NTPC LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW) EPC PACKAGE

TECHNICAL SPECIFICATION
FOR
COMPRESSED AIR SYSTEM

SPECIFICATION No. **PE-TS-508-555-A001**
REV NO. 0

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

INDEX

PROJECT INFORMATION

S. No.	DESCRIPTION	DETAILS
1	**CUSTOMER**	NTPC Limted
1.1	**CUSTOMER'S CONSULTANT**	NTPC Limited
2	**LOCATION**	Lara, Raigarh, Chhattisgarh, India
3	**METEOROLOGICAL DATA**	
3.1	SUMMER OUTSIDE DBT	44 deg C
3.2	SUMMER OUTSIDE WBT	25.5 deg C
3.3	MONSOON OUTSIDE DBT	31 deg C
3.4	MONSOON OUTSIDE WBT	27.7 deg C
3.5	WINTER OUTSIDE DBT	12.2 deg C
3.6	WINTER OUTSIDE WBT	6.6 deg C
3.7	SEISMIC ZONE, AS PER IS 1893	III
3.8	BASIC WIND SPEED	44 m/s
3.9	HEIGHT ABOVE MSL	220 m
4	**ELECTRICAL DATA**	
4.1	AMBIENT TEMPERATURE FOR DESIGN OF ELECTRICAL EQUIPMENT	50 deg C
4.2	RATED FREQUENCY	50Hz
4.3	FREQUENCY VARIATION	(+)3 to (-)5%
4.4	AC VOLTAGE	415V, 3 Phase
4.5	AC VOLTAGE VARIATION	+/-10%
4.6	SYSTEM FAULT LEVEL AT RATED VOLTAGE	50KA for 1 sec
4.7	SHORT TIME RATING FOR TERMINAL BOXES	50KA for 0.25 sec
5	**ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER**	
	CHARACTARISTICS	**VALUE**
i)	SILICA (Max.)	0.02 ppm as Sio2
ii)	IRON as Fe	NIL
iii)	TOTAL HARDNESS	NIL
iv)	pH VALUE	8.5 to 9.5
v)	CONDUCTIVITY	Not more than 0.1 _s/cm
5.1	DESIGN DMCW INLET TEMP. TO VARIOUS COOLERS	38 deg C

SCOPE

SCOPE OF THIS PACKAGE COVERS THE FOLLOWING:		
S.No.	**PARAMETERS**	**REQUIREMENT**
1	Supply Including Design, Engineering & Manufacturing of	
a)	Main Supply	YES
b)	Commissioning Spares	YES
c)	Consumables	YES
2	Painting	YES
3	Inspection & Testing	YES
4	Packing	YES
5	Transportation & Delivery to Site	YES
6	Transportation,Handling & Storage in the Plant	YES
7	Erection & Commissioning	YES
8	Supervision of Erection & Commissioning	NO
9	Performance Guarantee (PG) Test	YES
10	Training of BHEL/NTPC personnel	YES
11	Mandatory Spares	YES
12	O & M Service	YES
13	O & M Spares	NO
14	Handover of CAS system	YES

	GENERAL TECHNICAL REQUIREMENT - MECHANICAL
1.0	It is not the intent to specify herein all the details of design and manufacturing. Bidder shall ensure that the offered equipment confirms in all respects to high standards of design, engineering and workmanship.
2.0	The equipment shall comply with all applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed.
3.0	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
4.0	The equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
5.0	Drawing/document submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and training for the same. Bidder to ensure proper internet connectivity at their end.
6.0	Transit Insurance & Insurance till receipt of MRC/ MDCC is in the scope of CAS supplier.
7.0	Bidder shall carry out the inspection & testing as per the Quality Plan.
8.0	Bidder shall submit stamped QP on compliance route in the event of order. In case, the bidder is supplying the item from outside India, the third party inspection shall be arranged and considered by the bidder in their offer.
9.0	Sub vendor list is attached. Any additional sub - vendors proposed by biddder during contract stage shall be subject to BHEL & NTPC approval in the event of order.
10.0	Document approval by BHEL & NTPC shall not absolve the supplier of their contractual obligations of completing the work as per specification requirement without any commercial and delivery impact.
11.0	All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.
12.0	To clock equal number of running hours, sequential panel for the same is in CAS supplier scope.
13.0	Instruments to be used for PG test shall be additionally supplied over and above the instruments shown in tender P&IDs. PG test Instruments being supplied, installed and commissioned for each unit,shall be retained by employer after completion of PG test.
14.0	Mandatory Spares : Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the mandatory spare list (Refer Price format attached elsewhere in the spec).
15.0	CAS supplier shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software).
16.0	No material brought to the Site shall be removed from the Site by the CAS supplier and/or his Sub-supplier without the prior written approval of the BHEL & NTPC.
17.0	The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract.
18.0	The CAS Supplier shall have total responsibility for protecting his works till it is finally taken over by BHEL. No claim will be entertained by BHEL for any damage or loss to the CAS supplier works and the CAS supplier shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings.
19.0	In addition to all local laws and regulations pertaining to the employment of labour to be complied with by the CAS supplier, also will be expected to employ on the work only his regular skilled employees with experience of the particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.
20.0	All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the CAS supplier's employees shall be the sole responsibility of the CAS supplier.
21.0	The CAS supplier shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, installation, testing, commissioning and conducting Guarantee tests of the equipments covered under the Contract.
22.0	The CAS supplier shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site.
23.0	The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day.

