVES
11.	Plug Valves	
i.	Cast Iron	: AUDCO/FISHER-XOMOX SANMAR/BHEL/KSB
ii.	Cast Carbon Steel	: AUDCO/FISHER-XOMOX SANMAR/BHEL/KSB
iii.	Forged Steel	: AUDCO/FISHER-XOMOX SANMAR/BHEL/KSB
12.	Other	
i.	Safety Valve/Pressure Relief Valve	: TYCOSANMAR/AUDCO/ FAINGERLESER/ BHEL/ MAZDA
ii.	Pressure Reducing Valves	: JNM/FISCHER XOMOX/ILP/MIL



Annexure-2-B (cont'd)

Sl. No.	Item	List of Vendors
iii.	Control Valves	: JNM/FISCHERXOMOX/FISHER ROSEMOUNT/METSO/ R.K.CONTROL/TOSHNIWAL/ILP/ MIL
iv.	Pressure Release Valves	: FISCHER XOMOX/AUDCO CROSBY
v.	Needle Valves	: FISCHER XOMOX/TUFLIN/AUDCO
vi.	Float Valves	: LEVCON/IVI/IVC/G.M.DALUI
vii.	Spring Supports	: PIPE SUPPORTS / SUPPORTS SYSTEM /TECHNO INDUSTRIES
viii.	Valve Actuators	: AUMA/LIMITORQUE/ROTORK CONTROLS
ix	Knife Edge Gate Valve / Double Eccentric Butterfly Valve	: VAAS/FOURESS/KEY STONE/ JASH/VAG
x	Goggle Valve	: FOURESS/JOSHI JAMPALA
xi	Positive Displacement Pump (For Fuel Oil)	: UT / ROTO / TUSHACO / DELPD
xii	Strainer	: HAWA / FLUID TECH / XICON /PRECEDENCY/ GROTO
xiii	Oil Water Separator	: K PACK SYSTEMS PVT. LTD, BANGALORE/ GRAND PRIX FAB PVT LTD HARYANA/ FIL SEP EQUIPMENTS PVT LTD GUJARAT



ANNEXURE – 2-C

LIST OF PREFERRED VENDORS FOR ELECTRICAL

Sl. No.	Item	List of Vendors
A.	<u>HIGH TENSION (HT) EQUIPMENT (INDOOR)</u>	
1	11 / 6.6 kV Vacuum Circuit Breakers (Indoor)	: BHEL/SIEMENS/SCHNEIDER/ABB/ CGL/L&T
2	11/6.6 Kv PTs (Panel mounted type)	: AEP/PRAGATI/SCHNEIDER/ PRAYOG ELECTRICALS/KAPPA /SILKANS/ABB/BHEL
3	11/6.6 Kv CTs (Panel mounted type)	: AEP / PRAGATI / SCHNEIDER / PRAYOG ELECTRICALS/KAPPA/ SILKANS/ABB/BHEL
4	CT and PT (Outdoor type)	: AEP/SCHNEIDER/CGL/NTL/ ABB/ GE
5	HT Busduct (Phase-Segregated)	: C&S / ECC/KGSEL(STAR DRIVE)/ ENPRO/POWER GEAR/GE
6	Generator Transformer	: ABB/BHEL/CGL/GE T & D INDIA LTD/EMCO/SCHNEIDER/SIEMENS/ TRANSFORMER & RECTIFIERS (INDIA) LTD/TOSHIBA
7	Generator Busduct	: BHEL/C&S/GE/SCHNEIDER
8	HT Capacitors	: BHEL/ABB/UNISTAR/MEHER/ EPCOS/PCPL/SAVIN/ GE/SCHNEIDER
9	11/6.6 Kv Vacuum Contactors	: SCHNEIDER/BHEL/SIEMENS/ABB
10	11/6.6 Kv Lightning Arrestors & ZnO CR type surge suppressors	: ELPRO / RAYCHEM / SCHNEIDER / SIEMENS AG (Imported)/PCEPPL/ABB
11	HT HRC Fuses	: SCHNEIDER /PSPL(DP) / S&S / COOPER BUSSMAN/ SIEMENS/ABB /BHEL/JYOTI



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
12	Neutral Grounding Resistor	: NARKHADE/PEFCO/ RESITECH/ NATIONAL/ LACHHMAN/GE
13	Outdoor HT Isolators	: ELPRO (SIEMENS)/ALLIANCE / CONSOLIDATED/S&S/ TRANSELECTRICALS
14	Indoor HT Isolators	: PSPL(DP)/A BOND STRAND / ESWARI/SIEMENS (13.1 KA, 800 A)
15	11 Kv and 6.6 Kv Power Transformers (Oil-filled) & Earthing Transformers	: BHEL/CGL/SCHNEIDER/AREVA/ VOLTAMP/ KIRLOSKAR (KEC) /ABB/ SIEMENS
16	11Kv & 6.6Kv Cast Resin type power transformers	: ABB/VOLTAMP/BHEL/KIRLOSKAR (KEC) /INDCOOIL/CGL/SIEMENS
17	11 Kv & 6.6 Kv Dry type power transformers	: KIRLOSKAR(KEC)/ABB/BHEL/ VOLTAMP/BB/CGL
18	Winding and Oil Temperature Indicator	: SKII/PRECI MEASURE/PRECISION INSTRUMENT/PERFECT CONTROL/ OSMADIAL
	a) Control and Relay Panel	: SCHNEIDER/ABB/SIEMENS / GE
	b) Electromagnetic & Numeric Relay	: SCHNEIDER/ABB/SIEMENS/GE
19	Magnetic Oil Level Indicator	: SUKRUT/I&C/PRAYOG
20	Buchholz Relay	: PRAYOG / ATVUS/VIAT/I&C/GE
21	On Load Tap Changer	: EASUN / BHEL / CGL
22	Battery VRLA	: CHLORIDE (EXIDE)/AMCO/ STANDARD/HBL-NIFE (SABNIFE)/ AMAR RAJA
23	Battery Charger	: HBL-NIFE(SABNIFE)/CHHABI ELECTRICALS/CALDYNE/ AMAR RAJA
24	Power Socket outlets	: BCH/INDO ASIAN/SCHNEIDER



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
B.	MEDIUM VOLTAGE SWITCHGEAR AND CONTROL GEAR	
1	L.T. Air Circuit Breaker Distribution Board, fully drawout, single front (including circuit breaker), for main substation (process)	: L&T/SIEMENS/ABB/ SCHNEIDER/ GE
2	L.T. Busduct	: ECC/C&S/BRIGHT ENGINEERS /POWERGEAR APE/GODREJ (SANWITCH TYPE) UNITED ELECTRIC/JACKSON / COSMIC/UNILEC/VENUS TRICOLITE/KGSEL(STARDRIVE)/ SCHNEIDER
3	415 V Air Circuit Breaker	: SIEMENS/L&T/ABB / SCHNEIDER/GE
4	Moulded Case Circuit Breaker (MCCB)	: SIEMENS/L&T/ABB / SCHNEIDER/GE
5	LT Switch board (semi drawout) for auxiliaries & Non process units	: SIEMENS/L&T/SCHNEIDER/ABB/ GE
6	415V Motor Control Centre for process units	: SIEMENS/L&T/ABB / SCHNEIDER/ GE
7	415V Motor Control Centre for non-process units/ Power Distribution Boards(Single front)/ Outdoor Distribution Boards	: SIEMENS/L&T /SCHNEIDER/ABB/ GE
8	Power Distribution Boards (single front below 630A), Outdoor distribution boards (below 630A) and Lighting Distribution Boards	: SIEMENS/L&T /SCHNEIDER/ABB/ GE
9	MPCB	: SIEMENS/L&T/ABB / SCHNEIDER/ GE
10	Flameproof Switchgear	: AY/FCG HITECH/ABB/ GE



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
C.	<u>MOTORS</u>	
1	HT AC Motor (1000 kW and above)	: KEC/BHEL/CGL/MARATHON/ABB/SIEMENS
2	HT AC Motor (200 kW – 1000 kW)	: SIEMENS/CGL/KEC/BHEL/MARATHON/ABB
3	Synchronous & Sq. Cage Motors above 3000 kW	: BHEL/SIEMENS/ABB
4	LT AC Sq-cage induction Motor (General purpose)	: SIEMENS/CGL/ABB/ MARATHON/ BBL/BHEL/ KIRLOSKAR
5	LT AC Motor (Flame proof)	: KIRLOKAR (KEC)/CGL/SIEMENS / BBL /MARATHON/ABB
6	L.T. Geared Motor	: KIRLOSKAR (KEC)/POWER BUILD/ IC/BB/SEW/FIMET/REMI/WEG/ ABB/SIEMENS
7	DC Motors	: CGL/MARATHON/KIRLOSKAR/ BHEL /ABB/SIEMENS
D.	<u>DRIVES AND CONTROL EQUIPMENT</u>	
1	Converter duty cast resin transformer (6.6 kV)	: BHEL/ABB/KEC/VOLTAMP/RPG RAYCHEM
2	Thyristor Converter Unit	: BHEL/SIEMENS/ROCKWELL / SCHNEIDER/ABB/SCHNEIDER / NELCO/KEC/L&T/KELTRON
3	VVVF Drive	: SIEMENS/ABB/ROCKWELL / SCHNEIDER/L&T/BHEL/CGL/GE-POWER
4	VVVF Drive (Flux Vector Control) – 2 level & 3 level Controller	: ABB/SIEMENS/SCHNEIDER / HITACHI/ROCKWELL
5	Isolator	: SIEMENS/L&T/SCHNEIDER/ABB
6	HRC Fuses	: SIEMENS/SCHNEIDER/ABB/L&T/ GE POWER/BUSSMAN



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
7	AC Power Contactor	: SIEMENS/L&T/BCH /ABB/ SCHNEIDER/GE-POWER
8	DC Power Contactor	: BCH/BHEL/SIEMENS/ABB/L&T/ SCHNEIDER
9	Bimetallic Relay	: SIEMENS/L&T/BCH/C&S/ABB/ SCHNEIDER/GE
10	Single Phase Preventer	: L&T/MINILEC/SIEMENS/C&S/ABB/ SCHNEIDER/GE
11	Resistor	: SIEMENS/BCH/RSI/PEFCO /ELECTROMAG/RESITECH / NARKHADE/KAKKU/INDUSTRIES SYNDICATE
12	L.T. Capacitor	: UNISTAR/CGL/SCHNEIDER/SAVIN / KHATAU/MEHER/VPT/HAVELL'S/ PCPL/PE/AS/CEPL/EPCOS/ABB
13	Semiconductor Fuse	: SCHNEIDER/SIEMENS/COOPER BUSSMAN/ABB
14	Thyristor	: SIEMENS/BHEL/HIND RECTIFIER/ ABB
15	LT Vacuum Contactor	: GE/SCHNEIDER/L&T / SIEMENS/ ABB
16	Soft-starter (LT)	: ABB/ROCKWELL/SIEMENS / SCHNEIDER
17	UPS	: GUJARAT HI-REL/SIEMENS/ EMERSON/KEC/DB ELECTRONICS/ L&T/IL KOTA/ABB/ APC
E. <u>CONTROL DESKS AND CONTROL DEVICES</u>		
1	Control Desk / Control Panel / Control Station	: SIEMENS/L&T/BHEL/SCHNEIDER/ GE/ABB
2	Control Switch	: SIEMENS/KAYCEE/SCHNEIDER / L&T/VAISHNO/C&S/ABB



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
3	Push Button	: SIEMENS/BCH/L&T/VAISHNO /C&S/SCHNEIDER/TECHNIK/ KAYCEE/ HOTLINE/ESSEN/ABB
4	Limit Switch	: AG SYSTEMS/JAY BALAJI / TECHNOCRATS/KAKKU/SIEMENS/ BCH (may be considered only for light duty)/SCHNEIDER
5	Change Over Switch/Selector Switch	: C&S/STANDARD/HHE/KAYCEE / SIEMENS/BCH/L&T / HAVELL'S/ ABB/SCHNEIDER
6	Discrepancy Control Switch	: ABB/AG SYSTEMS
7	Timer/Time Delay Relay	: BCH/L&T/SIEMENS/ABB/CGL/ EAPL/AG SYSTEM/GE/SCHNEIDER
8	Emergency Switch/Belt Sway Switch/Pull Cord Switch/ Belt Slip Switch	: JSI/AG SYSTEMS/PB/JAI BALAJI/ BETA SYSTEMS/ IMSS/UIC/IS/ KAKKU
9	Semaphore Indicator	: SIEMENS/SCHNEIDER/GE
10	Auxiliary Relay/ Control Contactor	: SIEMENS/L&T/ABB/GE POWER/ SCHNEIDER/GE
11	Master Controller	: SIEMENS/STROMKRAFT / ELECTROMAG/AG SYSTEMS/IS / PERFECT ELECTRICS/GE
12	Control Transformer	: INDCOIL/SIEMENS/AEP/INDUSREE /KAPPA/UIC/BCH/UNIVERSAL MAGNETICS
13	Voltage/Power/Current/Frequency/Energy Transducers	: ABB/SIEMENS/SCHNEIDER
14	Indicating Lamp (Including Cluster LED type)	: SIEMENS/VAISHNO/TECHNIK/ BINAY/ESSEN/BCH/SWITCHING CIRCUIT/RISHAB/L&T/ABB/ SCHNEIDER
15	Temperature Scanner	: APLAB/SYSTech/MASIBUS/ECIL / ADVANI/ABB



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
16	Photo-cell transducer	: SYSTECH/TSC/INSTRUMENT ENGG.
17	Hooter/Buzzer/Bell	: GETCO/KHERAJ/EDISON/KAKKU
18	Solid State Annunciator	: APLAB/L&T/PROCON/CONTROL AND DYNAMICS/PIRI/SEMUDA / MINILEC/ELECMECH/EAPL / SWITCHING CIRCUIT
19	Proximity Limit Switches (Non-contact type)	: JSI/AG SYSTEMS/ROCKWELL /TELEMECHANIQUE/ACCENT/ SCHNEIDER/SIEMENS
20	Zero Speed Switches	: JAYSHREE/TELEMECHANIQUE / AG MECHANICAL/KAKKU/ TECHNOCRATS/SIEMENS
21	Current Transformer	: AEP/KAPPA/INDCOIL/SIEMENS/GE
22	Voltage Transformer	: KAPPA / INDCOIL/SIEMENS/GE
23	Tachos/Encoders	: SCHNEIDER/HUBNER/IFM / VURLEY-TELEDYNE/LEINE & LINDE/GLOBAL TECH
24	Pull chord and belt sway detection system	: PARAMETERIC/JAYSHREE
F. <u>PROTECTION RELAYS</u>		
1	a) Electronic Motor Protection Relays	: L&T/SIEMENS/ABB/SCHNEIDER/GE
	b) Microprocessor based Motor Protection Relays for LT Motors	L&T/SIEMENS/ABB/SCHNEIDER/GE
	c) Microprocessor based Protection Relays for HT Motors	: L&T/ABB/SCHNEIDER/SIEMENS/GE
2	Auxiliary Relays	: ABB/L&T/SCHNEIDER/SIEMENS/GE
3	Numerical Protection Relays (for HT system)	: ABB/SIEMENS/SCHNEIDER/GE



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
4	Numerical Protection Relays (for LT system)	: ABB/SIEMENS/SCHNEIDER / GE/SCHNEIDER/L&T
G.	<u>ELECTRICAL MEASURING AND TESTING EQUIPMENT</u>	
(i)	<u>ELECTRICAL MEASURING INSTRUMENTS</u>	
1	Ammeter/Voltmeter/Wattmeter/Var-meter	: AEP/IMP/MECO/RISHAB/SIEMENS
2	Watt-hour meter	: ALSTOM/BHEL/IMP/ RISHAB/ MECO/SIEMENS
3	PF meter	: AEP/IMP/MECO/KAPPA/ RISHAB
4	Frequency meter	: AEP/IMP/RISHAB
5	Multimeter	: MECO/MOTWANE/RUTTONSHAW
6	Low resistance ohm-meter and kelvin double bridge	: MOTWANE/AGRONIC/TOSHNIWAL
7.	Electronic energy meter	: SCHNEIDER/SEMS/SATEC/PML/ L&T/SIEMENS
(ii)	<u>ELECTRICAL TESTING EQUIPMENT</u>	
1.	Insulation resistance tester	: SHANTI/MOTWANE/MECO
2.	Earth resistance tester	: SHANTI/UTMC
3.	Tong tester (AC/DC)	: MECO
4.	Transformer oil testing set	: NTPL/UDEY
5.	AC high voltage test set	: AEP/AGRONIC/NTPL/UDEY
6.	DC hipot test set	: NTPL
7.	Primary & secondary current injection relay testing set	: AEP/NTPL/TOSHNIWAL/ALSTOM