24.0	E-Learning Package: e-learning packages for each equipment & for complete compressed air system is in CAS supplier scope (Refer Annexure- A).
25.0	All the Plant and equipments / Systems supplied under the contract shall be designed following “Fail Safe” concept. In case of failure of Power supply like Electric power, Hydraulic pressure, Pneumatic pressure, Vacuum etc. the system should be designed in such a way that the equipment/Valves/dampers etc. shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery.
26.0	After Rev-0 comments, the drawing will be locked in the system. CAS supplier will review the Rev-0 comments within 7 days & furnish the Comment Reply Sheet (CRS) to NTPC as an agenda point for TCM.
27.0	It is responsibility of the CAS supplier to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.
28.0	All the first fill and one year’s topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the CAS supplier. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.
29.0	All equipment name plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.
30.0	All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be.
31.0	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor’s "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
32.0	CAS supplier shall submit Field Welding Schedule for field welding activities. The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
33.0	Certification from OEM’s authorized signatory that software offered, declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.
34.0	The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. 3 sets hard prints & 2 nos. CD of O&M Manual shall be provided by CAS supplier. Bidder has to ensure the connectivity of compressed air system with DDCMIS.
35.0	All the materials stored in the open or dusty location must be covered with suitable weatherproof and flame-proof covering material wherever applicable.
36.0	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.
37.0	As the transit of compressor to project site and also the storage of Compressors at project site is in CAS supplier scope. CAS suppplier shall ensure the protection of Compressors during transit and storage at site. A.) In order to prevent corrosion during shipping following needs to be ensured and for this a note to be included in QAP’s of Compressors 1. Compressor to be tested with Oil (as per OEM recommendation), a film of which remains behind on shafts, gears and bearings. 2. Silica gel or equivalent adsorbent bags, to be placed inside compressor to absorb any traces of moisture.The compartments are closed off airtight as per OEM recommendation. 3. The vent holes are closed off with moisture repellent adhesive tape. 4. Instruments & Microprocessor panel is protected as per OEM recommendation. B.) Steps pre Installation 1.) Periodically, renewing the silica gel bags/ equivalent material at least once in six months or as recommended by OEM, whichever is less. 2.) Periodically, renewing the preservative oil-film by rotating the main drive coupling by hand during a few minutes in correct rotation direction, this will ensure re-distribute the oil film on bearings balls, rollers and drive gears. Same to be repeated at least once in a month or as recommended by OEM, whichever is less. C.) Steps post Installation C.1) Installation & commissioning of Sequential panel is a must in order to avoid long idleness of compressors. C.2) Atomatic provision shall be provided to replace wet air inside compressor with the dry air as per OEM recommendation.
38.0	Incase, any major fault/ failure occurs in Compressor & Dryer, CAS supplier shall visit project site within 7 working days and also needs to submit RCA report within 15 days from the date of visit to project site.

39.0	The scope of service under training of Employer's engineers shall include a training module covering the areas of Operation & Maintenance. Training module shall enable these personnel to individually take the responsibility of operating and maintaining the system in a manner acceptable to the Employer. Training on Erection methodologies for all the Sub-packages, System and Equipment's associated with the EPC Package, including a visit to power plant construction site. The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval. The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package. This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc. In all the above cases, the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same. For training purposes, 15 working days (excluding all intervening holidays) per person shall be provided. Location of classroom training for engineering shall be at Design/Engineering office. Classroom training for erection/O&M shall be at location of Manufacturers' works.
40.0	The bidder scope covers the Annual maintenance contract (AMC) for Preventive / Breakdown maintenance for a period of One (1) year from the date of successful commissioning of Compressed air system (Refer Annexure-B) .
41.0	**EXCLUSIONS** Compressor House – Civil Building Pipe trench EOT Crane - 8T cap. Power Cable, lugs & glands at BHEL end equipment. Ventilation Fire Protection
	GENERAL TECHNICAL REQUIREMENT -C&I
1.0	Complete C&I system for Compressed Air System is in bidder scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder.
2.0	Integrated microprocessor based control system along with suitable operator interface shall be provided for each Instrument Air Compressor, Service Air Compressor & their Dryers. All profibus based instruments like PT, DPT, TT, and other instruments inside & outside the compressor skid shall also be hooked-up to this system. Further, critical signals shall be monitored through soft link between combox (used for integrating the soft communication among various compressors) and DCS (DCS in BHEL scope). MODBUS Protocol shall be used to establish connectivity with DCS. In addition to the soft link, provision for hardwired START, STOP and LOAD & UNLOAD commands from DCS to all the compressors & their status feedbacks to DCS shall also be provided. Bidder to furnish the configuration diagram of control system of compressor showing communication with DCS along with the bid. Bidder to furnish signal exchange list between DCS and compressed air system's control system in BHEL format.
3.0	Compressors operation and bearing temperature / vibration monitoring in main DCS shall be through redundant bus serial link interface between Compressor control system and DCS. In case, if redudant connectivity is not feasible as per OEM design, same shallbe discussed & finalised during detailied engineering.
4.0	Bidder to provide Profibus PA protocol compatible PT (Pressure Transmitters), DPT (Differential Pressure Transmitters), TT (Temperature Transmitters) and Flow/Level Transmitters (DP type) for entire Compressed air system (CAS). Instruments with compressors & dryer skid shall be as per OEM standard.
5.0	VOID
6.0	Profibus based electronic positioner (as per standard and proven practice of valve OEM) is to be provided with all the pneumatically operated control valves(if applicable).
7.0	The Profibus protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.
8.0	The scope of C&I cable shall be referred in Electrical scope split sheet in Electrical portion of the specification. Cable from Combox to DCS for softlink shall be in BHEL scope.
9.0	Bidder to include all the instruments required for the package along with fittings, accessories and valve manifold. All fittings shall use metric threads. Use of process actuated switches shall be avoided unless unavoidable.
10.0	Vibration monitoring system envisaged for motors of compressors shall be in bidder's scope as per OEM design. Also, for mounting of vibration sensors/probe, bidder to provide vibration pad for mounting of sensors and a notch/slot for mounting of key phasor.
11.0	Profibus DP based IMC in LV SWGR/MCC (BHEL's scope) shall be provided.
12.0	Redundancy of instruments within skid shall be provided by bidder as per OEM standard. For all control instruments outside skid, dual redundancy of the sensors shall be provided by the bidder.

13.0	Bidder to provide Junction Boxes in field for termination of all the instruments.
14.0	Bidder to note that Instrumentation Cable shall be as per Electrical Cable scope matrix attached elsewhere in the Specification.
15.0	Bidder to provide at least 20% spare terminals in Junction boxes, LIE/LIRs etc.
16.0	All the transmitters supplied by Bidder shall be LIE/LIR mounted. The LIE/LIRs shall be in Bidder's scope of supply.
17.0	All the instruments having contact with corrosive media shall be provided with chemical/diaphragm seal.
18.0	For level transmitters, electronics items etc. all weather canopy\ rack enclosures shall be provided by Bidder for protection from direct sunlight and rain for open locations. For applications where transmitter location is not accessible, the transmitter shall have separate sensor unit and electronic unit for such applications. It should be mounted at accessible location.
19.0	All field instruments/analyzers/actuators/sov/control valves etc. shall be hooked with DDCMIS based control system as per requirement mentioned elsewhere in the specification.
20.0	The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.
21.0	All measuring instruments/equipment/analysers and subsystems offered by the Bidder shall be from reputed experienced manufacturers ((from BHEL/customer approved vendor list) of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards.
22.0	VOID
23.0	230 V AC UPS/ 415 V AC power supply shall be provided by BHEL at single point. Further, distribution to various instruments/equipment of the system shall be in bidder's scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder's scope. Further, bidder to furnish UPS load data during detailed engineering in BHEL format.
24.0	VOID
25.0	All instruments are cat-III items except Profibus type transmitters. Quality plan of profibus type transmitter shall be submitted by bidder.
26.0	The instruments, equipment offered by the bidder shall be as the approved sub-vendor list mentioned elsewhere in the specification.
27.0	Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation regarding FAT shall be given 2 days in advance. All the expenses like boarding, lodging and travel, air fare etc. shall be in bidder's scope.
28.0	Bidder's presence is required for 15 Man days (in two visits) at site during commissioning of DDCMIS for assistance related to process correctness. Three visits shall be made with total 10 Man days (excluding travel time) in which one visit shall be of 5 man days each. All the expenses like boarding, lodging and travel, air fare etc. shall be in bidder's scope.
29.0	Bidder shall furnish Instrument Schedule, Control Scheme, I/O list, Drive list, Cable Schedule, Cable interconnection, Instrument/SOV/Analyzers Installation diagram, Instrument/Analyzer datasheets, JB grouping, SOV grouping, Annunciation list, List of Instruments/devices for Profibus/HART, configuration diagram for Profibus based actuators/instruments in BHEL approved format. Also, editable database format like MS Excel, MS Access etc. of these documents shall also be provided by Bidder.
30.0	Bidder shall provide complete Instrumentation for control, monitoring and operation of entire CAS package. The requirements given are to be read in conjunction with detailed Technical specification. Further in case of any discrepancy in the requirement, the more stringent requirement as per interpretation of BHEL/customer shall prevail without any commercial implication.
31.0	RTD/BTD signals from motor shall be terminated in compressor panel.
32.0	24 V DC supply for actuation of coil in switchgear shall be drawn from compressor panel.
33.0	Junction Box for profibus shall be pre-issued by bidder. Erection and termination of cables in junction box shall be done by bidder.
34.0	**TYPE TEST GENERAL REQUIREMENT**
	For profibus type transmitter, submission of valid type test report shall be acceptable provided:
i)	The same has been carried out by the Bidder/ sub-vendor on exactly the same model / rating of equipment.
ii)	There has been be no change in the components from the offered equipment & tested equipment.
iii)	The test shall be carried out as per the latest standards alongwith amendments as on the date of Bid opening.
	In case, the report is not available, type test is to be conducted and results shall be submitted for approval.