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
8.	Cable fault locator & cable burn down instrument (for high resistance cable fault)	: UTMC/SHANTI/APLAB
9.	Earth leakage current tester	: NTPL/AEP
10.	Capacitance & tan delta measuring instrument	: TELTEX AG (L&T)
11.	Phase Sequence indicator	: AEP/MECO/NIPPEN
12.	Synchroscope	: AEP
13.	DC Powerpack	: ACCESS ELECTRONICS
14.	Transformer winding Resistance Meter	: SCOPE T&M PVT LTD
(iii) <u>SPECIAL INSTRUMENTS</u>		
1.	Microprocessor based digital power meter	: AEP/MECO/ALACRITY/DIGI
2.	Maximum demand meter	: AEP
3.	True RMS' digital panel ammeter/voltmeter	: AEP/MECO/ALACRITY
4.	Intelligent P.F. regulator	: AEP/MECO/ALACRITY
5.	Computer aided cable fault analyser	: APLAB/UTMC
6.	Transducer operated metering system	: AEP
7.	Portable energy audit instrument	: ALACRITY
8.	Energy meter Calibrator (ACCUCHEK)	: SEMS
H. <u>LIGHTING AND POWER WIRING EQUIPMENT AND ACCESSORIES</u>		
1	LED Lighting Fitting	: PHILIPS/GE/BAJAJ/CGL/WIPRO/HAVELLS



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
2	Flameproof LED Lighting Fittings and Accessories	: BAJAJ/BALIGA/CGL/FLEX PRO/PHILIPS
3	a) 240 V Switch Socket Outlet (10A & 20A)	: HENSEL/HAVELL'S/BCH/ABB/LEGRAND/INDO ASIAN/SCHNEIDER
	b) 415 V Switch Socket Outlet (30A, 63A & 100A)	: BCH/ABB/HENSEL/LEGRAND/INDO ASIAN/SCHNEIDER
4	Flame-proof Equipment	: BALIGA/FLAME PROOF EQPT. MFG. CO./LUZ/CEAG/FCG HITECH/FLEXPRO
5	MCB	: LEGRAND(MDS)/STANDARD/CGL/SIEMENS/GE/HAVELL'S/MERLIN GERIN/ABB/INDO ASIAN/SCHNEIDER
6	ELCB	: LEGRAND(MDS)/SIEMENS/GE/MARLINGERIN/HAVELLS/HPL/HAGER /ABB/SCHNEIDER
7	MCB DB	: LEGRAND(MDS)/HAVELL'S /MERLIN GERIN/SIEMENS/GE/ HPL/ABB/INDOASIAN/SCHNEIDER
8	Single-core flexible copper wire	: RAJNIGANDHA / HAVELL'S /FINOLEX/THERMO PAD/NICCO/RPG/FINECAB/RADIANT/POLYCAB/LAPP/DELTON/UNIFLEX/KDK/KEI
9	High Mast Towers	: BAJAJ/PHILIPS/CGL
10	Street Light Poles	
	Octagonal Type	: BAJAJ/PHILIPS/CGL/BMW/BP PROJECTS
	Tubular Type	: ELECTRO STEEL/QUALITY STEEL/CALCUTTA POLES &TUBES/STEEL POLE CORPORATION/BMW/JINDAL
11	Dry type Lighting Transformers	: UNIVERSAL MAGNETICS/TRANSO INDIA/INDCOIL/INDUSREE/AE/DEVIKA



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
12	Thermoplastic Junction Boxes	: HENSEL/SYNTEX/RITTAL/ DEVI POLYMERS/ SHRENIK/ SPELSBERG/PUSTRON
13	Aviation Obstruction Light	: BENOY/BALIGA/MICROTECH/ SPECTRUM
I. <u>CABLES AND CABLING ACCESSORIES</u>		
1	33kV/ 11kV/ 6.6 kV XLPE Cable (Only Dry cured)	: KECIL(RPG)/UNIVERSAL/CCI/ NICCO/TORRENT CABLES/ INDUSTRIAL/KEI/POLYCAB/RAVIN (PRIME CAB)
2	a) 1.1 kV PVC/XLPE/ HRPVC Cable (Power)	: KECIL(RPG)/UNIVERSAL/CCI/ NICCO /TORRENT/INDUSTRIAL/ POLYCAB/FINECAB / RADIANT / CRYSTAL/KEI/SPECIAL/ PARAMOUNT/ RAVIN(PRIME CAB)/ RRK/GPIL/AVOCAB/SHYAM CABLES/LAPP
	b) 1.1 kV PVC/XLPE/ HRPVC Cables (Control)	: KECIL(RPG)/UNIVERSAL/ NICCO/TORRENT/INDUSTRIAL /POLYCAB / DELTON /CCI / CORDS/SPECIAL/ CAPCAB/ FINECAB/RADIANT/CRYSTAL/LAPP /THERMOPADS/KEI/BELDEN/ DELTON/PARAMOUNT/RAVIN (PRIME CAB)/RRK/GPIL/ AVOCAB/ SHYAM CABLES/LAPP
3	Silicon Rubber insulated copper Cable	: KECIL(RPG)/UNIFLEX/UNIVERSAL/ NICCO/INCAB/INDUSTRIAL/ POLYCAB/LAPP/TORRENT/ UNIFLEX/GOVIND/KEI/ SHYAM CABLES/LAPP
4	Flexible trailing copper cable	: KECIL(RPG)/ UNIVERSAL/NICCO/ INCAB/CCI/LAPP/THERMOPADS/ INDUSTRIAL/POLYCAB/TORRENT / GOVIND/KEI/RRK/ SHYAM CABLES/LAPP
5	HT Cable Termination Kit/straight through jointing kits	: TYCO(RAYCHEM) /3MECI(MSEAL-MECP)



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
6	LT Cable Termination Kit/straight through jointing kits	: TYCO(RAYCHEM)/3MECI (MSEAL-MECP)/DENSION/CCI
7	Cable Reeling Drum (Stacker Reclaimer)	: ELECTRO ZAVOD/ELECTROMAG/TECHNOCRATS
8	Cable Reeling Drum (Cranes, Hoists, Transfer Trolleys)	: ELECTRO ZAVOD/ELECTROMAG/IS/TECHNOCRATS
9	Cable Lugs	: DOWELLS/FORWARD/COMMET/3D/RATAN ENGG/ABB.
10	Cable Gland	: ELECTROMAG/CC I/COMMET /PHOENIX/DOWELLS /RATAN ENGG.
11	Terminal Block	: ELMEX/ESSEN/CONNECTWELL/C&S/WAGO/PHOINEX/ABB.
12	Cable Coupler	: A. BOND STRAND/ABB.
13	Weather proof outdoor Junction Box	: ELECMECH/TECHNOCOM/ABB
14	Passive Fire Protection System	: LLOYD/PROMAT/3-M/KBS/SIGNUM/ HILTI
15	Cable Tray / Rack	: RATAN ENGG./INDIANA/IDS COMPOSITES/INDIA ELECTRICALS SYNDICATE /PREMIER/ TECHNO
J. <u>MISCELLANEOUS</u>		
1	Diode	: HIND/USHA RECTIFIER/BHEL/RUTTON SHAW/APEPL
2	Battery	: EXIDE/HBL-NIFE/AMAR RAJA /AMCO
3	Braking Resistance Panel	: RESISTEC / BCH
4	DC EM Brake	: BCH/STROM KRAFT/ELECTROMAG/ELECTROMECH CORPN./EPC/IS
5	Thrustor brake	: IS/STROMKRAFT /ELECTROMAG /ELECTROMECH/EPCC



Annexure-2-C (cont'd)

Sl. No.	Item	List of Vendors
6	Lifting Magnet	: ELECTROMAG/SUPERLIFT/EPCC / ELECTRO ZAVOD
7	Power Pack for Magnet	: ELECTROMAG/SUPERLIFT
8	Earthing Resistor	: BHEL/BCH/IS/EEF/RESITECH / NARKHADE
9	MG Welding Set	: KEC/ADVANI/PHILIPS
10	Portable Welding Transformer	: ADVANI/IOL/KEC
11	Harmonic Filter	: AMTECH/ABB
12	FRP/SMC, S/O outlet & PB STN	: RITTAL/HENSEL/DEVI POLYMERS/ SHRENIK/SYNTEX/SPELSBERG/ PUSTRON
13	Autoglo safety posters/ photo Luminiscent signages	: PROLITE



ANNEXURE – 2-D

LIST OF PREFERRED VENDORS FOR INSTRUMENTATION AND CONTROL SYSTEM

S1. No.	Item	List of Vendors
A	CONTROL ROOM EQUIPMENT	
1.	Distributed Control System (DCS)	: BHEL/YOKOGAWA/HONEYWELL/EMERSON/ABB/SIEMENS/SCHINDER
2.	Programmable Logic Controller (PLC)	: ROCKWELL AUTOMATION- ALLEN BRADLEY/ SIEMENS/ABB/ SCHNEIDER
3.	Programmable Logic Controller Components/Remote IO (RIO)	: ROCKWELL AUTOMATION- ALLEN BRADLEY/SIEMENS/ABB/ SCHNEIDER
4.	HMI PC/ Server/ Data storage system	: IBM/HP/DELL/SIEMENS
5.	HMI Software (3rd Party)	: WONDERWARE(INTOUCH)/INTELLUTION (FIX)/US DATA (FACTORY LINK)/ ABB/GE/SCHINDER
6.	TFT MONITOR	: DELL/SAMSUNG/IBM-LENOVO/ NEC/HP
7.	LARGE SCREEN DISPLAY MONITOR	: BARCO/DELTA/PLANER/ PYROTECH
8.	COMPUTER FURNITURE	: ADARSH CONTROLS/COSMOS MEDIA/ FEATHER LITE/ GODREJ/ OTS/ PYROTECH/ RITTAL
9.	Printer	:
1.	DOT Matrix Printer	TVS/WIPRO/HP/EPSON
2.	LASER Printer	CANON/HP/IBM/XEROX
3.	INKJET Printer	CANON/HP/IBM/XEROX/EPSON
10.	Controller	: YOKOGAWA/HONEYWELL/ SIEMENS/ ABB/TOSHIBA/ INVENSYS (FOXBORO) / MASIBUS/MOORE/ FUJI/BHEL
11.	Bargraph & Digital Indicator (EDLI) /Panel Digital Indicators/Hydrastep	: MASIBUS/EUROTHERM/YOKOGAWA/HONEYWELL/TELETHERM/ HI-TECH SYSTEM/ABB/LEVEL STATE/ YARWAY



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
12.	Totalisers	: YOKOGAWA/ABB/MASIBUS/ HONEWELL
13.	Scanner	: MASIBUS/APLAB/ECIL/M.B. CONTROLS/ EUROTHERM/ ACCSYS/ABB
14.	Recorder	: YOKOGAWA/ABB/HONEYWELL/MOORE/ DIGITAL/EUROTHERM/MOORE
15.	Alarm Annunciator	: IIC/MINILEC/PROCON/ACC SYS/AP LAB/ DIGICONT
16.	Signal Isolator/Multiplier	: MTL/YOKOGAWA/MASIBUS/ PEPPERL & FOCHS/ PYROELECTRIC/ABB/GE
17.	Instrument Panel/Cabinet /Desk	: RITTAL/RKC/SIMCON/ PYROTECH/ INDUSTRIAL CONTROLS/ SYSPRO
18.	Pneumatic actuators (cylinder or rotary)	: ELOMATIC/KROMBACH/ MECCAIR/ NUCON /PRIMA
19.	Power Supply Unit	: SIEMENS/PHONEX/MTL/ APLAB/ ELNOVA/MCTH/ CYBERNICS/ COSEL/ ABB
20.	Intrinsic Safety Barrier /Surge protection device	: MTL/P&F/ABB/ENDRESS-HAUSER/ PHOENIX/SIEMENS
21.	Terminal Blocks (Power and Control)	: PHOENIX/WAGO/ELMEX/ WEIDMULLER/CONNECTWELL/ SCHNEIDER-TELEMECANIQUE/ BECKHOFF/ELMEX/ BECKHOSS/ ABB/GE
22.	Plugs and Sockets	: ANCHOR/CRABTREE/ABB/ SCHINDER
23.	Interposing Relays	: OEN/JVOTI/PARAMOUNT/ ABB/GE/ SIEMENS
24.	Digital Indicators	: ABB/FOXBORO/MASIBUS/ PTROTECH /GANZ/GOSSEN/WEIGEL/ RISHAB/AE
25.	Cables-Fibre Optic/ Co-axial/UTP	: MOLEX/RPG/AT&T/LUCENT
26.	SCADA System	: REPUTED AS PER OEM STANDARD



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
27.	Operating System	: REPUTED AS PER OEM STANDARD
28.	Data Base	: REPUTED AS PER OEM STANDARD
29.	Control Desk (Instrument Panel/Cabinet /Desk)	: ICA/PYROTECH/RADHA KRISHNAN CONTROLS/ RITTAL/INDUSTRIAL CONTROLS/SYSPRO/ABB/ SIEMENS/ ALSTOM/POWER & PROTECTION/ SCHINDER
30.	Power distribution system/ Marshalling/ Control Panels	: RITTAL/SIEMENS/GE/ SCHINDER
31.	Push Buttons	: BCH/L&T/SIEMENS/ SCHNEIDER-TELEMECANIQUE/ABB
32.	LED Lamp	: GE/BCH/SCHNEIDER-TELEMECANIQUE/BINARY/ ABB/ SIEMENS
33.	Manageable Switches	: REPUTED AS PER OEM STANDARD
34.	LIU Units	: REPUTED AS PER OEM STANDARD
35.	Ni-Cd Batteries	: REPUTED AS PER OEM STANDARD
B Network Components		
1.	Switches/Routers	: CISCO/3-COM/NORTEL/DLINK/GE/ SIEMENS
2.	Converts/Repeaters/Modems /Radio Modems	: LOTUS/DLINK/US ROBOTICS/ NORTEL/MULTI TECH/ PRUDENT/ SIEMENS
C FIELD INSTRUMENTS		
1.	Pressure Gauge	: GIC/H.GURU/WAREE/INDUSTRIAL INSTRUMENTATION / WIKA/GENERAL INSTRUMENTS/GOA INSTRUMENTS/AN INSTRUMENTS
2.	Draught gauge & DP gauge	: SWITZER /GIC/H.GURU/ WAREE/ WIKA



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
3.	SMART Transmitters	: YOKOGAWA/HONEYWELL/ ABB/ SIEMENS/ EMERSON/E&H/FUJI
4.	Pressure/DP/temperature & Flow Switches	SWITZER / H. GURU INDUSTRIES/ DANFOSS/ VARMA-TRAFAG/GENERAL INSTRUMENT/GEORGIN
5.	Temperature Gauge	: WIKA/GIC/H.GURU/WAARE/ INDUSTRIAL INSTRUMENTATION/ GENERAL INSTRUMENTS/GOA INSTRUMENTS/AN INSTRUMENTS
6.	Temperature Elements (RTD & T/C)	: NAGMAN/TEMPSENS/ TOSHNIWAL INDUSTRIES/PYROELECTRIC/ GIC/ GOA INSTRUMENTS/ALTOP/FUJI
7.	Temperature transmitters	: HONEYWELL/EMERSON/ YOKOGAWA /E&H/ABB/FUJI
8.	Temperature Switch	: SWITZER / INDFOS/ HONEYWELL/ VERMA TRAFAG /P& F / H. GURU INDUSTRIES/GEORGIN
9.	Level gauges and float type level switches	: GIC//LEVCON/V. AUTOMAT/PLACKA/ TECKTROL/KHRONE/CHEMTROL (VEGA)/SWITZER/S.B. ELECTROMECHANICAL/ V.AUTOMAT/EIP/NIVELCO/EUREKA /V. AUTOMAT/Hi-TECH
10.	Level Switches (Conductivity/capacitance/Resonance)	: LEVCON/ENDRESS-HAUSER/ EIP/S.B. ELECTROMECHANICAL / SAPCON/ NIVO/ABB
11.	Nucleonic Level Gauge	: CONCORD (BERTHOLD) / EMERSON (K.RAY)/ECIL/ CHEMTROL (VEGA) /ENDRESS HAUSER
12.	Ultrasonic/Radar type Level (Guided wave RADAR (SILO) etc) transmitter	: TOSHBRO (MILTRONICS)/ ENDRESS-HAUSER/SIEMENS/ VEGA /EMERSON (SAAB)/SBEM/ABB
13.	Rotameter	: IEPL/EMERSON(BROOKS) / EUREKA/ AL FLOW/KROHNE MARSHALL/PLACKA /ROTA/ABB



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
14.	Vortex Flow Meter	: ENDRESS HAUSER/ YOKOGAWA / KHRONE/EMERSON/ABB/ ROSEMOUNT/SIEMENS
15.	Mass Flow Meter	: EMERSON/ ABB/ ENDRESS HAUSER/ YOGOKAWA/ KHRONE/SIEMENS
16.	Pollution Control & Stack Monitoring System	: HONEYWELL/EMERSON/FORBE MARSHALL/ABB/CHEMTROL /AMETEK/SICK & LAND
17.	SWAS & other water analysers/meters	: FORBES MARSHALL /ABB ANALYTICAL /YOGOKAWA / EMERSON/ STEAM EQUIPMENTS/HACH
18.	RF Capacitance (Hopper)	: EIP / EIP ENVIRO/ABB/MAGNETROL
19.	Flow Elements (Orifice Plate, Flow Nozzle, Venturi Tube etc)	: ENGG. SPL/MICRO PRECISION/IL/ BALIGA/GI/ STAR MECH/MECHANICAL ENGINEERS/GENERAL INSTRUMENT / STARMECH/EMERSON
20.	Control Valves /On-Off Valves	: IL/ FISHER-XOMOX/ FORBES MARSHALL/MIL/ABB/KOSO/ EMERSON PROCESS MANAGEMENT/ SEVERN GLOCON INDIA PVT LTD/SPX-FLOW/FLOW SERVE/ IMI-CCI
21.	Motorised/Electric Actuators	: AUMA/ IL / LIMITORQUE/ ROTORK/ DANFOSS
22.	Pneumatic Actuators (Cylinder or Rotary/Rack and Pinoin Type etc)	: ELOMATIC/KROMBACK/MECCAIR/ NUCON/PRIMA/AUDCO/FISHER/ VIGRO/NORGREN/ASCO NUMATIC/ JANATICS/SMC/ROTEX/ SCHRADDER
23.	Air filter Regulator	: PLACA/SHAVO NORGREN/ ABB/ CONTROL AIR/BELLS CONTROLS/ FAIR CHILD
24.	I/P Convertor	: HONEYWELL/EMERSON/FORBE MARSHALL/ABB/CHEMTROL /AMETEK/FAIR CHILD/WATSON-SMITH