ANNEXURE- A (E-LEARNING PACKAGE REQUIREMENT)

e-learning package shall be provided for the system. e-learning package shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI), NTPC located at Noida. The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.

1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified and to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system.
2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied.

a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc.

b. The commissioning course(s) should include instructions on pre-commissioning, commissioning initial operation etc.

c. The operation course(s) should include instructions on the permissive, interlocks, physical check-ups, start-up, shutdown and protections etc.

d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling.

Depth of coverage of above courses shall be as specified for “Instruction Manuals” in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system.

3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site.

The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit.

4. e-Learning course broad requirements:

a. The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.

b. The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.

c. Course content text shall be in English language and be associated with a voiceover in English language with Indian accent.

d. Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.

e. Each course shall have every physical and functional detail of the equipment / system supplied.

f. Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.

g. There shall be option for self-assessment test after every course. In case the user doesn’t opt for self-assessment.

test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.

h. If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.

i. Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.

j. The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course.

k. The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.

l. The system shall provide the user with the ability to select the information with a Cursor.
m.The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop-up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function.
n. Every course shall contain the 3D design/drawing/exploded view/360 deg. Turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable) , animation and audio.
o. The users shall be able to control audio sound level associated with the courses.
p. Drawings / text in the courses shall be scalable (Zoom In/ Out).
q. The user shall have the capability to record a bookmark to mark displayed information for later recall, whenever he accesses the same course next time.
Notes:
1. e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.
2. e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.

ANNEXURE-B

ANNUAL MAINTENANCE CONTRACT SERVICES

The bidder scope covers the Annual maintenance contract (AMC) for Preventive / Breakdown maintenance for a period of One (1) year from the date of successful commissioning of Compressed air system.

AMC scope also covers all regular maintenance by certified and trained service engineers. Total Six visits (06) (Including 2 Breakdown visit) shall be provided in a year and each visit shall consist of 1 to 2 days, depending upon the nature of work.

1.0 Scope of Work:
The scope of work includes:

1. To carry out Preventive Maintenance checks as per mentioned schedule provided by bidder ensuring min. one routine visit per quarter, to attend Air compressors, its motor, Air dryer and all its accessories.

2. In case of breakdown, bidder shall depute qualified Service manpower and rectify the same with in strict time frame, not exceeding 48 hours.

3. Spares, consumables, maintenance kits etc. required for preventive AMC / breakdown shall be provided to successful bidder's service provider by BHEL on the written request basis. Any specific item not available in BHEL inventory, shall be provided by bidder on mutual settlement of related commercial issues.

2.0 Detail description of major equipment: -

S. NO.	EQUIPMENT	MAKE & MODEL	Qty.
1	AIR COMPRESSOR WITH MOTOR (55 Nm3/min. @ 8.0 kg/cm2(g))	As per Bidder	7 nos. (5W+ 2S)
2	AIR DRYER (55 Nm3/min. @ 8.0 kg/cm2(g))	As per Bidder	4 nos. (3W+ 1S)

3.0 General Checklist for Air compressor: -

The checklists are intended for general description of work to be carried out. They are not intended to cover all minute details. The work shall be executed in accordance with Manufacturer's O&M Manuals and modern techniques. Preventive Maintenance checks includes but not limited to as specified below:

MAINTENANCE OF SCREW COMPRESSOR

- Carry out external cleaning of equipment.
- Check the oil level in the tank if low top-up with oil.
- Change the lube oil & lube oil filter element.
- Check the tightness of foundation bolt & take corrective action, if applicable.
- Check the coupling gear installed between compressor and motor.
- Check & clean the air breather in oil tank.
- Setting and checking of safety valves
- Pressure switch setting, Trips condition checking.