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
25.	Terminal Block	: CONNECTWELL/ELMEX/WAGO/ PHOENIX/WEIDMULLER/BECKHOFF/ ABB
26.	Solenoid Valves	: ROTEX/ASCO/VICKERS/SMC/ NORGREN/SCHRADER BELLOW
27.	Magnetic Flow meter/Ultrasonic Flow meter	: ENCDRESS-HAUSER/KHRONE/ABB/ INVENSYS (FOXBORO)/EMERSON/ YOKOGAWA/SIEMENS
28.	Positive Displacement Flow meter	: TOSH. HYD(BOPP & FEUTHER) /ROCKWIN/ABB/SWITZER/ KRAL
29.	Encoder	: P & F / ROCKWELL / HUBNER/MTL/ PHOENIX/SIEMENS
30.	Vibration Monitoring Systems	: BENTLEY-NEVADA/FROBESMARSHALL (SHINKAWA)/ROCKWELL AUTOMATION /ABB
31.	UPS	: EMERSON/HI-REL/APC/NUMERIC/ ABB
32.	Limit switches	: ABB/JAY BALAJI/ ELECTROMAG/ KAKKU/ SIEMENS/HONEYWELL/ TELE-MECHANIQUE/ ALLEN- BRADLEY/GO-SWITCH (EMERSON)/ SCHINDER
33.	Ultrasonic Level Switch (Measurement- Liquid/Solid)	: ENDRESS-HAUSER/KHRONE/ EMERSON/SIEMENS/VEGA/ ABB
34.	Microwave Solid/Liquid Level Measurement	: ENDRESS-HAUSER/KHRONE/ EMERSON/MILLITRONICS/VEGA/ SIEMENS/ABB
35.	Control Valve with Diaphragm Actuator (Critical Application)	: MIL/KOSO/FISHER/DRESSER/IMI-CCI /EMERSON PROCESS MANAGEMENT/ SPX-FLOW/ SEVERN GLOCON INDIA PVT LTD/ IL
36.	Pull Chord/Belt sway/Zero Speed & Proximity Switches	: JAYSHREE/JAI BALAJI/AG SYSTEM/ ROCKWELL/SCHNEIDER- TELEMECANIQUE/ SIEMENS



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
37.	Voltage/Power/Frequency/Current/Energy Transducers	: ABB/SIEMENS/ALSTOM/SCHINDER
38.	Humidity Sensor	: SIEMENS/HONEYWELL/ FOXBORO
39.	HART CONFIGURATOR (UNIVERSAL)	: ROSEMOUNT/ABB/YOKOGAWA
40.	PVC coated copper Tubes/Copper Tubes	: REPUTED AS PER OEM STANDARD
41.	Tank Level Indicator	: NIVO/LEVCON/SWITZER/MEGNETROL
42.	Annubar	: SWITZER/EMERSON/ ENGG.SPL
43.	Water Meter	: KAYCEE/RAJKAMAL/CAPSTAN
44.	Flow meters	: E & H / KHRONE / ROSEMOUNT / YOKOGAWA/ABB

D SPECIAL INSTRUMENTS

1.	Electronic Weighing System	: ABB/SCHENCK/SARTORIOUS MECHATRONICS/TRANSWEIGH/METTLER-TOLEDO/NOVA WEIGH /IPA /KLISTER –MORSE/STOCK REDLER/ MERRIC INDUSTRIES/SIEMENS
2.	Gas Analysers/Meters (CO,Co2,O2 etc.,)	: EMERSON /ABB ANALYTICAL /SIEMENS/YOKOGAWA/ FORBE MARSHALL/ HONEYWELL (TELEDYNE) /CHEMTROL/POTENCE/SICK/FUJI & LAND/METTLER TOLEDO
3.	Water Analysers/Meters (SWAS etc.,)	: FORBES MARSHALL /ABB ANALYTICAL /YOGOKAWA /HACH/ION EXCHANGE / CHEMTROL/POTENCE/EMERSON
4.	Ph,DO and Conductivity Meter	: EMERSON / YOKOAGAWA/ FORBESMARSHALL / INVENSYS (FOXBORO/ TOSHBRO CONTROLS\ION EXCHANGE/ POLYMETRON /HONEYWELL/ HACH/ABB



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
5.	Infrared Pyrometer	: MAGMAN (IRCON) / EUROTHERM (LAND) LAXSON (CHINO) / FLUKE / TEMPSSENS/ABB
6.	Moisture Analyser	: CONCORD (BERTHHOLD) /EMERSON K-RAY) ECIL/SHAW/ENDRESS HAUSER/ YOKOGAWA/ CHINO-INSTRUMENTS
7.	Vibration Sensor & Monitor	: BENTLEY-NEVADA/FROBESMARSHALL (SHINKAWA)/SHERMAN (SKF) / ROCKWELL AUTOMATION/SIEMENS
8.	Governor System	: WOODWARD/TRISEN/BHEL
9.	Flame detector/Scanner	: HONEYWELL/FIRE-EYE/DURG/ABB/DURAG/ BHEL
10.	Gas Leak Detector	: MSA / HONEYWELL
E INSTRUMENT CABLES/CABLE TRAYS (PERFORATED) AND ACCESSORIES		
1.	Instrumentation Cables (Screened Cables, Control cables & Compensating Cables) Non Mineral Insulated /Insulated and Armoured/Unarmoured etc.	: DELTON/FINOLEX/SPECIAL CABLES /CORDS / GOYOLENE/THERMOPADS /UNIVERSAL / LAPP / BROOKS CABLES/PYROCABLES/UDAY/HEAVEL S THERMO CABLES/KEI
2.	FIBER OPTIC CABLES/Co-axial/UTP	: RPG/ FINOLEX/ MOLEX/ LUCENT
3.	Instrument (Isolation/root) Valves (BALL/GLOBE/GATE/NIDDLE)	: AUDCO/ KSB/ VIRGO / BDK/FLUID CONTROLS/XOMOX
4.	Instrument Fittings/Air Line Fittings	: SWAGALOK/ PARKER /FLOW TECH/EXCEL-HYDRO/ASTEC/HP/MET-LOCK



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
5.	Junction Boxes	: BALIGA/PYROTECH/HENSEL/EXPROTECTA/FLEXP/FLAMEPACK/SUDHIR SWITCHGEAR/ RITTAL/ABB
6.	Cable Gland	: BALIGA/DOWELLS/CCI/ELECTROMAG/HUMMEL
7.	Cable Termination Kit	: RAYCHEM/M-SEAL
8.	Testing and Calibration Instruments	: NAGMAN/FLUKE
9.	Cable Lugs	: CONNECTWELL/DOWELLS/ PHONEIX
10.	Cable Trays (Perforated Type) -GI Material & FRP	: INDIANA/PROFAB/SADHANA/ ERCON/ SYNTEX
11.	Manifolds/Condensate Pots	: REPUTED AS PER OEM STANDARD

F FIRE DETECTION AND ALARM SYSTEM

1.	Pressure Gauge	: GIC/H.GURU/WAREE/GE GAUGES PVT LTD/INDUSTRIAL INSTRUMENTATION /MANOMETER/WIKA /FORBES MARSHALL/ PRECISION INDUSTRIES /GENERAL INSTRUMENTS/GOA INSTRUMENTS/AN INSTRUMENTS
2.	Temperature Gauge	: WIKA/GIC/H.GURU/ WAARE/FORBES MARSHALPRECISION INDUSTRIES/ INDUSTRIAL INSTRUMENTATION/ GENERAL INSTRUMENTS/GOA INSTRUMENTS
3.	Temperature Elements (RTD & T/C)	: NAGMAN/TEMPSSENS/TOSHNIWAL INDUSTRIES/ PYROELECTRIC/ GIC/GOA INSTRUMENTS/ALTOP
4.	Detector (Intelligent & Addressable)	: NOTIFIER/EDWARD/TYCO/ CERBERUS/HONEYWELL AND UL/FM/ LPC/ APPROVED
5.	All modules (Intelligent & Addressable)	: NOTIFIER/EDWARD/TYCO/ CERBERUS/HONEYWELL AND UL/FM/LPC/ APPROVED



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
6.	Fire Alarm Panel (Intelligent & Addressable)	: NOTIFIER/EDWARD/TYCO /CERBERUS/HONEYWELL AND UL/ FM/LPC/ APPROVED
7.	Repeater Panels (Intelligent & Addressable)	: NOTIFIER/EDWARD/TYCO/ /CERBERUS/HONEY WELL AND UL/ FM/LPC/ APPROVED
8.	Cables	: DELTON/FINOLEX/SPECIAL CABLES /CORDS/GOYOLENE/THERMOPADS /UNIVERSAL/LAPP/BROOKS CABLES /PYROCABLES/UDAY/THERMO CABLES
9.	Battery	: AMCO/STANDARD/EXIDE
10.	Manual Call Points	: UL/FM/LPC AND TAC APPROVED
11.	Electronic Hooters (Addressable)	: UL/FM/LPC AND TAC APPROVED
12.	HMI PC/ Server/ Data storage system	: IBM/HP/DELL/SIEMENS
13.	Printer	:
	1. DOT Matrix Printer	TVS/WIPRO/HP/EPSON
	2. LASER Printer	CANON/HP/IBM/XEROX
	3. INKJET Printer	CANON/HP/IBM/XEROX/EPSON
14.	Cables - Fibre Optic/Co-axial/UTP	: RPG/ FINOLEX/ MOLEX/ LUCENT
15.	Networking Cables	: DELTON/FINOLEX/CMI/RPG/ HCL/ RELIANCE/SIEMENS
16.	Manageable Switches	: REPUTED AS PER OEM STANDARD
17.	Ni-Cd Batteries	: REPUTED AS PER OEM STANDARD
18.	LIU Units	: REPUTED AS PER OEM STANDARD



Annexure-2-D (cont'd)

Sl. No.	Item	List of Vendors
G	PLANT COMMUNICATION SYSTEMS	
1.	Telecom Cables (PVC Armoured/Unarmoured and Jelly Filled etc)	: DELTON/FINOLEX/CMI/RPG/ HCL/ RELIANCE
2.	Plant Telephone Systems	:
	i) EPABAX System	GTL/SIEMENS/TADIRAN/AVAYA
	ii) Telephone handset	BEETEL/AVAYA/SONY/BPL/ SIEMENS/ITI
	iii) Power Supply Unit	AMARA RAJA/PULSE POWER/ SIGNOTRON
3.	Loud Speaker (PA) System	:
	i) Selective calling system	INDUSTROINCS/NEUMANN/ FEDERAL/BOSCH/ PHILIPS
	ii) Page Party Type	MICO BOSCH(PHILIPS)/ INDUSTROINCS/NEUMANN
4.	Radio Communication System	: MOTOROLA/KENWOOD/ SIMOCO
5.	Hooter/Buzzer/Bell	: ALAN/PROCON/MASSIBUS/ PROCON

**ANNEXURE – 2-E****LIST OF PREFERRED VENDORS FOR CRANES & HOISTS**

Sl. No.	Item	List of Vendors
1.	Double Girder EOT Cranes	: MUKAND/KONE/FAFECO/DEMAG
2.	Single Girder EOT Cranes	: KONE/FAFECO/MM ENGINEERS/GRIP ENGINEERS
3.	Electrical Hoist	: BRADY & MORRIS/ MM ENGINEERS/ GRIP ENGINEERS/
4.	Mechanical Hoist	: INDEF/TRACTOR TIRFOR/BRADY
5.	Geared coupling	: HICLIFF/FENNER/ELECON/UNIVERSAL/FMG/NAW
6.	Wire rope	: USHA MARTIN/BOMBAY WIRE ROPE/ FORT WILLIAMS/ UNITED WIRE ROPE
7.	Hook	: MOZUMDAR & MOSUMDAR /HERMAN & MOHATTA/ EE KARACHIWALA/STEEL FORGINGS/FORGING ENTERPRISE
8.	Gear Box	: NAW/ELECON/SHANTHI



ANNEXURE - 2-H

LIST OF PREFERRED VENDORS FOR AIR CONDITIONING, AIR COOLING AND VENTILATION SYSTEM

Sl No.	Package	Supplier
1.	VAM Chillers	: VOLTAS/CARRIER/ TRANE/ KIRLOSKAR/HITACHI/THERMAX
2.	Air Handling Unit	: BLUE STAR/VOLTAS/EMERSON/ CARRIER/HITACHI/TRANE
3.	Split Air Conditioners	: BLUE STAR/VOLTAS/ CARRIER/HITACHI
4.	Package type FRP cooling Tower	: PAHARPUR/ HAMON SHRIRAM/ THERMOPAK/GEM/MIHIR/
5.	Pump	: MATHER & PLATT / KIRLOSKAR / KSB / AKAY
6.	Insulation	: BEARDSHELL/FGP/LLOYD/ ROCKWOOL/ TWIGA
7.	Centrifugal Fan/Axial flow Fan	: C.DOCTOR/BATLIBOI/DUSTVEN/KLEENAI R/NADI/FLAKT/SK SYSTEM
8.	Roof extractors	: C. DOCTOR / DUSTVEN / S.K. SYSTEMS / KHAITAN
9.	Filters	: DYNA/IMPEC/PUROFIL/ SPECTRUM /CHEMFARM
10.	GI Sheet	: TATA/JINDAL/SAIL/ISPAT
11.	Pipe	: TATA TUBE/JINDAL/RSP/SAIL/ AJANTHA TUBES
12.	Valves	: L&T /BDK/DEWRANCE/KSB MCNEILL/LEADER/FOURESS/J.N. MARSHALL/SAUNDERS
13.	Traps & Strainer	: UNI KLINGER/ESCO/ FORBES MARSHAL
14.	Fittings	: FLASH FORGE/SIVANANDA PIPE FITTING/TRUE FORGE/FITTING MFG. CO.



CORPORATE STANDARD

AA0490010

Rev. No. 01

PAGE 1 of 26

DOMESTIC PACKING

COMMON GUIDELINES

1 GENERAL:

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

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

2 TYPES OF PACKING:

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

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

3 DESCRIPTION OF TYPES OF PACKING:

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

3.1 'OP' - Open Type

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

3.2 'PP' - Partially Packed

Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film to Specification No.AA51420. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film

3.3 'CP' - Crate Packing

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

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

Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of

Revisions:

APPROVED:

PROCEDURAL GUIDELINES COMMITTEE –
PGC (Packing)

Rev. No. 01

Amd. No.


Reaffirmed

Prepared
HPBP, TrichyIssued
Corp. R&DDt. of 1st Issue
31-05-2018

Dt: 12-06-2018

Dt:

Year:

AA0490010	CORPORATE STANDARD	
Rev. No. 01		
PAGE 2 of 26		

silica gel to AA55619 or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420, wherever required.

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

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel to AA55619 packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 70GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420 before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel to AA 55619.

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

4 PREPARATION OF PACKING CASES

4.1 DOMESTIC:

Based on the availability, the wood shall be Rubber wood (Havea Brasiliensis)/Pine wood for packing of cubicles, loose items, spares and photovoltaic items meant for customers in India.

4.2 DIMENSIONS:

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

4.3 JOINTING OF PLANKS

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

4.4 TONGUE AND GROOVE JOINTS

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

4.5 PERMISSIBLE DEFECTS

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



CORPORATE STANDARD

AA0490010

Rev. No. 01

PAGE 3 of 26

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

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

4.6 CHEMICAL TREATMENTS FOR PRESERVATION OF WOOD

- 1) This treatment provides protection to the packing wood against deterioration due to fungi and attack by termites, borers and marine organism and any kind of infections.
- 2) The wooden planks, after making tongues / grooves shall be treated with chemicals. For pine wood, treatment with ASCU/ CCA solution need not be done.
- 3) The chemical used shall be ready mix ASCU paste. This consists of Arsenic pent oxide, copper sulphate sodium dichromate. This Paste shall be mixed at the rate of 1 kg of paste per 10 liters of water to the extent of water used. Alternate this CCA paste as mentioned at Para 4.6.5) can also be used.
- 4) The chemical treatment shall be done at the premises of the contractor. A cement concrete tank of capacity to hold a minimum of 2000liters of solution shall be constructed. The solution shall be prepared in the presence of BHEL Representative by contractor. The wooden planks shall be soaked in the solution for a minimum of 12 hours. The solution shall be replenished after treating a maximum of 12 cubic meters of wood. A log book shall be maintained by the contractor to give the details of date of preparation of solution, quantity of solution prepared, quantity of chemicals used, Quantity of wood treated and the details of replenishment. Samples of solutions before mixing will be tested at the laboratories designated by BHEL. The testing fees to be paid to the laboratories will have to be borne by the contractor. The paste shall be tested as and when required.
- 5) Specifications for water soluble type wood preservatives: Copper – Chromium – Arsenic [CCA]: Copper – Chromium – Arsenic preservative formulation shall be as per IS:10013 Part – II – 1981 shall consist of following active ingredients in nominal proportions by weight as shown below:

– Arsenic Pent oxide	AS ₂ O ₅ 2H ₂ O	12.5
– Copper Sulphate	CuSO ₄ 5H ₂ O	37.5
– Sodium Dichromate	Na ₂ Cr ₂ O ₇ 5H ₂ O	50.0
– Or Potassium Dichromate	K ₂ Cr ₂ O ₇	

4.7 OTHER MATERIALS

4.7.1 NAILS

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

4.7.2 BLUE NAILS

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

4.7.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6 +0.01mm. The material shall be free from rust.

4.7.4 CLIPS

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

4.7.5 BRACKETS

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

**4.7.6 FASTENERS**

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

4.7.7 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

70GSM (Colourless) Multi Layered Cross Laminated Polythelene Film Specification No: AA51420 are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

4.7.8 RUBBERISED COIR:

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

4.7.9 FOAM RUBBER / 'U' FOAM:

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

4.7.10 MARKING PLATE:

This shall be of anodized aluminium sheet. Details and specifications are given in Fig-4

4.7.11 PACKING SLIP HOLDER:

This shall be of galvanized iron tinned sheet /Aluminium sheet

4.7.12 SILICA GEL:

This shall be of indicating type to conform to IS: 3401/AA55619.

4.7.13 COTTON BAGS:

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

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

4.7.14 COTTON/ PLASTIC TAPE:

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

4.7.15 MARKING INK:

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

4.7.16 POLYETHYLENE BAGS:

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



CORPORATE STANDARD

AA0490010

Rev. No. 01

PAGE 5 of 26

4.7.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.

4.7.18 Mechanical Latching clamps:

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

4.7.19 STICKERS

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

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

5 PACKING OF CUBICLES WITH RUBBER WOOD:

5.1 The packing is to be done as per clause 4 in all respects.

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

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

5.4 MULTI LAYER CROSS LAMINATED POLY FILM

The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.7.7) using blue nails (as per 4.7.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.

The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 4.7.7). This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 4.7.7).

5.5 SILICA GEL:

Silica gel (as per 4.3.15) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 4.7.13).

5.6 LOOSE PARTS:

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

5.7 WOODEN BATTENS:

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

5.8 RUBBERISED COIR:

Gap between the cubicle and the case shall be filled with rubberized coir (as per 4.7.8) with distance between consecutive layers less than 500mm.

**5.9 CLAMPING:**

Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 4.7.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

5.10 PACKING SLIP:

Packing slip kept in the polyethylene bag (As per 4.7.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 4.7.11) shall be nailed to front / rear of case.

5.11 MARKING PLATE:

One no. (As per 4.7.10) shall be nailed to the front side of the case.

5.12 CASE MOUNTING:

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

5.13 Different types (Typical) of Cubicles with sizes for Packing

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

5.14 PACKING OF CUBICLES WITH PINE WOOD

Packing of cubicles for export shall be done exactly in same manner as described at Cl.No 5 except for the following changes: -

Wood shall be Silver oak/ Pine wood instead of rubber wood.

- Double polyethylene petticoat instead of one.
- Fumigation may have to be done if required (BHEL Scope).

6 PACKING OF LOOSE ITEMS/SPARES USING RUBBER WOOD:

- 1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.
- 2) Wood shall be rubber wood with Tongue and Groove joint as per clause 4.4.
- 3) Chemical treatment as per Clause 4.6 to be done.
- 4) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.
- 5) External surface of planks on front and rear shall be plane 100% (except bottom plank).
- 6) Inner surfaces of all 6 sides shall be lined with bitumen coated hessian polyethylene Kraft paper (as per clause 4.7.7) using blue nails.
- 7) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
- 8) Internal packing: Items that go into the box shall be packed using 70GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No: AA51420. Any space left Between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect .
- 9) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.



CORPORATE STANDARD

AA0490010

Rev. No. 01

PAGE 7 of 26

- 10) Silica gel as per clause 4.7.12 held in cotton bags as per clause 4.7.13 shall be kept at proper places in the box.
- 11) Packing slip kept in polyethylene bag (clause 4.7.16) shall be placed in the box.
- 12) Marking plate as per clause 4.7.10 shall be nailed to side of the box.
- 13) Two numbers of hoop iron strips as per clause 4.7.3 shall be strapped tightly on the case using clips.
- 14) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
- 15) Loose items to be kept inside the cubicle
 - The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.
 - Other items which are given loose in addition to cubicle shall be packed in separate boxes.

7 BOX SIZES

7.1 BOX SIZES

Table 1 – SPARES WOODEN BOX DETAILS

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

7.2 BOX SIZES**Table 2 – VALVES WOODEN BOX DETAILS**

BOX TYPE	BOX SIZE (in MM)	BOX Wt (in KG)	Carrying Capacity
1A	320X250X260	10	
1	320X250X430	15	
2	430X370X430	25	
3	670X670X470	65	
4	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	
10	1300X770X1050	155	
11	2500X850X800	225	
12	2000X1500X1200	305	
14	1850X1050X1250	260	
15	2000X800X800	180	
17	2600X1500X1600	470	
21	250X250X600	20	
22	250X250X880	30	
23	300X300X700	25	
24	380X380X880	45	
25		25	
26	510X510X1400	60	
27	570X570X1400	80	
28	575X575X1875	105	
29	3600X1100X1100	390	
30	900X500X800	110	
52	2000X950X740	225	
53	1600X1120X700	220	
54	2500X2000X1200	490	
55	2900X1900X1400	525	
56	3000X1000X900	370	
57	3200X2200X950	450	
58	2150X1100X750	325	
61	2000X2000X700	130	
62	700X1200X1325	130	

TYPICAL PATTERN OF WOODEN BOX

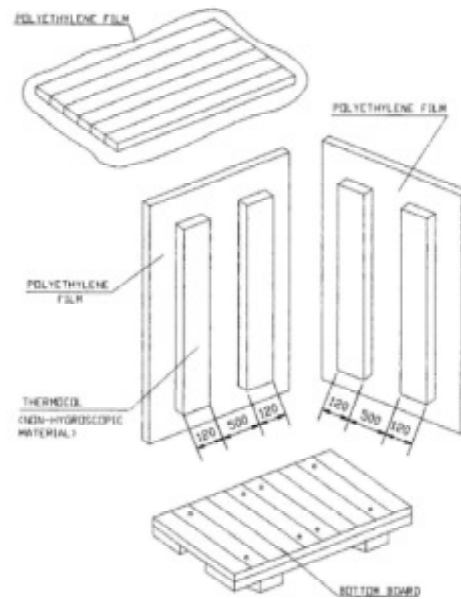


Figure 1

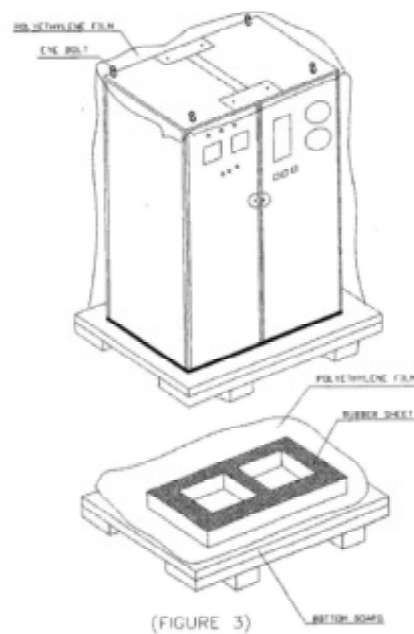


Figure 2

7.3 STANDARD BOX SIZES

WOODEN BOXES:

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
01	I	2370	1570	1650	675	4000
02	IIA	1570	720	885	200	2500
03	II	1200	900	600	150	2000
04	III	900	600	600	100	1000
05	IV	600	450	450	40	750
06	V	600	300	300	35	500

STEEL BOXES:

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
07	I	2480	1680	1500	339	4500
08	II	1200	900	600	061	2000
09	IIB	1800	850	950	115	2500
10	III	900	600	600	029	1000
11	IV	600	450	500	019	750
12	V	400	350	300	011	500

Table 3

7.4 STEEL CONTAINERS

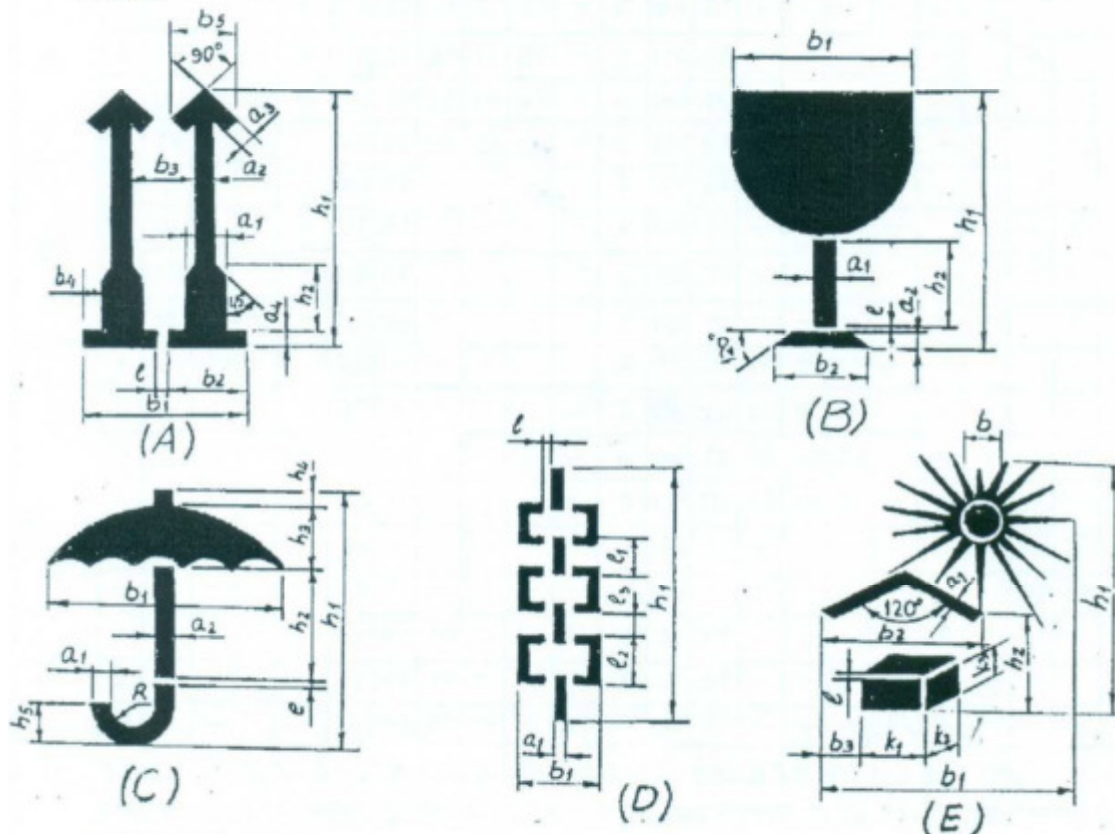
Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies. The containers are to be made of structural steel as per AA10108 with proper reinforcement with I, C and T Sections.

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

8 MARKINGS/STENCILINGS

MARKINGS ON PACKING CASES

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



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



Center of Gravity

Figure 3

DESIGN- ATION		DIMENSION IN MM																									
		a1	a2	a3	a4	b1	b2	b3	b4	b5	b	l	h1	h2	h3	h4	h5	k1	k2	k3	l1	l2	l3	R			
A	1	12	5	5	4	52	25	19	8	21		2	84	23													
	2	17	7	7	6	75	36	29	11	30		3	119	33													
	3	24	10	10	8	104	50	38	16	42		4	168	46													
	4	34	14	14	11	147	71	59	23	60		5	239	65													
B	1	5	5			50	33					2	84	25													
	2	7	7			71	47					3	119	36													
	3	10	10			100	66					4	168	50													
	4	14	14			142	94					5	239	71													
C	1	4	3			66						2	80	39	19	5	11								6		
	2	6	4			85						3	114	55	27	7	16								9		
	3	8	6			120						4	160	78	38	10	22								12		
	4	11	9			170						5	227	110	54	14	31								17		
D	1	6				30						4	148								30	30	10				
	2	9				42						5	209								42	42	14				
E	1	3				69	47	10			16	2	91	26				17	8	11							
	2	4				98	67	15			23	3	128	33				24	11	16							
	3	6				138	94	20			32	4	182	62				34	16	22							

Table 4

Black and Red Marking Ink to IS:1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink

"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".

Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.

In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel(AA56126).

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.

Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: Incase the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

225			
CONSIGNEE	BHEL-EDN-BANGALORE-26		
MATERIAL			
CUSTOMER REF.	MO. NO.		
DESPATCH ADVICE NOTE NO.	CASE NO.		
DIMENSIONS(MM) LXBXH	<table border="1"> <tr> <td style="text-align: center;">NET WT -KGS</td> <td style="text-align: center;">GROSS WT -KGS</td> </tr> </table>	NET WT -KGS	GROSS WT -KGS
NET WT -KGS	GROSS WT -KGS		
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT		
170			

Figure 4 – TYPICAL MARKING PLATE



Figure 5

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

9 RECYCLING OF INCOMING WOODEN PACKING CASES

OBJECTIVES

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

AA0490010	CORPORATE STANDARD	
Rev. No. 01		
PAGE 14 of 26		

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

10 STANDARD METHOD OF PACKING

Table 5 –

STANDARD METHOD OF PACKING								
DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
PRESSURE VESSELS								
TOWERS					O			
TANKS					O			
VESSELS					O			
GASKETS	O							
FASTENERS	O							



CORPORATE STANDARD

AA0490010

Rev. No. 01

PAGE 15 of 26

STANDARD METHOD OF PACKING

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
COVERS		O						
EXCHANGERS								
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
AIR BOTTLES	O							
TITANIUM BOTTLE	O							
WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
BOILERS								

AA0490010		CORPORATE STANDARD							<div>बी एच ई एन</div> <div>BHEL</div>		
Rev. No. 01											
PAGE 16 of 26											
BOILER DRUMS					O						
BOILER ITEMS											
COILS			O								
PANELS					O						
HEADERS			O		O						
FEEDERS											
MACHINED ITEMS											
SHELL SEGMENTS					O						
SHELL SEGMENTS IN STACKS					O						
SPHERE PETALS											
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O						
ROLLERS	O										
VALVE TRAYS											
VALVE TRAY COMPONENTS	O										
LATTICE GIRDERS		O									
FASTENERS	O										
GASKETS	O										
DESCRIPTION				CA SE	CRA TE	SK ID	BUN DLE	BA RE	DR UM	METAL DRUM	FIBRE DRUM
SUB CONTRACTS											
FAB STRUCTURALS								O			
SUPPORTING STRUCTURALS								O			
STRUCTURE SUB ASSEMBLY								O			
FAB PIPES								O			
GRATINGS								O			
STAIR CASES								O			
HANDRAILS/ PLATFORMS								O			
BOUGHT OUT COMPONENTS											
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)								O			
PIPE FITTINGS											
CS PIPES, TUBES								O			
SS PIPES, TUBES								O			
FIN TUBES				O							
ELBOWS					O			O			
FLANGES				O	O						
VALVES				O							
GAUGES				O							
DEMISTERS					O						
DESCRIPTION				CA SE	CRA TE	SKI D	BUND LE	BA RE	DR UM	METAL DRUM	FIBRE DRUM



CORPORATE STANDARD

AA0490010

Rev. No. 01

PAGE 17 of 26

ABSORBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							
SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								
MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

11 PROCEDURE FOR HANDLING OF COMPONENTS

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

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

11.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

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

- a) The markings showing the upright position.
- b) The markings showing the sling position
- c) Markings showing the fragile contents.
- d) Other required markings as per CI.no:08



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

12 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH

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

12.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):

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

2. LOW BED TRAILERS (LB 16):

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

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

Bigger Dia equipment are loaded in the Well with overhanging.

Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.

The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/ Weight of the Consignment

12.2 PACKING:

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

For Diameter up to 4000mm

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

NUMBER OF SADDLES:

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

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

12.3 NUMBER OF LASHINGS ARE:

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

13 GUIDELINES FOR HANDLING/LOADING/LASHING

13.1 HANDLING



Figure 6

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

Pipes with split type end cover will be checked

**Figure 7**

All Coil Tubes to be provided with End Caps.

**Figure 8**

Neatly stacked Coil Assemblies.

**Figure 9**

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

**Figure 10**

13.2 LOADING

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



Figure 11

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



Figure 12

No component loaded over the crating.



Figure 13

Headers supported with wooden V blocks at 3 meters interval.



Figure 14

Spacers in between each coil assembly.

**Figure 15**

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

**Figure 16**

13.3 LASHING

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



Figure 17

Nylon Belts used for lashing the beams.



Figure 18

14 PRODUCT WISE SPECIAL INSTRUCTION

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

**15 REFERRED STANDARDS (Latest publications including amendments):**

- | | | | |
|------------|------------|------------|------------|
| 1) AA51420 | 2) AA55619 | 3) AA51414 | 4) IS:3401 |
| 5) AA10108 | 6) AA56126 | | |

ANNEXURE-9

NO DEVIATION CERTIFICATE

To,
Purchase / PE&SD
BHARAT HEAVY ELECTRICALS LIMITED,
Ramachandrapuram
Hyderabad-502032

Sub : No Deviation Certificate.