- Blow down valve functioning and repairing if necessary
- Clean the inlet air filter / oil filter element.
- Checking / cleaning of all heat exchangers.
- Checks the leakage in oil line, water line and airline if found then rectify the same.
- Cleaning of cooling water inlet line strainer, back flushing of air and oil cooler, air purging oil scavenging & connecting tube, Cleaning & servicing of moisture separator installed at compressor outlet, cleaning of all moisture & dust separating filter elements as prescribed by manufacturer.
- Check for Electrical connections intact.
- Check for compressor control panel as per manufacturer recommendation.
- Any other maintenance as recommended by manufacturer.

MAINTENANCE OF AIR DRYER

- Carry out external cleaning of equipment.
- Clean the suction filter/ moisture strainer.
- Check the tightness of foundation bolts & take corrective action if required.
- Assisting for inspection / repair / servicing during expert visit as per instructions.
- Check change over valve.
- Check for any leakages in pipeline.
- Check for Electrical connections intact.
- Equipment external and internal cleaning.
- Any other maintenance as recommended by manufacturer.

4.0 Tools and tackles

Tools and tackles required for handling the component will be provided to the Bidder (successful bidder) on the written request basis. Bidder shall not claim any delay or compensation due to unavailability of these items, if any. In such cases bidder need to arrange the required tools and tackles at his own cost.

5.0 Bidder is to arrange all the safety gears like helmets, air plugs, safety shoes etc. during the maintenance.

6.0 In case of breakdown, Bidder is to depute service manpower within 48 hrs. without fail.

7.0 For Breakdown Maintenance, Bidder is to service and operate the compressor with satisfactory operating parameters within a week (6 working days) of reporting.

8.0 Bidder is to submit the Servicing Report (SR) of completed Breakdown Maintenance.

9.0 If any damage to the equipment and its accessories due to improper maintenance by bidder shall be recovered from the bidder.