Job: **Supply and E & C of AC System**

Ref: 01 ENQUIRY No. **T7B1U38966 Dated 01.07.2021**
02 BHEL's NIT with technical documents reference no PY51446– **Technical specification for Air conditioning System**
03 All other pertinent issues till date.

Dear Sirs,.

With reference to above, this is to confirm that, we have read the tender documents and noted the job content. We also confirm that we have not changed/ modified the tender documents as appeared in the website/ issued by you and in case of such observance at any stage, it shall be treated as null and void.

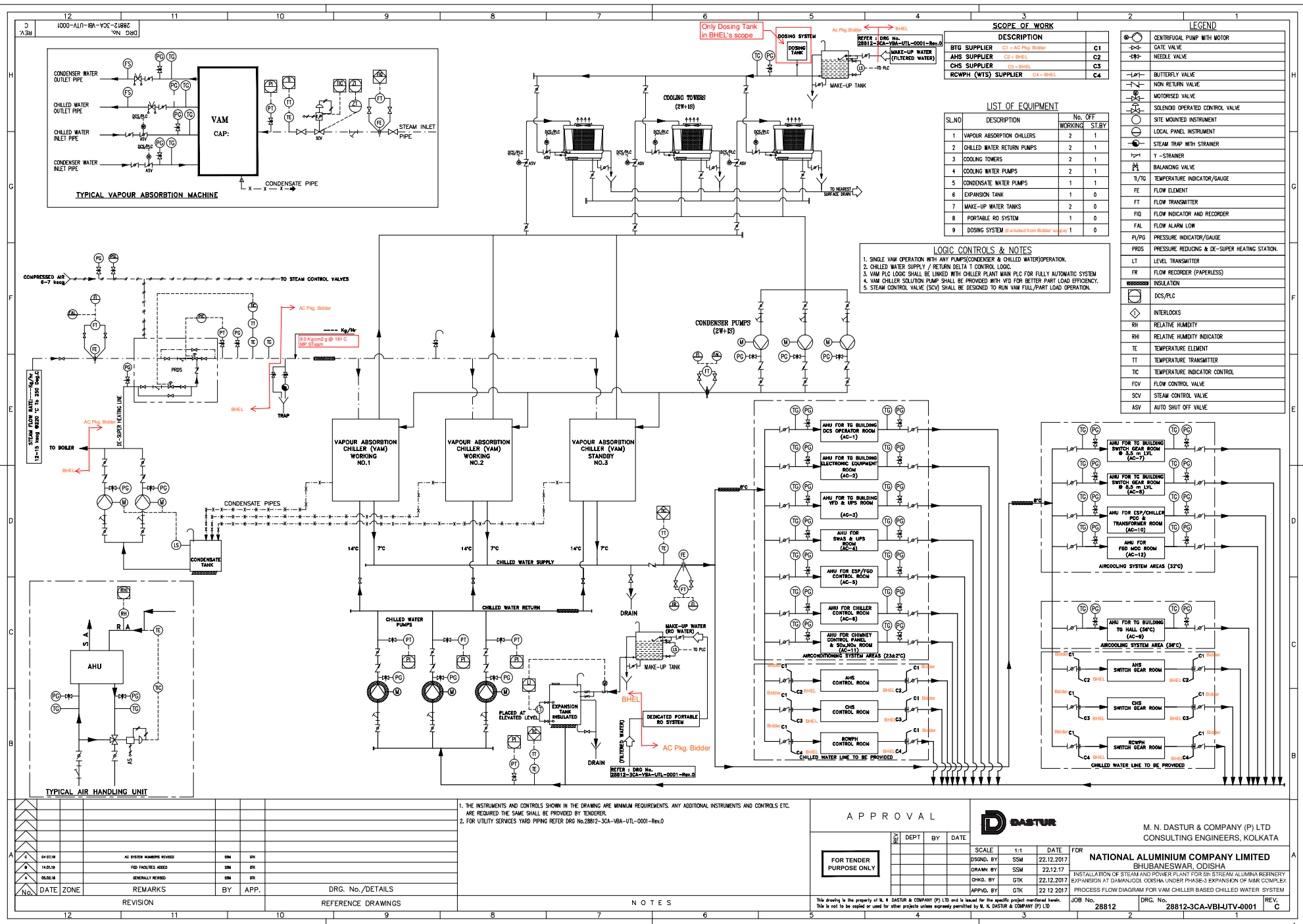
We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above-referred NIT. We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification, integrity pact (if applicable) and acceptance to reverse auctioning process.

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

We confirm to have submitted offer in accordance with tender instructions and as per afore-said references.

Thanking you,

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



THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

GENERAL DIMENSIONAL LIMITS, FITS & TOLERANCES AS PER HY0230261

PEASO INTERNAL REVIEW
REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

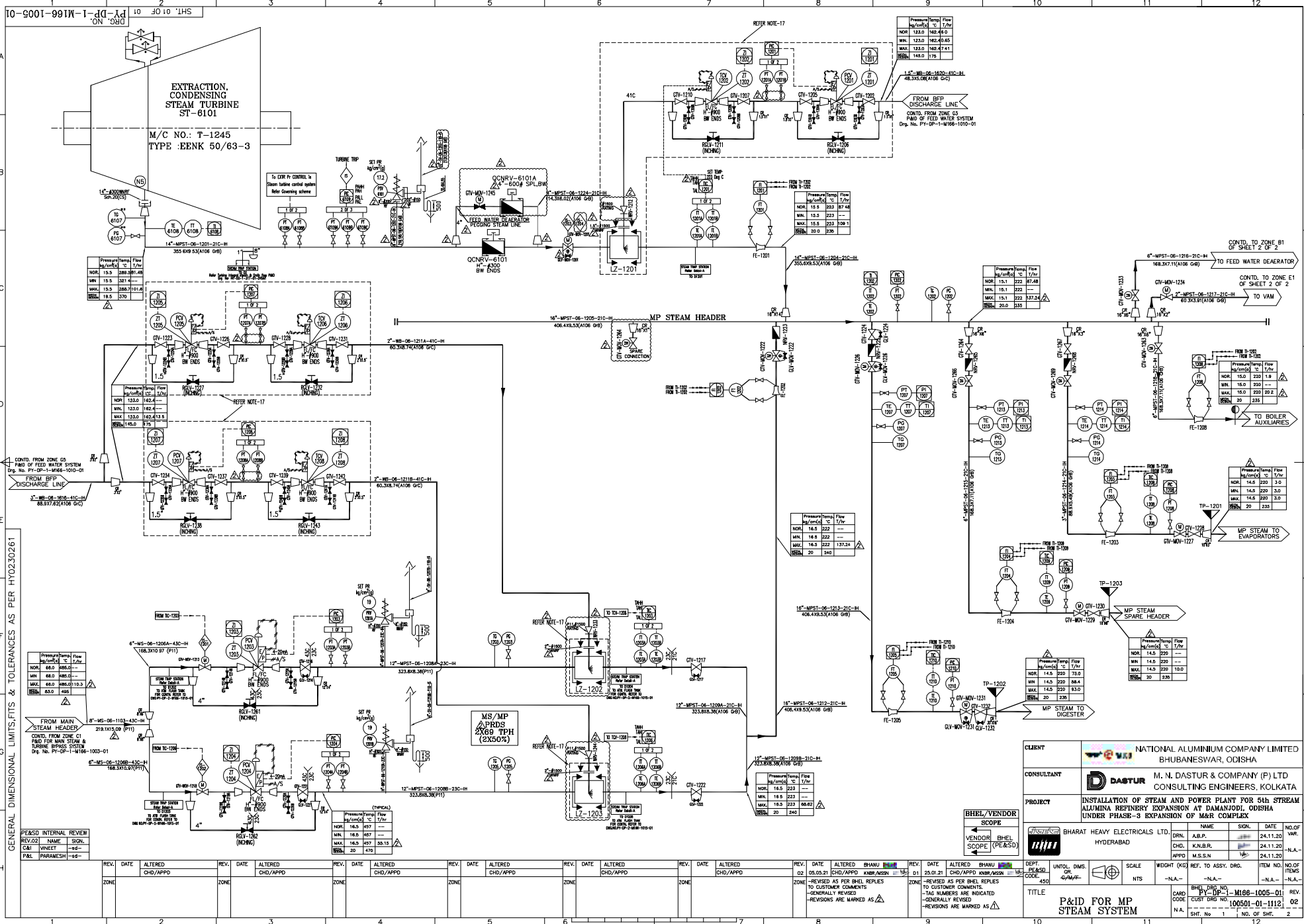
REV. DATE ALTERED
CHD/APPD

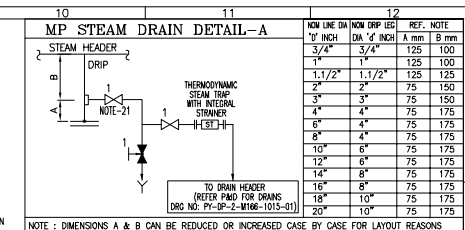
REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD

REV. DATE ALTERED
CHD/APPD





1. HIGH POINT VENTS AND LOW POINT DRAINS SHALL BE PROVIDED AT SUITABLE LOCATIONS AS PER PIPING LAYOUT.

2. DRAIN & VENT LINES SHALL BE 1" SIZE UNLESS OTHERWISE STATED.

3. ALL VENTS SHALL LEAD TO A SAFE AREA AND SHALL NOT BE DIRECTED TOWARD PATH WAY.

4. THE UPSTREAM AND DOWNSTREAM MINIMUM STRAIGHT LENGTHS FOR ALL ELEMENTS SHALL AS PER VENDOR RECOMMENDATIONS.

5. MINIMUM STRAIGHT LENGTH OF PIPE DOWNSTREAM OF DESUPERHEATER AND MINIMUM DOWNSTREAM STRAIGHT LENGTH OF INSTRUMENT SERVICER IS TO BE MAINTAINED AS PER VENDOR RECOMMENDATION.

6. ALL VALVES SHALL BE PROVIDED WITH INTEGRAL BYPASS VALVE IF THE VALVE SIZE IS 8" & ABOVE. RATED PRESSURES SHALL BE 3000- AND VALVE SIZE IS 10" & ABOVE FOR RATINGS 1500 TO 3000

7. THE MAIN VALVE OPERATOR OPERATED THEN THE BYPASS VALVE SHALL BE MOTOR OPERATED.

8. FOR PIPES/ LINES SUBJECT TO DESIGN PRESSURES EQUAL TO OR MORE THAN 40 KG/502CM² DOUBLE ISOLATION VALVES SHALL BE PROVIDED FOR DRAINS, VENTS AND PRESSURE INSTRUMENTS.

9. ALL PRESSURE INSTRUMENTS SHALL BE WITH PROCESS ISOLATION VALVE.

10. ALL TEMPERATURE INSTRUMENTS ARE PROVIDED WITH THERMOWELL.

11. END CONNECTIONS FOR THE INSTRUMENTS SHALL BE:

- i) ROOT VALVE ENDING WITH 1/2" SW FOR PRESSURE.
- ii) M3X32 CONNECTION FOR TEMPERATURE

12. MOTOR OPERATED VALVES ARE PROVIDED WITH INTEGRAL TYPE STARTER.

13. * INDICATES ITEMS SUPPLIED ALONGWITH EQUIPMENT.

14. DELETED.

15. ** - INDICATES INSTRUMENTS MOUNTED ON CLIQUE BOARD.

16. THE PARAMETERS OF LINES INDICATED IN PARAMETERS TABLE CORRESPOND TO THE NORMAL FLOW, MAXIMUM FLOW AND MINIMUM FLOW CONDITIONS.

Δ17. THE DESUPERHEATER AND THE SPRAY CONTROL VALVE CONFIGURATION IS INDICATIVE. THE DESIGN OF DESUPERHEATER AND THE SPRAY CYS WILL BE UPDATED BASED ON ACTUAL VENDOR DATA.

18. INSTRUMENTS MARKED WITH TAG "T1" INDICATES TEMPERATURE TEST POINTS AND INSTRUMENTS MARKED WITH TAG "C1" INDICATES CONTROL TEST POINTS WHICH USED DURING PERFORMANCE GUARANTEE TEST. THE TEST POINTS INDICATED ARE PRELIMINARY AND SHALL BE REVISED BASED ON THE APPROVED PERFORMANCE GUARANTEE TEST PROCEDURE.

Δ19. ALL INSTRUMENT TAG AND INTERLOCK NUMBER SHALL BE PREFIEXED WITH 06-02 EG. PG-1202 SHALL BE READ AS 06-02-PG-1202.

TE-1202 SHALL BE READ AS 06-02-TE-1202.

20. FOR TYPICAL INSTRUMENTS DETAILS BETWEEN 06-02 TAG NUMBERS AND DRIVES (LIKE MOTORS, MOV, SOV etc) REFER TO THE APPROPRIATE "DRIVE CONTROL PHILOSOPHY".

21. THIS VALVE IS NOT REQUIRED IF STEAM TRAP ASSLY. IS INSTALLED WITHIN 3M FROM DRAINS.

22. ALL VALVES NUMBER SHALL BE PREFIEXED WITH 06

EG. GTV-1245 SHALL BE READ AS 06-GTV-1245.

NRV-1260 SHALL BE READ AS 06-NRV-1260.

Δ23. DESIGN TEMPERATURE FOR VALVES WITH TAG NUMBERS GTV-1228, GTV-1230 & GTV-1232 IS 300 DEG C.





Reference Drawings:	BHEL Drawing No.:
a) LEGEND for P&IDs	PT-DM-1-M166-1000-01
b) Numbering Philosophy	PT-AN-4-M166-1000-01
c) Turbine integral steam & drain P&ID diagram	HY-DS-1-317-01-24561
d) P&ID for Feed water System	PT-DP-1-M166-1010-01
e) P&ID for main steam & turbine bypass system	PT-DP-1-M166-1003-01
f) P&ID for AC System	PT-VP-1-M166-8310-01
g) Scheme of Blowdown	1-00-301-99081

INTERLOCK SUMMARY				
EQUIPMENT INVOLVED	LOGIC NO.	TAG NOS INVOLVED	CONDITION FOR LOGIC EXECUTION	ACTION
GTW-MOV-1213	IS-1201	TT-1203A TT-1203B	TEMP TIT-1203A DOWNSTREAM OF ACQUAPUTER HIGH HIGH	CLOSE GTW-MOV-1213
GTW-MOV-1218	IS-1202	TT-1206A TT-1206B	TEMP TIT-1206A DOWNSTREAM OF ACQUAPUTER HIGH HIGH	CLOSE GTW-MOV-1218
TURBINE	IS-1203	GTW-MOV-1201	ON TURNING TRIP	CLOSE GTW-MOV-1201
GTW-MOV-1201	IS-1204	TT-1201A TT-1201B	TEMP TIT-1201A DOWNSTREAM OF ACQUAPUTER HIGH HIGH	CLOSE GTW-MOV-1201

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHG/APPD			CHG/APPD			CHG/APPD			CHG/APPD
ZONE			ZONE			ZONE			ZONE		
1		2	3			4			5		

DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REMARKS
CHG/APPD			CHG/APPD			CHG/APPD			CHG/APPD		
			ZONE			ZONE					REVIS-AS FOR SHL REPLIES TO CUSTOMER COMMENTS -GENERALLY REVISED -REVISIONS ARE MARKED AS Δ
5		6			7			8			

BHEL HYD		BHEL/VENDC	
INTERNAL SCOPE		SCOPE	
T&C/GT	PE&SD		
ENGG			
BHEL (PE&SD)	BHEL (HPVP)	VENDOR SCOPE	BHEL (PE&SD)

CLIENT	 NATIONAL ALUMINIUM COMPANY LIMITED BHUBANESWAR, ODISHA						
CONSULTANT	 M. N. DASTUR & COMPANY (P) LTD CONSULTING ENGINEERS, KOLKATA						
PROJECT	INSTALLATION OF STEAM AND POWER PLANT FOR 5TH STREAM INDIA REFINERY EXPANSION AT DAMUDURDI, ODISHA UNDER PHASE-3 EXPANSION OF M&E COMPLEX						
	BHARAT HEAVY ELECTRICALS LTD. HYDERABAD		DRL.	NAME	SIGN.	DATE	NO. OF PAGES
			CHD.	A.B.P.		12.10.20	N.A.
			K.H.R.B.			12.10.20	N.A.
			APPD.	M.S.S.N		12.10.20	N.A.
DEPT. HEAD OFFICE NO. 150	UNITS, DIVS. OR SAMS.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NOS.	NO. OF ITEMS
			NTS	"N.A."	"N.A."	"N.A."	"N.A."
TITLE	P&ID DRAWING No. - MEG-1006-001-REV. 02 STEAM SYSTEM				CARD CODE N.A.	CUST GRD NO. - 100601-01-1112-	REV.
10	11				SHT. No	2	NO. OF SHT. 2

Comments on Document/Drawing : P&ID FOR MP STEAM SYSTEM
Drawing no: ...PY-DP-1-M166-1005-01...