SPECIFIC TECHNICAL REQUIREMENT

	SPECIFIC TECHNICAL REQUIREMENT -MECHANICAL
1.0	The compressed air system shall consist of Instrument Air compressors, Air Drying (ADPs) Plants, Service Air compressors, air receivers, instrumentation and control, control panels, interconnecting compressed air piping in the compressor house.
2.0	Four (04) numbers (3 working+ 1 standby) oil free, rotary screw/centrifugal type air compressors for instrument air duty for the complete plant each of 55Nm3/min. capacity & 8.0 kg/cm2(g) discharge pressure with intercooler, aftercooler, lubrication system, automatic drain traps (zero purge loss type) and other accessories. Motor shall be free issue by BHEL at compressor supplier works.
3.0	Four (04) numbers (3 working+ 1 standby) Air Drying Plants (one for each instrument air compressor) of 55 Nm3/min. capacity with all interconnecting piping, valves, fittings, etc. The Air drying plant, at its rated capacity, shall be designed to deliver continuously air at dew point of minus (-) 40 deg C at atmospheric pressure and the Quality of dry outlet air to conform to Instrument Society of American Standard S7.3 "Quality Standard for Instrument Air". Discharge pressure available at the outlet of Air drying Plant shall be minimum 7.5 Kg/cm2 (g).
4.0	Three (03) numbers (all working) oil free, rotary screw/centrifugal type air compressors for service air duty for the complete plant each of 55Nm3/min. capacity & 8.0 kg/cm2(g) discharge pressure with intercooler, aftercooler, lubrication system, automatic drain traps (zero purge loss type) and other accessories.. Motor shall be free issue by BHEL at compressor supplier works. In addition, the service air (SA) compressor may be used for instrument air system connecting ADP with service air compressor in case of failure of instrument air compressor.
5.0	Air Receviers - The design pressure and temperature shall be minimum 10 Kg/cm2 (g) and 50 deg.C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent. Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be atleast 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure. Each receiver shall be provided with pressure indicator, temperature indicator and drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valves. The drain trap shall be timer based. Manual draining facility shall also be provided in the drain trap. The material of construction of shell, dished ends, flanges, etc of the air receivers shall be of carbon steel as per IS:2062 or equivalent.
5.1	One number of air receiver of minimum capacity 10 m3 at the discharge of each air compressor (Total: 07 numbers).
5.2	One number unit air receiver of minimum capacity 10 m3 for each unit to be located in TG building. (Total: 02 numbers).
5.3	One number unit air receiver of minimum capacity 10 m3 for each unit to be located near ESP Buffer Hopper Area for Ash Handling System. (Total: 02 numbers).
5.4	One number of air receiver of minimum capacity 10 m3 for Fly ash storage Silo area and Ash classification system to be located near Silo Utility building.
5.5	One number of air receiver of minimum capacity 2 m3 for DM plant to be located in Water Treatment Area.
6.0	All the equipments shall be designed for continuous duty and as well as for intermittent operation. Frequent start/stop of the system shall not result deterioration in performance nor damage to the equipment.
7.0	The compressors and Air Drying plants shall operate under the following ambient conditions. i. Minimum temperature : 10 deg.C ii. Maximum temperature : 50 deg. C iii. Design condition (temperature & : 45 deg.C& 75% RH Relative humidity) iv. Height above MSL (m) : 220M
8.0	The compressor capacity & discharge pressure of instrument air system and service air system shall be identical.
9.0	The heat exchangers are DMCW cooled and the maximum cooling water temperature at compressor coolers inlet shall be 38 deg. C. The temperature rise of cooling water in the heat exchangers of the Compressed air system shall be limited to 5-10 deg C.
10.0	Noise level shall not exceed 85 dBA to a reference level of 0.0002 microbar when measured at a distance of 1.5 meter above the floor and 1m horizontal distance. Required acoustic enclosures may be provided to meet the above condition. The discharge blow-off silencer and intake silencers shall be designed to meet the above noise limitation level. For eventual noise, from the discharge line, accessories and/or ancillary equipment which are not included, a correction factor of (+)8 dBA maximum shall be allowed for background & ambient noise.
11.0	Vibration level of screw compressor shall be as per VDI-3836. However velocity vibration shall be limited to 10mm/sec (rms). Vibration level of centrifugal compressor shall be as per manufacturer standard & proven practice.
12.0	Air Compressors (Screw /Centrifugal type) shall be designed for continuous operation with high efficiency to satisfy the performance requirement. As more than one compressor with drive is specified, satisfactory operation in parallel shall be ensured without any uneven load sharing, undue vibration, keeping noise level within permissible limits for a number of compressors working simultaneously in the same room.Parallel operation of compressors shall be possible without any undue vibration and noise.
13.0	The flow in compressed air piping shall be designed for the design capacity of each compressor and the flow in header and ring mains to be designed for the total capacity of working compressors.
14.0	All hot vessels/pipelines/ valves shall be insulated to restrict the outside temperature within 60 deg.C or less with mineral wool (or equivalent), GI wire netting and aluminum cladding/cover.

15.0	The canopy shall be designed to cater the load of air filter with 100% chocked condition.
16.0	**SCREW AIR COMPRESSORS**
16.1	CODES AND STANDARDS - The design, manufacture, testing and performance of the various components of the rotary screw type air compressors shall comply with the requirements of relevant codes (IS-5456, IS-10431 [part -1], ASME PTC-9, IS-6206, IS-5727, ISO-1217 and CAGI).
16.2	**DESIGN AND CONSTRUCTION**
a.)	The compressor shall be oil free multistage, horizontal, water cooled, rotary screw type, heavy duty, rugged construction. Their speed shall be so selected as to result in low maintenance and trouble-free operation under specified conditions.
b.)	Each compressor unit shall be complete with electric motor drive of suitable capacity. Driver rating shall be minimum 110% of compressor rated BKW at rated conditions.
c.)	The rotor and shaft shall be made of forged steel. The stator (casing) shall be of Cast-Iron (IS-210) construction with integral jacket cooling. The rotors shall be dynamically balanced to reduce vibration.
d.)	The seal rings and retainers shall be of stainless steel construction and be free for radial self adjustment along the rotor shafts.
e.)	Bearings shall be high precision antifriction type IS- 25 Grade 84). The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement.
f.)	Lubrication system shall be as per manufacturer standard practices.
g.)	Any superior material & type (as per proven practice and relevant standard) of various components of screw compressor is also acceptable.
h.)	Gears shall have a rating of AGMA-12 or equivalent. Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving the pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position.
17.0	**CENTRIFUGAL AIR COMPRESSORS**
17.1	CODES AND STANDARDS - The design, manufacture, testing and performance of air compressors and accessories shall comply with the requirements of one or more of the relevant codes as applicable (IS-2825, IS-4503, CAGI, IS-5727, IS-6206, ASME-PTC-10, API 672 and IS-11727).
17.2	**DESIGN AND CONSTRUCTION**
a.)	Each compressor unit shall be complete with electric motor drive of suitable capacity. Driver rating shall be minimum 110% of compressor rated BKW at rated conditions or BKW at unthrottled minimum ambient temperature whichever is higher
b.)	Air Compressors shall be oil free centrifugal air compressors with non-contact air/oil seals, each capable of delivering continuously rated volume flows at rated delivery pressure. Compressor components shall be interchangeable as far as possible.
c.)	The rotor shaft shall be made of Stainless Steel. The rotors shall be dynamically balanced to reduce vibration.The gaskets shall be of asbestos free material. Any superior material & type (as per proven practice and relevant standard) of various components of screw compressor is also acceptable.
d.)	Each compressor shall be provided with Inlet Guide Vane (IGV) control for suction air volume control.
e.)	Each compressor shall be provided with coupling guard with fixing arrangement.
f.)	Proper and robust supporting arrangement shall be provided from foundation/ floor for overhang casing, oil coolers, air piping, cooling water piping, oil piping, etc.
g.)	Compressors shall be provided with adequate safety, protection control system including anti surge protection with bypass valve etc. and auto dual control (either; controlled for constant pressure or constant volume flow). The duty points shall be at least 15% away from the anti surge line.
h.)	Compressor shall have 25% minimum turndown capability (at 45 deg C & 75% RH). Compressor shall be provided with IGV at the suction flange.
18.0	**INTERCOOLER, AFTERCOOLER & OIL COOLERS (FOR SCREW/CENTRIFUGAL)**
a.)	Intercoolers & after coolers shall be designed in accordance with Section VIII, Division 1 of ASME Code or equivalent.
b.)	Outlet temperature of air from intercooler shall be suitable to suit the equipment and outlet temperature of air from the compressor house outlet header shall be limited to 45 deg.C. Design pressure of coolers shall be 10 Kg/cm2 (g)
c.)	Coolers shall be provided with removable tube bundle design in accordance with design code TEMA Class C and shall be constructed with removable shell cover. However, plate type oil coolers as per OEM standard & proven design are also acceptable.
d.)	The coolers shall be designed for maximum heat load and atleast 10 percent design margin shall be provided in the number of tubes.

e.)	Adequately sized safety valves shall be provided for both intercoolers and after coolers. However, in case of centrifugal compressors, safety provisions as per manufacturer's standard & proven design are also acceptable.
f.)	Each intercooler and aftercooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge glass with isolating cock.
g.)	Electrically operated automatic drain trap stations with bypass and isolating valves shall be provided for moisture separators for automatically draining of condensed moisture. The drain trap shall be timer based. Manual draining facility shall also be provided in the drain trap.
h.)	Cooler shells, channels and covers shall be of carbon steel (SA 285 Gr C / SA 516 Gr 70). Tube sheet shall be of Brass or SS and the tubes shall be of Admiralty brass or Aluminium brass or Copper or SS 304. However, any superior material as per proven practice and relevant standard is also acceptable.
19.0	INTAKE AIR FILTER AND SILENCER - Filters with multiple elements quick removal type for easy cleaning shall be provided at suction of each air compressor and also be of heavy-duty dry type. The filters shall be complete with integral silencers. Separate silencers, if specified, shall be provided. The filtering elements shall be easily removable for cleaning. The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.
20.0	**AIR DRYING PLANT**
a.)	Hot unsaturated compressed air shall be used for regeneration of exhausted desiccant in Heat of compression type ADP. Regeneration of desiccant shall be achieved by Heat of compression method without any air purge loss
b.)	Each ADP shall be provided with two adsorber towers each sized for design drying cycle of minimum 8 hours. After this period, the adsorber tower which was under drying mode shall be put under regeneration/reactivation mode while the other tower will take over the drying duty. The change of drying mode to reactivation mode or vice-versa shall be automatic with provision for manual operation also. The change over from one mode to another shall be through automatic solenoid operated valves.
c.)	HOC type drier, the reactivation shall be achieved by the heat of the compressed air itself. The hot unsaturated compressed air from the outlet of last stage of compressor shall be passed through the adsorber tower. The moist air shall be cooled in dehumidifier and passed through the second adsorber for final drying. The design reactivation cycle/period of the tower shall be less than 8 hours including cooling period for desiccant for both the types of ADP.
d.)	Each ADP shall be provided with two (2) numbers of 100 percent capacity pre-filters and two (2) numbers of 100 percent capacity after-filters at the upstream & downstream of towers. The filtering media shall be of ceramic candle type elements designed to withstand atleast 50% of static pressure as differential pressure. However, as per manufacturer's standard & proven design, any superior material to the material specified is also acceptable. The prefilters shall be provided with automatic electrically operated drain trap arrangement with isolation and bypass valves.
e.)	The electric heaters (if required) (2x100% capacity for each ADP) shall be provided with thermostatic control for heater and relief valve for safety and shall be flanged type to facilitate easy replacement of element. Each electric motor driven blower (2x100% capacity for each ADP) shall be provided with individual dry type filters at inlet.
f.)	The adsorber tower shall be designed with sufficient cross-sectional area resulting low air velocity and pressure drop. Minimum 20% of desiccant depth shall be provided as free board in adsorber vessels. Adsorber vessels to be provided with suitable number of inspection/sight windows of "Persplex" for observation of adsorbent condition. Desiccant filling and removal connections shall be provided for the adsorber vessels.
g.)	The coolers/heat exchangers/ dehumidifiers of ADP shall be designed & constructed as per the requirements specified for "Intercoolers, After coolers & Oil coolers" above.
h.)	All pressure vessels such as pre-filters, after-filters, adsorber vessels, heaters, heat exchangers/de-humidifiers / coolers etc associated with ADP shall be designed in accordance with Section VIII, Division 1, of ASME Code or equivalent. The pressure vessels shall be provided with air tight gasketted manholes/handholes and relief valves.
i)	Quantity of desiccant to be calculated shall take into account residual moisture content at the end of regeneration cycle.
j)	Desiccant shall be activated alumina only and adsorption capacity and density of the same shall not be more than 8% and 900 kg/m3 respectively.
k)	In case of Heat of compression type, adsorbers shall be sized so that even when the compressor is operating at part load, complete regeneration shall be achieved within the cycle time and quality of air (dew point) shall be maintained throughout the design cycle period. Complete ADP equipments shall preferably be mounted on a skid. Required sample connections in piping be provided for sampling of air at desired locations.
l)	Non-lubricated two way / three way / four way valves ball valves with pneumatic actuators be provided. The material of Construction for various components of ADP shall be as per manufacturer's proven standard.
m)	HOC dryers of single rotating drum type design using packed desiccant with in-built regeneration and adsorption compartments are also acceptable in place of specified twintower type dryers, if the design ensures specified performance guarantee. In case, the CAS supplier offers such a type, the same shall be of proven design. The control & instrumentation requirements specified is applicable for such design also.
21.0	**CONTROL PHILOSPHY**