S.No	NALCO/DASTUR OBSERVATION ON REV.00A (16.12.2020)	BHEL RESPONSE DATED 25.01.21	DASTUR'S REPLY	BHEL RESPONSE DATED 05.05.21
1	On turbine: Update equipment details	Noted and same are updated in the revised document.	Noted . Point closed	--
2	On LP process steam flow for turbine extraction Process steam (peak requirement is enclosed along with P&ID)	Maximum LP process steam requirement (221 TPH to customer battery limit) is noted by BHEL. However, same shall be considered from MS/LP PRDS only. So, there is no change of flow parameters from turbine extraction and same are retained in the revised document.	Noted . Point closed	--
3	relocate the flow nozzle at the inlet of MP steam header	Noted, same is updated in the revised document.	Noted . Point closed	--
4	On LP process steam flow for turbine extraction Max. flow shall be decided considering maximum process flow + steam requirement for boiler + TG + Other auxiliaries	Please refer the reply in SI. No. 2 above.	Noted . Point closed	--
5	To indicate MOV in extraction line near the header	Please note, one MOV (GTV-MOV-1201) is already considered in extraction line. The preferable location of this MOV shall be nearer to the turbine instead of header to meet the interlock (IS-1203) requirements. Please refer the interlock summary table in the P&ID for details. This is the standard practice followed by BHEL in all the projects and customer is requested to accept the same.	In case of turbine failure / during normal operation PRDS will be in operation, the MP Steam header will be located at 13.7 M Level. In order to avoid the backflow steam in flow nozzle and spray zone MOV to be provided for isolation	Please note, during normal operation turbine is also in operation along with PRDS. When there is no extraction from turbine, there cannot be back flow in spray zone as there is NRV in this line. Also, there won't be any back flow through flow nozzle continuously, only dead leg will be formed in this line till MOV which is approximately 30 meters length. As per the above, one more MOV in extraction line is not required hence not considered.
6	On spray flow of MP PRDS: Max. flow to be revised based on inlet steam requirement to MP Header	Noted, BHEL has considered maximum MP process requirement as 96 TPH. PRDS sizing criteria is done by considering the same along with internal consumption. Document is revised to indicate the same. For calculation of spray water requirement for maximum MP process flow customer may refer the PRDS, Desuperheaters & turbine bypass valve sizing criteria document (Doc. No. PY-SZ-4-M166-9401-01).	Noted. Point closed. Please note that the boiler capacity is finalised as 300 TPH.	Noted & point closed
7	On inlet steam flow of MP PRDS: Max. flow shall be decided considering maximum process flow + steam requirement for boiler + other auxiliaries	Noted, BHEL confirms the same and please refer the reply in SI. No. 6 above.	Noted. Point closed. Please note that the boiler capacity is finalised as 300 TPH. Exceeding the flow requirement is not acceptable	Noted & point closed
8	To shift the MS/MP PRDS description location	Noted, same is relocated as per customer comment in the revised document.	Noted . Point closed	--
9	On downstream flow of MP PRDS system Max. flow shall be decided considering maximum process MP steam flow + steam requirement for boiler + TG + Other auxiliaries	Noted, BHEL confirms the same and please refer the reply in SI. No. 6 above.	Noted. Point closed	--
10	Comment related to MP process steam export lines:	Noted & incorporated in the revised document.	Noted. Point closed	--
11	To indicate the following data: 1) header parameters to be indicated : Flow Pressure : Temperature : 2) Continuation drg no at applicable locations 3) MP steam header description on MP header	Noted and same are indicated in the revised document.	Noted. The parameters shall be as per MOM dated 11.01.2021	Noted & MP steam parameters are updated accordingly.
12	customer has indicated hold on BHEL line sizes	Please note, individual MP process steam line sizes are finalised and indicated in the revised P&ID based on the maximum flows confirmed by the customer. BHEL has considered suitable expander or reducer to match the MP process battery limit sizes and same is indicated in the revised P&ID.	Noted. However the same to be finalised after discussion with tkis/NALCO	As per the customer confirmation through mail dated 31.03.21, the line sizes indicated by BHEL are acceptable to customer. Suitable expander or reducer has considered by BHEL to match the MP process battery limit sizes
13	COMMENTS 1. INSTRUMENT TAG NUMBERS TO BE INDICATED 2. LINE TAG NUMBERS TO BE INDICATED 3. CONTINUOUS DRAWING REFERENCE NUMBER TO BE INDICATED	Noted and same are indicated in the revised document.	Noted. Point closed	--
14	On max parameters of inlet steam line to feed water deaerator: Check the flow requirement with respect to the feed water cycle requirement	BHEL confirms that the maximum flow data indicated in pegging steam line to feed water deaerator is by considering the maximum flow operating case (i.e. 330 TPH of condensate & make up water) of feed water cycle requirement only.	The maximum flow to be indicated considering maximum operating condition (300 boiler capacity + maximum spray water requirement+ other requirement). Overall mass balance should not exceed 300 TPH.	BHEL once again confirms that the maximum flow data indicated in pegging steam line to feed water deaerator is by considering the maximum flow operating case (i.e. 330 TPH of condensate & make up water) of feed water cycle requirement only, which is inline with the specification requirement. Please note, overall mass balance of 300 TPH is applicable for main steam only. Also note that maximum flow mentioned in parameter table are the maximum flow in a particular line. Simultaneous maximum flows may not happen in different lines. Hence, mass balance can not be checked in P&IDs for maximum flow condition. The indicated maximum flows are in order for individual lines.
15	On MP PRDS steam pressure control valves: 900# is marginal hence 1500# is recommended.	please note, for the design parameters (design pressure of 83 kg/cm2(a) & design temperature of 490 Deg C) and for the pipe MOC of P11 #900 rating is in order and same rating was followed in the existing NALCO TG-4 & TG-5 units. As per the above, the rating of #900 is in order for these control valves and same is retained in the revised document.	1500# is recommended.	Please note, for the design parameters (design pressure of 83 kg/cm2(a) & design temperature of 495 Deg C) and for VALVE MOC of A217 Gr WC6/A182 Gr F11 C12, as per ASME, #900 rating is in order and same rating was followed in the existing NALCO TG-4 & TG-5 units. As per the above, the rating of #900 is in order for main steam line and same is retained in the revised document.
16	On MP PRDS down stream maximum steam parameters: Revise based on inlet steam	Noted, same is updated in the revised document.	Noted. Point closed	--
17	To show vent & drain on MP steam header	Please note, header vent & drain valves will be provided (as applicable) as per the layout requirement and as per Note 1 of P&ID. All vents & drains cannot be shown in the P&ID.	Noted. Point closed	--
18	On Maximum flow to VAM system: Flow requirement to be decided after obtaining firm steam requirement from air conditioning system package vendor	Customer comment is not clear. However, VAM system is in scope of BHEL and maximum flow is indicated as per the system requirement only.	The flow 2.1 tph was indicated in the tender document is for reference only. The same was also considered in your P&ID. The steam requirement to be updated as per chiller plant vender requirement	Value of steam indicated for VAM PRDS is revised to 2.5 TPH, which is not to exceed value. same is updated in the revised document.
19	On Maximum spray flow to VAM desuperheater: flow to be indicated	Noted, same is indicated in the revised document.	Point closed	--
20	To remove Preliminary block	Noted, same is removed in the revised document.	Point closed	--
21	To update the title block, interlock summary table & Tag number table	Noted, same are updated in the revised document.	Point closed	--
New comments received on Rev01				
22.			To update the main steam to MS/MP PRDS tap off line design temperature as 500 Deg C instead of 490 Deg C	As per the VC dated 24.02.21, BHEL explained to customer that Main steam header design temperature is finalised as 495 Deg C with 5 Deg C margin over maximum operating temperature. BHEL also confirmed that this main steam design temperature value is inline with the design temperature of existing main steam headers in NALCO TG-4 & TG-5 units. Same is noted by M/S NALCO/MN Dastur. Inline with above, the design temperature is considered as 495 Deg C and P&ID is revised to indicate the same. As per the above, this comment is closed in this P&ID.

S.No	NALCO/DASTUR OBSERVATION ON REV.00A (16.12.2020)	BHEL RESPONSE DATED 25.01.21	DASTUR'S REPLY	BHEL RESPONSE DATED 05.05.21
23.			As per ASME B 16.34, for P11 MOC 900# corresponds for 72.3 kg/cm2, hence kindly consider 1500#	Customer has given this comment on BFP discharge valves. However, we understand customer comment is on MS/MP pressure reducing control valves & BFP discharge valves. Please find the reply as given below. <u>For MS/MP PRDS pressure control station valves</u> We understand this comment is corresponding to the BHEL reply dated 12.01.21 in SI. No. 15 above. Please note, valve rating shall be checked for valve MOC i.e. A217 Gr WC6/A182 Gr F11 C12 at design parameters. Please refer the modified reply in SI. No. 15 above. As per the above, the rating of #900 is in order for the valves in main steam line and same is retained in the revised document. <u>For BFP discharge valves</u> Please note, for the design parameters (design pressure of 145 kg/cm2(a) & design temperature of 175 Deg C) and for VALVE MOC of A216 Gr WCC, as per ASME, the acceptable rating shall be #900. As per the above, the rating of #900 is in order for BFP discharge line and same is retained in the revised document.
25.			To consider NRVs in individual MS/MP PRDS lines	Please note the following: 1) These PRDS stations are near to header and one NRV is already there in MS/MP PRDS common line to MP header. 2) Also note, the PRDS pressure control valves are near to the MS/MP PRDS common line. So, as per the above, one more NRV in individual PRDS downstream lines is not required hence not provided.
26.			<u>on all MP process steam lines</u> To consider MP process steam design temperature as 300 Deg C instead of 240 or 235 Deg C.	As per the VC dated 24.02.21, Customer requested BHEL to consider only the last isolation valve at customer battery limit of all MP process steam lines shall be designed for 300 Deg C. Same is noted by BHEL. As per the above, this comment is closed in this P&ID.
			<u>On max flow common MS/MP PRDS downstream line</u> Max. flow shall be decided considering maximum process flow + steam requirement for boiler + TG + other auxiliaries	Please note this comment is already closed by customer. Please refer the reply in SI. No. 9 above.
28.			To consider the LP extraction desuperheater downstream line design temperature as 370 Deg C instead of 235 Deg C	As per the VC dated 24.02.21, BHEL explained to customer that, in case of spray control system failure for Extraction DSH, upstream MOV (GTV-MOV-1201) will be closed based on the high high temperature alarm (TAHH-1201, set point - 230 Deg C) & interlock (IS-1204). Same is noted by M/S NALCO/MN Dastur. Interlock summary table in the P&ID is revised to update the same. Cl. No. 2.4.1. of system write up (PY-AW-4-M166-1000-01) for further details. As per the above, this comment is closed in this P&ID.
29.			<u>On MP extraction line (upstream & downstream of DSH)</u> When considering maximum operating pressure, the calculated velocity is on higher side. Kindly recheck the pipe size.	Please note, the referred case is corresponding to maximum MP steam extraction case, which is intermittent. BHEL confirms that the velocities in this line are in order w.r.t. process requirements & pressure drop.
30.			To consider MOV isolation valve in extraction line enar MP header	Please refer the reply in SI. No. 5 above
31.			<u>on Pressure parameters of all MP process steam export lines near battery limit</u> maximum & minimum pressure at the battery limit shall be as per MOM dated 12.01.2021	Noted, P&ID is revised to indicate the same.
			customer has indicated hold on BHEL line sizes	Please refer the reply in SI. No. 12 above
			<u>On MP steam header line</u> Max. flow shall be decided considering maximum process flow + steam requirement for boiler + TG + other auxiliaries	Please note this comment is already closed by customer. Please refer the reply in SI. No. 9 above.
32.			<u>On max parameters of inlet steam line to feed water deaerator</u> Check the flow requirement considering feed water flow to boiler (300 TPH) + maximum spray water requirements + other requirement.	Please refer the reply in SI. No. 14 above



SECTION - VIII

AIR-CONDITIONING, AIR COOLING AND VENTILATION SYSTEM

1.0 GENERAL

1.1 This section of specification covers the Chilled Water Plant, Air-Conditioning, Aircooling ~~and Ventilation~~ Systems for the various premises of coal based thermal power plant and its auxiliaries. These systems are intended for creating acceptable room inside condition within the premises for proper equipment cooling and human comfort.

1.2 Design ambient condition as given below shall be considered for air conditioning ~~and ventilation~~ systems.

	<u>Summer</u>	<u>Monsoon</u>	<u>Winter</u>
Dry bulb temperature, °C	: 46.6	30.6	3
Relative humidity, %	: 50	89	71
Maximum rainfall in a day, mm	: 354		
Maximum hourly rainfall, mm	: 80		
Annual rainfall, mm	: 1430 (10 year average 2008-2017)		
Design wind velocity (as per IS:875, Part-3, 2015), m/sec.	: 50		
Predominant wind direction	: Predominantly in Southwest direction		
Average altitude from mean seal level, m	: 910		
Seismic zone	: Zone - II		

2.0 SCOPE OF WORK

2.1 Chilled Water Plant

2.1.1 A centralized chilled water plant shall be installed at the power plant area for air-conditioning and air cooling of all major electrical premises, and their auxiliaries and for comfort cooling of occupants at different plant areas. The chilled water plant shall have



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

chillers, chilled water pumps, condenser cooling water pumps, cooling towers, condensate water pumps, condensate tank, expansion tank, Make-up water tank, interconnecting pipework for steam, chilled water & cooling water with valves, fittings & insulation, electrical facilities, instrumentation & controls etc.

Steam required at a lower pressure and temperature, necessary pressure and temperature reducing devices (PRDS) shall be included in the scope of supply of the Tenderer. The Tenderer shall obtain necessary IBR clearances for the pressure reducing devices (PRDS) as well as any steam piping coming inside the plant room.

2.2 Air-conditioning and Air Cooling Systems

2.2.1 Air conditioning and air cooling systems shall be provided for the various rooms located in TG building area and Chiller Plant area with complete air handling units, ductwork, pipework, insulation, electrics, instrumentation etc. The air handling units shall be provided with filters, fans, cooling coil, flow meter, valves, strainers, dampers, electrics, including motors, starters, cabling and earthing, instrumentation and control etc. complete as per the requirement. Heater and humidifier shall be provided where control of dry bulb temperature and relative humidity are required.

2.2.2 Only Chilled water at a temperature of 7°C (maximum) shall be provided at the battery limit for areas like Ash handling system, coal handling system, RCWPH for air-conditioning and air cooling of these electrical premises. Air handling unit for these areas will be supplied by the respective package suppliers.

2.2.3 Other building such as LDO pump house MCC and Control room located in independent area shall be provided with split air conditioners of adequate capacity with one (1) No. of equal capacity acting as standby unit. Split AC for Ammonia Storage Control Room- As per Corrigendum

2.2.4 All necessary consumables such as refrigerant, lubricants, etc. required as first fill shall be supplied and any replenishment/ replacement during commissioning till conducting the PAT and FAT test and handed over to the Purchaser.

~~2.3 Ventilation Systems~~





Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)**3.0 DESIGN BASIS****3.1 Chilled Water Plant**

3.1.1 The chilled water plant shall be of vapour absorption type.

Three (3) chillers of identical capacity are envisaged in two working + one standby configuration. The chilled water plant shall be provided with chilled water pump, condenser cooling water pump and cooling tower of adequate capacity. The chilled water plant shall be selected to generate chilled water at a temperature of 7°C and the return water temperature to the chilled water plant shall be limited to 14°C maximum.

3.1.2 Steam line at a pressure of 12-15 kscg shall be provided for the vapour absorption chillers. Necessary PRDS shall be incorporated to provide suitable pressure and temperature parameters as required at chiller inlet. PRDS shall be in BHEL's scope

3.1.3 The chilled water from the chiller plant to various consumers shall be taken by insulated chilled water piping through yard and shop area. These pipes shall be installed on available/dedicated supporting structure depending on the requirement.

3.1.4 All the units in Chilled water plant like chilled water pump, condenser cooling water pump and cooling tower shall be envisaged for two working (2 x 50%) and one standby configuration. Flexibility of operation shall be provided for part load operation. Refer Process flow diagram for the above system is indicated in drawing no. 28812-3CA-VBI-UTV-0001.

3.1.5 Make-up water (Filtered water) will be available for the chilled water expansion circuit make-up tank near the chiller plant room battery limits. Dedicated portable RO system shall be provided by the tenderer to maintain the quality of water.

3.1.6 Make-up water (Filtered water) will be available for the condenser (cooling) water circuit make-up tank near the chiller plant room battery limits. Dedicated dosing system shall be provided by the tenderer to maintain the quality of water.

Dosing system shall be constructed with dosing tank, stirrer and necessary accessories, etc.

3.2 Air conditioning and Air cooling Systems

3.2.1 The air conditioning and air cooling system shall be designed on the basis of the prevailing ambient conditions as per Clause No. 1.2 and heat dissipation from the electrical and C&I panels



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

as well as other possible means and sources. Air-conditioning system and air cooling system, cooling capacity calculations shall be prepared and submitted by the successful tenderer preferably based on Carrier E20 format.

3.2.2 Chilled water based Air conditioning system shall be provided for the various Control rooms, DCS panel room, SWAS room and UPS room located in TG building area, Chiller Plant, in order to maintain dry bulb temperature of $(23 \pm 2 \text{ deg C})$ and relative humidity of $55 \pm 5\%$.

3.2.3 Chilled water based Air cooling system shall be provided for various Switch Gear rooms/MCC rooms & Transformer rooms of TG building area, Chiller plant, in order to maintain dry bulb temperature of (32 Deg. C) and relative humidity (RH) of maximum 70%.

3.2.4 Chilled water based Air cooling system shall be provided for TG hall, in order to maintain dry bulb temperature of (36 Deg. C) and ~~roof extractors shall be provided on roof top for ventilation.~~ Roof extractors are excluded from AC pkg. bidder's scope.

3.2.5 Other rooms such as control rooms, switch gear room/transformer room located in independent areas like Ash handling, Coal handling, RCWPH etc. only chilled water temperature of 7°C shall be provided at the battery limit.

3.2.6 LDO pump house MCC and Control room located in independent area shall be provided with split air conditioners of adequate capacity in order to maintain dry bulb temperature of $(23 \pm 2 \text{ deg C})$ with one (1) No. of equal capacity acting as standby unit.

3.2.7 List for various buildings where air conditioning and air-cooling system required are furnished in Table- 1 & 2.

3.2.8 Each floor to be air-conditioned or air cooled shall have its dedicated air handling unit. If two temperature conditions are to be maintained in any floor separate airhandling unit shall be provided for different conditioned areas. Each of these airhandling units shall be installed in a separate room to be provided on the respective floor. Similarly, each of the airconditioners shall be installed in a separate room to be provided adjacent to the conditioned space.

3.2.9 The conditioned or cooled air shall be supplied by insulated G.I. duct and distributed within the premises by diffusers/grilles. Return air may also be taken back through G.I. duct.



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

3.2.10 Each air conditioning and air cooling system shall be interlocked with fire detection panel, so that in case of fire, the respective units are tripped automatically.

3.2.11 Wherever any duct crosses wall/ceiling, fusible link type fire damper shall be provided at the separating surface.

3.2.12 The Tenderer shall furnish the heat load calculation for selection of each air conditioning, air cooling & ~~ventilation~~ systems. Final selection of the equipment shall be on the basis of these approved calculations. The Tenderer shall submit necessary layout drawings for all the systems.

~~3.3 Ventilation Systems~~

AC
ope



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

3.3.11 If during detail engineering, any other premises require airconditioning or ventilation, the same shall be provided by successful Tenderer, without any price implication.

4.0 PLANT AND EQUIPMENT**4.1 Chilled water plant**

4.1.1 Chilled water plant shall be of vapour absorption type with Lithium Bromide as absorbent.

4.1.2 The system shall be complete with VAM chillers having absorber, evaporator, generator, condenser, vacuum pump, chilled water and condenser water pumps, cooling towers, expansion tank, make up water tank, condensate tank, condensate water pumps, steam pipe line, PRDS, pipework with insulation, valves, strainers, fittings, electrics, instrumentation and control etc. as required. The Chilled water plant layout and location is indicated tentatively in the enclosed drawing Nos. 28812-3CA-VBI-UTV-0002 and 28812-000-000-PRJ-0002 respectively.

4.2 Vapour Absorption Machine (Li Br-Water) Chiller Unit

The unit shall be double effected steam fired model duly performance tested and factory assembled with first charge of Li Br solution. The unit shall comprise, but not be limited to, the following main components. All the materials used shall be suitable for handling the corrosive solution:

- i) *Evaporator:* Shell and tube type with process chilled water in the tubes and refrigerant water in the shell. The refrigerant water is evaporated at very low pressure. The refrigerant shall be circulated by a canned refrigerant pump.
- ii) *Absorber:* Shell and tube type (outer shell common with evaporator). In the shell, the concentrated Li Br solution (absorbent) absorbs the vaporised refrigerant. The cooling water from cooling tower is circulated in the tube to remove the heat of absorption.
- iii) *Low & High Temperature Heat Exchangers:* Shell and tube type with dilute absorbent solution in the tubes and concentrated absorbent solution in the shell.



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

- iv) *High temperature Generator:* Shell and tube type with steam in the tube. Dilute absorbent from absorber enters the shell and is concentrated to the required value. Refrigerant vapour released by the concentrated absorbent passes into the low temperature generator section of the shell.
- v) *Low Temperature Generator:* The refrigerant vapour coming from high temperature generator passes through the tubes to concentrate the lithium bromide to its desired level. The referred vapours then pass on to the condenser section which is a part of the same shell.
- vi) *Condenser:* Shell and tube type with cooling water from absorber in the tube. The shell shall be common with low temperature generator. Refrigerant vapour from generator shell enters the condenser shell and gets condensed. The tube shall be made of copper.
- vii) *Absorbent pump, refrigerant pump with SS impellers and vacuum pump with drive motor and all accessories.*
- viii) All interconnecting pipe work with necessary valves, fittings, insulation, cladding etc.
- ix) Insulation along with cladding for chiller unit.
- x) Control panel with all necessary instruments gauges etc.
- xi) Absorbent (solution) pump with VFD for better part load efficiency.
- xii) Sight glasses shall be bolted type with gaskets, safety protection shall include, but not be limited to the following:
 - Thermal shock protection.
 - Antifreeze protection.
 - Crystallization protection (Auto-decrystalliation circuit to be provided).
 - Cavitation protection of refrigerant pump.
 - Absorbent pump thermal cutout (ATHC).



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

- xiii) Alarm sequences shall be included, but not be limited to the following:
 - Dilution cycle alarm sequence.
 - Total shutdown alarm sequence.
 - Power failure alarm sequence.
- xiv) Steam control valve at inlet of chiller.

4.3 Chilled Water Pumps

Chilled water pumps shall be horizontally split casing type. Pump casing shall be of close grained, high tensile cast iron. Impeller shall be of bronze with high tensile steel shaft. The pump speed shall be preferably less than 1500 RPM. The pumps shall be directly coupled to drive through flexible coupling. The pumps shall be complete with electric motor, common base frame, insulation etc. The impellers shall be statically and dynamically balanced. The bearing shall be of anti-friction type.

4.4 Condenser (Cooling) Water Pumps

Cooling water pumps shall be horizontally split casing type. Pump casing shall be of close grained, high tensile cast iron. Impeller shall be of bronze with high tensile steel shaft. The pump speed shall be preferably less than 1500 RPM. The pumps shall be directly coupled to drive through flexible coupling. The pumps shall be complete with electric motor, common base frame etc. The impellers shall be statically and dynamically balanced. The bearing shall be of anti-friction type.

4.5 Pipework

4.5.1 All pipework for steam, chilled water, condenser cooling water, make-up water to cooling tower, drain connections etc. within battery limits, shall be complete with necessary valves, fittings, supports, instrumentation and controls shall be provided and included in the scope of Tenderer.

4.5.2 Chilled water and condensate drain piping shall be insulated.

4.6 Cooling Tower

Cooling tower casing shall be of FRP construction with an axial flow fan mounted on top. Water basin shall be of FRP construction with a cylindrical auxiliary suction tank at the bottom. Drain shall be provided to facilitate easy removal of dust from the bottom of the tank.



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

Supporting structure and framework for tower casing and water basin shall be made of galvanised steel and finished with epoxy painting. Sprinklers shall be corrosion-proof and abrasion resistant, the sprinkler head shall be made of aluminium alloy and fitted with sealed ball bearings. Fan shall be of axial flow type and aluminium alloy material. The fan shall be designed for delivering large air volume at high efficiencies and low noise levels, the cooling tower shall be complete with all pipework.

4.7 Condensate water transfer Pumps

The pumps shall be of mono-block type with one working and one standby.

4.8 Expansion tank

The required expansion (chilled water storage) tank for supply and return of adequate capacity with insulation shall be provided.

4.9 Steam Condensate tank

The required steam condensate tank of adequate capacity with insulation shall be provided.

4.10 Air handling units

4.10.1 Filter Section

Two layers of filters shall be used. The first layer used as pre-filter shall be polyethylene fibre panel type air filters with an efficiency rating of 90% down to 20 microns dust particles size. The second layer of filter shall be of fabric panel type with an efficiency rating of 90% (min.) down to particle size of 5 microns. The face velocity shall not exceed 2.5 m/s. Wherever the AHU room has a 'Fresh air system' with pre-filters in filter frames provided on the exterior walls, pre-filters need not be provided in the AHU.

4.10.2 Chilled Water Coil Section

AHU coil section shall be of heavy construction and shall have insulated drain pan made out of GI sheet. Side and top panels shall be of 1.6 mm thick MS sheets. The coils shall be made of seamless copper tubes staggered and spaced on equilateral triangles with continuous plate type rippled aluminium fins adequately bonded to the tubes by expansion. End sheets shall be of silver brazed, tin coated steel. Coils shall be suitable for horizontal air flow. Inlet and outlet headers shall be of GI medium class tubes with flanges, vent and drain connection. Single circuit coils are preferable. The coils shall preferably be '5-6 rows deep'. Most economical coil selection shall be adopted. Air velocity through the coil shall be 2.5 m/s maximum shall be adopted.



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

Air velocity through the coil shall be 2.5 m/s maximum. Water velocity through the coil shall be between 0.6 m/s and 1.8 m/s. The coil shall be tested and rated as per relevant ASHRAE Standards. The coil selection shall be made so as to maintain an inside RH of 50%-60%.

4.10.3 Fan Section

Fan section shall be made out of 1.6 mm thick MS sheets with adequate stiffeners and support channel base and shall have drainage provision. Fan section inside shall be insulated with 50 mm thick TF quality thermocole. The fan shall be of centrifugal, double inlet double width (DIDW) design with forward curved impeller. The fans shall be provided with V-belt and pulley drive. The fan shall develop sufficient static pressure to meet the system requirements. Testing of fan shall be done as per AMCA / IS codes. The motor shall be positioned in such a way that the slack side of the belt is at the top. The fan and motor shall have common channel-base mounted on AHU channel base with suitable vibration isolator.

4.10.4 Face and Bypass damper

The dampers shall be fabricated out of GI sheet of 1.6mm for the louvers and 2mm for the casing. The casing shall be of ball bearing type and connecting links shall be of least frictional resistance. The bypass section shall have at least 33% of the damper. The damper shall be of opposed blade type. The dampers shall be electrically operated.

4.10.5 The air-conditioning system shall have a fresh air system consisting of wire guard / bird screen, inlet louvre / inlet cowl, primary filter arranged in a filter framework with supports and inlet control damper with fan.

4.11 Split Air Conditioners

The air conditioning units shall be complete with condensing units, evaporating units, filters, refrigerant piping, drain connection, electrics and other accessories. The units shall be suitable for continuous duty application.

5.0 AIR DISTRIBUTION SYSTEM

5.1 General

Ductwork for conveying air for air-conditioning systems shall be of circular or rectangular cross-section. In general, these shall be constructed as per latest edition of IS:655 with galvanised steel conforming to IS:277.



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

5.2 Duct Sizing

Duct sizing shall be done as per the norms recommended by ASHRAE. In general, the supply air velocity in AC duct shall be about 8 m/s in main headers and the same in ventilation duct shall not exceed 12 m/s. Preferably the velocity shall be 4 m/s at grilles/outlets.

5.3 Duct Supports

Supports for horizontal and vertical ducts shall be made and positioned so that no weight is transferred to equipment connected and duct works not deformed during erection and operation.

5.4 Diffusers / grilles / louveres

These shall preferably be of anodized / powder coated aluminium. The selection shall be based on manufacturer's performance data for air delivery, air throw, terminal velocity, pressure drop, noise level, etc. Volume and directional control devices shall be provided. All flanged joints shall be provided with suitable gasket / packing for leak proof performance.

5.5 Flexible Joints

Flexible joints shall be fitted at connection to the AC unit to prevent the transmission of noise and vibration without any leakage of air. The joints shall be made of canvas or PVC coated nylon or equivalent. The length of the joint shall be about 250 mm.

5.6 Dampers

Dampers with operating levers and position indicator, showing percentage opening shall be provided on all branches and main duct. Dampers shall preferably be multi blade type with good opening and closing characteristics and low pressure drop.

5.7 Fire Dampers

Fire dampers shall be provided in accordance with the relevant codes of the National Fire Protection Association (NFPA) or equivalent. Damper frame and blades shall be galvanized.

5.8 Insulation

5.8.1 Under Deck Insulation

All exposed roofs (inner surfaces of the ceiling of air-conditioned, air cooled space and the ceiling of AC plant room) shall be provided with underdeck insulation by others (Civil Contractor).



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

5.8.2 Duct Insulation

Supply air duct shall be provided with 50 mm thick resin bonded glass wool having density of 24 kg/m³ covered with 0.3 mm GI sheet.

Return air duct shall be provided with 25 mm thick resin bonded glass wool having density of 24 kg/m³ covered with 0.3 mm GI sheet.

Any portion of the supply/return duct running outside the building shall be insulated with 50 mm thick expanded polystyrene. The insulation shall be given weather proofing of 20 mm thick sand cement plaster.

5.8.3 Acoustic Insulation

Supply air duct shall be acoustically insulated with 12 mm thick rigid fibre glass board wool having density of 48 kg/m³ covered with perforated aluminium sheet and fixed to the inside of the duct with GI bolts, nuts and washers. The noise level inside the conditioned space shall be limited to 50 dB. Supply air duct up to a distance minimum of 6 meter from the outlet of AHU.

5.8.4 Pipe Insulation

Supply and return of chilled water pipe and drain pipes within battery limits shall be insulated with Polyurethane foam.

5.9 Strip heaters

Strip heaters of adequate capacity shall be provided in the common plenum of ducts with thermostat, humidistat, air stat/safety thermostat etc., in order to maintain the necessary temperature/humidity inside the air conditioned areas all through-out the year

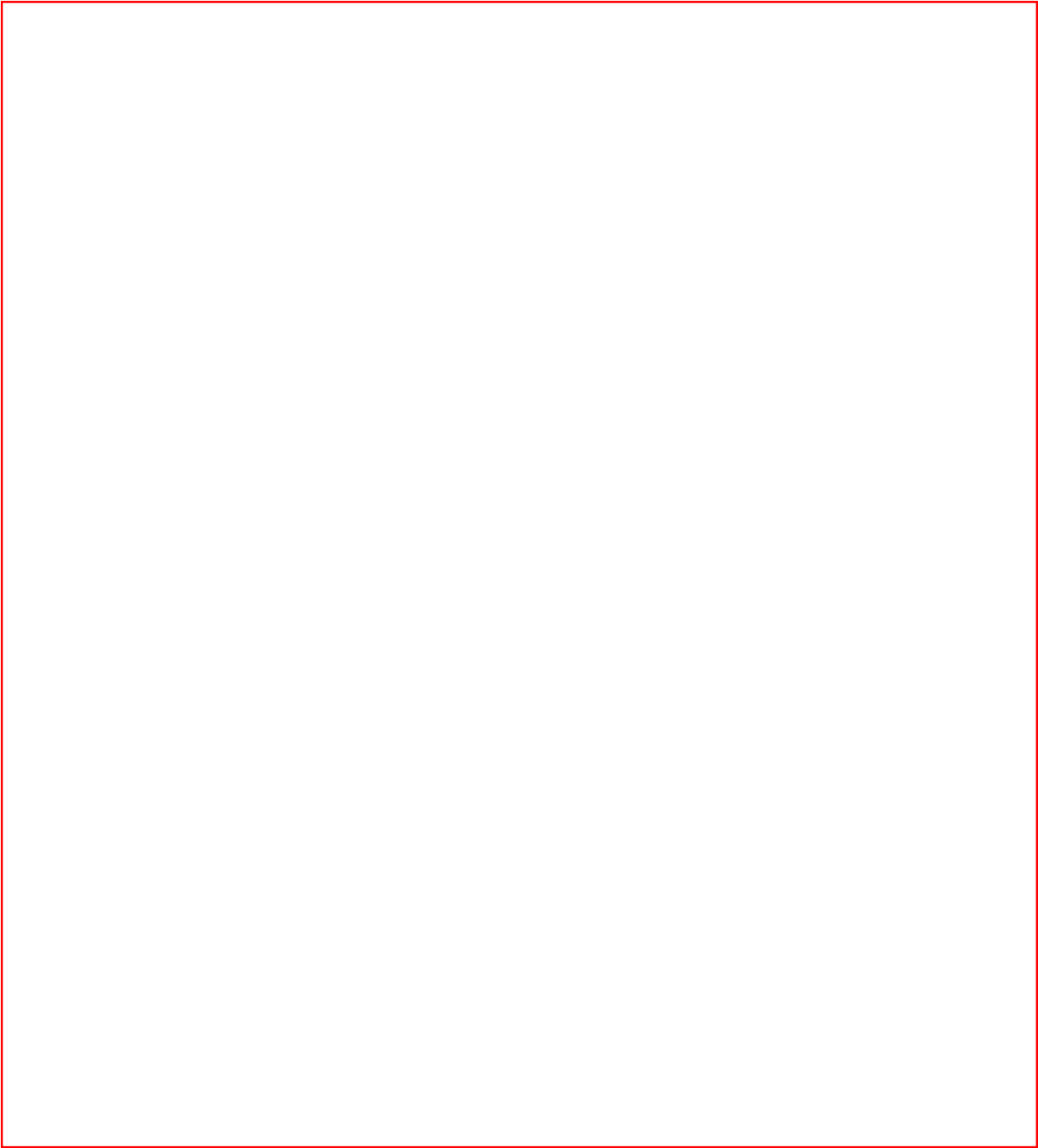
5.10 Pan humidifiers

Pan humidifiers of adequate capacity shall be provided in the AC plant rooms of air conditioned rooms with adequate capacity of humidistat controlled immersion heater, GI water tank, low level switch, overflow, drain, make-up connection with float valve etc., in order to maintain the necessary humidity inside the air conditioned areas all through-out the year.



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

~~6.0 VENTILATION SYSTEM~~





Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

~~6.5 EOT Crane~~**7.0 DRAWINGS AND DOCUMENTS**

The Tenderer shall supply with the tender a set of GA drawings of the equipment along with equipment list and technical data to clarify the nature and scope of work included in his offer.

The successful Tenderer shall supply the following drawings / documents and test certificates as per the following schedule of submission, unless otherwise agreed in the Contract.

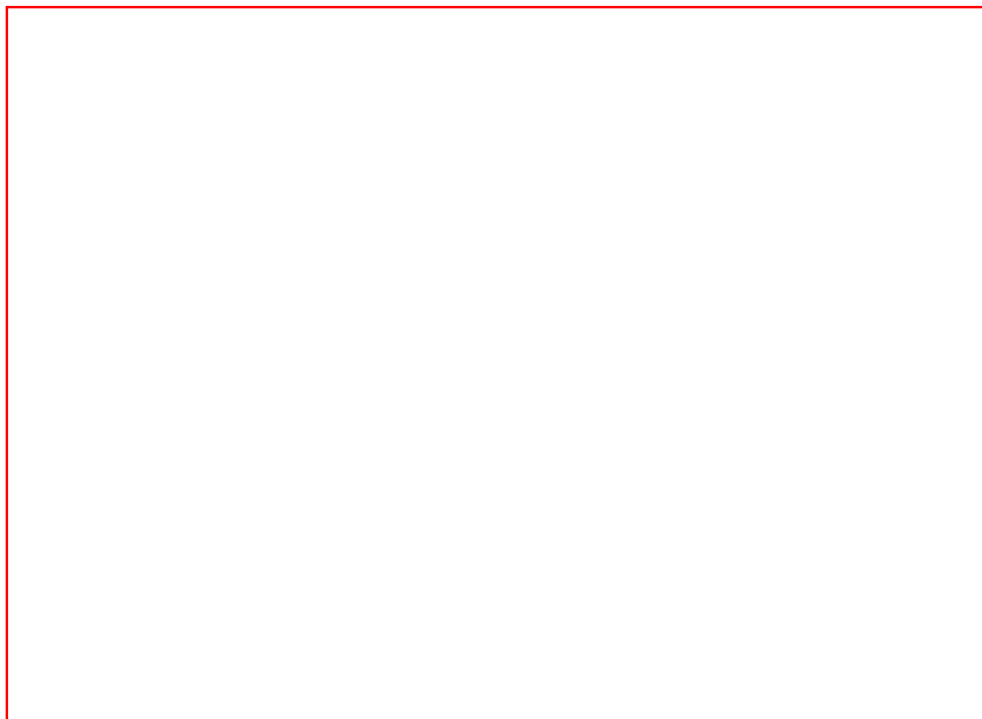
Sl. No.	Description	With tender No. of copies	<u>During Engineering</u> Category No. of copies
A. MECHANICAL			
CHILLER PLANT			
1	General arrangement of all equipment with dimensions		A
2	Chiller House layouts with cross-sectional details, clearances, side views, sectional details, piping, cabling and other details		A
3	P & I diagram		A
4	Equipment foundation drawings/ load data		I
5	Technical data sheet		A
6	Catalogues for equipment		I
AHU (FOR EACH CAPACITY)			
1	General arrangement of all equipment with dimensions		A
2	Ducting layout		A
3	P & I diagram		A



Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

Sl. No.	Description	With tender No. of copies	<u>During Engineering</u>	
			Category	No. of copies
4	Characteristic curves for fans		I	
5	Plant room layouts with cross-sectional details, clearances, side views, sectional details, piping, cabling and other details		A	
6	Equipment foundation drawings/ load data		I	
7	Technical data sheet		A	
8	Pressure drop calculations		I	
9	Catalogues for Equipment		I	
10	Installation, Operation and Maintenance Manuals		I	

~~VENTILATION~~





Section-VIII- Air conditioning, Air cooling and Ventilation system (cont'd)

Sl. No.	Description	With tender No. of copies	<u>During Engineering</u>	
			Category	No. of copies
B	INSTRUMENTATION			
1	Instrument list		I	
2	Sequence & Interlocking logic diagram		I	
3	GA of control panel, junction box & power distribution board		A	
4	Field & panel mounted instruments data sheets and catalogues.		A	
5	GA and sizing calculations of Control valve and flow elements		A	
6	Wiring diagram for power distribution board, control panel etc.,		I	
7	Instrument hook-up & installation drawings		I	
8	Cable routing and Interconnecting diagram.		I	
<ul style="list-style-type: none"> • A- Approval • I- Information 				



Refer Corroendum-3

TABLE -1

LIST OF AIRCONDITIONING SYSTEMS

Sl. No.	Area Description	Tentative Dimension Details (m)	System Description	System No.	Tentative Heat Load (kW)	Capacity of each unit	Dehumidified Air quantity of each unit (CFM)	Qty (Nos.)
A)	TG Building							
1.	DCS Operator room	16 x 8 x 4	AHU (Chilled water based)	AC-1	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
2.	Electronic Equipment room	20 x 8 x 4	AHU (Chilled water based)	AC-2	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
3.	VFD & UPS room	8 x 12 x 5	AHU (Chilled water based)	AC-3	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify

**TABLE -1 (Rev.A)****LIST OF AIRCONDITIONING SYSTEMS**

Sl. No.	Area Description	Tentative Dimension Details (m)	System Description	System No.	Tentative Heat Load (kW)	Capacity of each unit	Dehumidified Air quantity of each unit (CFM)	Qty (Nos.)
A)	TG Building							
1.	DCS Operator room	16 x 8 x 4	AHU (Chilled water based)	AC-1	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
2.	Electronic Equipment room	20 x 8 x 4	AHU (Chilled water based)	AC-2	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
3.	VFD & UPS room	8 x 12 x 5	AHU (Chilled water based)	AC-3	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
B)	CHILLER CUM ESP CONTROL ROOM BUILDING							
4.	SWAS room & UPS room	10 x 5 x 4.5	AHU (Chilled water based)	AC-4	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify



Table-1 (Rev.A) – List of airconditioning systems (cont'd)

Sl. No.	Area Description	Tentative Dimension Details (m)	System Description	System No.	Tentative Heat Load (kW)	Capacity of each unit	Dehumidified Air quantity of each unit (CFM)	Qty (Nos.)
5.	ESP/FGD Control room	7 x 10 x 5.5	AHU (Chilled water based)	AC-5	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
6.	Chiller Control room	4 x 5 x 5.5	AHU (Chilled water based)	AC-6	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
7.	Chimney Control panel & SOx , NOx Room @ 0.00 m LVL	10 x 5 x 4.5	AHU (Chilled water based)	AC-11	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
C)	LDO PUMP HOUSE							
8	MCC room	3x3x4	Split Units	AC-13	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
9	Control room	3x3x3.5	Split Units	AC-14	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
D)	ASH HANDLING SYSTEM							
10	Control room	5 x 5 x 3.5	AHU (Chilled water based)		6			Only chilled water to be provided



Table-1 (Rev.A) – List of airconditioning systems (cont'd)

Sl. No.	Area Description	Tentative Dimension Details (m)	System Description	System No.	Tentative Heat Load (kW)	Capacity of each unit	Dehumidified Air quantity of each unit (CFM)	Qty (Nos.)
E)	COAL HANDLING SYSTEM							
11	Control room	5 x 5 x 3.5	AHU (Chilled water based)		5			Only chilled water to be provided
F)	RCWPH							
12	Control room	5 x 5 x 3.5	AHU (Chilled water based)		5			Only chilled water to be provided
G)	AMMONIA STORAGE AREA							
13	Control room	6 x 5 x 4.5	Split Units	AC-15	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify



TABLE – 2 (Rev.A)
LIST OF AIRCOOLING SYSTEMS

Sl. No.	Area Description	Tentative Dimension Details (m)	System Description	System No.	Tentative Heat Load (kW)	Capacity of each unit (TR)	Dehumidified air quantity of each unit (CFM)	Qty. (Nos.)
A)	TG BUILDING							
1.	Switch Gear room @3.5 m LVL	40x12x5	AHU (Chilled water based)	AC-7	Tenderer to specify and Tentative heat load for switch gear supplied by other packages shall be of 80KW.	Tenderer to specify	Tenderer to specify	Tenderer to specify
2.	Switch Gear room @8.5 m LVL	24x12x5	AHU (Chilled water based)	AC-8	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
3.	TG hall	40x15x10	AHU (Chilled water based)	AC-9	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify



Table-2 (Rev.A)– List of airconditioning systems (cont'd)

Sl. No.	Area Description	Tentative Dimension Details (m)	System Description	System No.	Tentative Heat Load (kW)	Capacity of each unit (TR)	Dehumidified air quantity of each unit (CFM)	Qty. (Nos.)
B)	CHILLER CUM ESP CONTROL ROOM BUILDING							
4.	ESP/Chiller PCC & Transformer room @ 13.5 m LVL	11x30x7	AHU (Chilled water based)	AC-10	Tenderer to specify and Tentative heat load for switch gear supplied by other packages shall be of 50KW.	Tenderer to specify	Tenderer to specify	Tenderer to specify
5.	FGD MCC room @ 21.5 m LVL.	11x15x6.5	AHU (Chilled water based)	AC-12	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify
C)	ASH HANDLING SYSTEM							
7.	Switch Gear room	20x12x5	AHU (Chilled water based)		30			Only chilled water to be provided
D)	COAL HANDLING SYSTEM							
8.	Switch Gear room	20x8x5	AHU (Chilled water based)		35			Only chilled water to be provided



Table-2 (Rev.A)– List of airconditioning systems (cont'd)

Sl. No.	Area Description	Tentative Dimension Details (m)	System Description	System No.	Tentative Heat Load (kW)	Capacity of each unit (TR)	Dehumidified air quantity of each unit (CFM)	Qty. (Nos.)
E)	RCWPH							
9.	Switch Gear room	20x10x5	AHU (Chilled water based)		35			Only chilled water to be provided
F)	AMMONIUM STORAGE AREA							
10.	Switch Gear room @ 4.0m LVL	25x12x6.5	Air-cooled PAC (Dx-type Packaged air-conditioner)	AC-13	Tenderer to specify	Tenderer to specify	Tenderer to specify	Tenderer to specify

**ANNEXURE - 1****PACKAGED AIR CONDITIONING UNIT****4.12 Packaged Air Conditioning Unit****4.12.1 General**

The Package air-conditioning units shall be (indoor evaporating unit, air cooled type outdoor condensing unit) complete with intake filter compressor, condenser, expansion valves, evaporator refrigerant piping, centrifugal blower, pan humidifier, humidistat, strip heater the panel box shall house the meters, gauges, control devices, wiring etc. Necessary brackets or other structural members shall be provided to mount the evaporator, centrifugal fan, compressor condenser etc. Lifting hooks/holes shall be provided at appropriate points on the units for loading and unloading. All necessary provision shall be provided for evacuation of refrigerant gas from the package units.

4.12.2 Intake Filter

Intake filter shall be made of HDPE material. The HDPE mesh/fiber shall be reinforced with GS wire mesh for rigidity. The casing shall be of aluminum/ galvanized steel sheet. The filter shall be suitable for cleaning with compressed air. The size and thickness of the filter shall be such as to minimize the pressure loss and have an efficiency of 90% down to 10 microns.

4.12.3 Expansion Valve

The expansion valve shall be of reputed make, controlled thermostatically for precise metering and control of refrigerant into the evaporation coil.

4.12.4 Evaporator Coil

The evaporator coil shall be of direct expansion type and constructed with copper tubes and aluminium rippled type fins mechanically bonded for maximum heat transfer. Equalizing distributor shall be provided to ensure equal amount of refrigerant to each circuit.

4.12.5 Centrifugal Blower

The centrifugal blower shall have a casing of galvanised steel sheets. The impeller, also made of galvanised steel sheet, shall be of multi blade, forward curved, double suction type mounted on a shaft with two bearings. It shall be driven by a motor through pulleys and belts. The blower shall be capable of producing enough static pressure to



overcome losses in filters, ducts, grilles, etc. The entire rotor consisting of impeller, shaft and pulley shall be dynamically balanced to ensure vibration free running.

4.12.6 **Discharge Damper**

Discharge dampers shall be of multi blade type. Casing and blades shall be made of galvanised steel sheets suitably stiffened and strengthened by press bending. The crank, linkage and lever etc. shall be of adequate size and strength to open and close the damper against the force of airflow while the fans are in operation. Suitable locking arrangement shall be provided. There shall be an indication for opening and closing directions.

4.12.7 **Insulation**

The inner surface of the air passage after the evaporator coil shall be insulated, to prevent heat loss and sweating and also to reduce the noise level.

4.12.8 **Compressor**

The compressor shall be scroll type. The motor winding shall be cooled by the refrigerant gas. The compressor unit shall be mounted on vibration isolators to minimize vibration transmitted to the AC unit. Safety devices for high inlet and low outlet pressure and other standard accessories shall be provided. It is preferable to have 2 compressors of 50% capacity in each unit with suction cut off unloader for better part load efficiency and saving in power.

4.12.9 **Condenser (Outdoor) unit**

The condenser shall be of air cooled, finned type condenser coil shall be of copper material and fin shall be of aluminium.

4.12.10 **Refrigerant Piping**

Refrigerant piping shall be of hard drawn copper tubes. The piping shall be capable of absorbing the expansion and contraction due to the anticipated system temperature change. It shall be free from leakage. The suction line shall be insulated to avoid sweating and heat gain.



QUESTIONNAIRE FOR PACKAGED AIR CONDITIONING UNIT

8.2 Packaged AC Units

8.2.1 General

- Nominal cooling capacity, kcal /h :
- Nominal air quantity, cu m/s :
- No. of outlets :
- Size of each outlet, mm :
- Overall dimensions :
 - Width, mm :
 - Depth, mm :
 - Height, mm :
- Net weight, kg :
- Operating weight, kg :

8.2.2 Intake Filter

- Type :
- Model No. :
- Filter size :
- Face area of each filter, sq.m :
- Total No of filters :
- Total quantity of air handled, cu m/s :
- Face velocity, m/s :
- Filter medium details :
- Material :
- Thickness/dia, mm :



- Mesh size, mm :
- No. of plies :
- Efficiency down to 5 microns, % :
- Pressure drop, Pa :
- Casing details :
 - Material :
 - Thickness :

8.2.3 **Compressor**

- Type :
- Make :
- Model :
- No. of cylinders (each compressor) :
- Bore, mm :
- Stroke, mm :
- Operating speed :
- Displacement (each cylinder),/s :
- Power Consumption, kW :
- Type of lubrication :
- Lubricant details :
- Quantity of lubricant charged, kg :
- No. of compressors (in each packaged AC unit) :

8.2.4 **Condenser (outdoor) unit**

- Size of condenser :



- Face velocity, m/s :
- Fin spacing, mm :
- Fin material :
- No. of rows :
- Tube material :
- Air quantity, cu m/hr :
- Condenser cooling fan speed, rpm :
- Condenser cooling fan meter rating, rpm :
- Max. permissible distance between condenser unit and evaporator, m :

8.2.5 **Expansion Valve**

- Type :
- Make :
- Nominal capacity, kW :
- Range, °C :
- Capillary length, mm :
- Inlet size, mm :
- Outlet size, mm :
- Quantity per AC unit :

8.2.6 **Evaporator**

- Make :
- Type :
- Size of the evaporator, l x b, :
- Total face area, sq.m :



- Face velocity, m/s :
- Fin spacing, mm :
- Fin material :
- Fin thickness, mm :
- No. of rows :
- No. of tubes per row :
- Tube size, mm :
- Tube thickness, mm :
- No. of circuits :
- Quantity per AC unit :

8.2.7 **Blower**

- Make :
- Type :
- Model :
- Size (dia x length), mm :
- Air quantity, cu m/s :
- Outlet velocity, Pa :
- Speed, rpm :
- Shaft power, kW :
- Motor rating, kW/rpm :
- No. of impeller / fan :
- No. of fans per AC unit :
- Material, size / thickness of :
- Scroll :



- Side plate :
- Centre plate :
- Shroud :
- Blades :
- Shaft :
- Bearings :

8.2.8 **Outlet Damper**

- Nominal size, mm :
- Air quantity, handled, cu m/s :
- Face velocity, m/s :
- Pressure drop, Pa (when fully open) :
- Leakage factor, % :
- Material and thickness of :
- Frame :
- Blades :
- Crane / lever :
- Linkage :
- Bearing :

8.2.9 **Refrigerant Piping of Gas line**

- Material :
- Size, mm :
- Thickness, mm :
- Provision of :
- Fittings :



- Valve :
- Supports :
- Liquid line :
 - Material :
 - Size, mm :
 - Thickness, mm :
- Provision of :
 - Fittings :
 - Valves :
 - Supports :
 - Insulation :

8.2.10 **Insulation**

- Material of insulation :
 - Fan section :
 - Evaporator coil :
 - Liquid line :
- Thickness of insulation :
 - Fan section :
 - Evaporator coil :
 - Liquid line :