21.1	The minimum requirements are specified herein and the same shall be elaborated by CAS supplier. The CAS supplier shall include controls & instrumentation to facilitate safe, reliable and efficient operation for the system. The controls, protection, interlock and instrumentation system offered by the contractor shall be subjected to approval of the BHEL & NTPC during post award engineering stage.
21.2	Any of the compressor and Air drying Plant may be selectable for "shutdown", "working" or "standby" duty.
21.3	On tripping of working equipment, the standby equipment shall come into operation automatically in case of very low air pressure in the system. All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio-visual indication/annunciation in the control panel.
21.4	An electrically operated automatic valve shall be provided on cooling water return line of each compressor & dryer which will automatically shut off the cooling water supply, in case any of the compressor/dryer is not running for more than set time duration. Suitable interlock shall also be provided for opening the valve before starting of any of the compressor.
21.5	The following indications shall be made available in the control panels for repeating the same in main plant Control System / Panels. (a) Status of each compressor (b) Instrument air pressure low/high (c) Service air pressure low/high (d) Dew point of instrument air (e) Status of each ADP
21.6	Lube oil pressure and temperature in the oil circuit of compressor shall be automatically controlled.
21.7	Automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor.
21.8	**Screw /Centrifugal compressor**
a.)	Each compressor shall be in the control panel to operate either in Base duty (Auto Load- Unload) or Standby duty (Auto On-Off) mode in case of Screw and unload/modulate/energy optimization (Auto Dual Mode) in case of centrifugal. In "Base duty" mode, whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unloaded condition. When system pressure drops due to more demand, the load-unload circuit shall operate again to bring the compressor to 100% load after closing the blow -off valve. In "Stand-by" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a pre-set lower limit, compressor should start in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to pre-set high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by a timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a pre-set time.
b.)	The control system shall provide warning to the operator that a hot-start condition exists for the motor driver and adequate cool-down period has not occurred after the motor was shut down.
c.)	The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/system each compressor: (a) "Air temperature high" at inlet to last stage - Alarm & trip (b) "Low lube oil pressure" - Alarm & trip (c) "High Lube oil supply temperature" - Alarm & trip (d) "High oil filter differential pressure" - Alarm (e) "Low lube oil level in lube oil sump" - Alarm (f) "High inlet air filter differential pressure" - Alarm & trip (g) "Low cooling water flow to air compressor" - Alarm
21.9	**Air Drying Plant**
a.)	Sequential operation of the adsorber towers & air compressors shall be controlled automatically with a provision for manual take over.
b.)	Change over of tower from drying mode to regeneration mode shall happen automatically if the dew point is high at the outlet of ADP sensed by the dew point (using aluminium oxide probe) meter/sensor. Automatic operation during regeneration, starting and stopping of blowers, starting and stopping of heaters, etc shall be timer controlled. During the process, in case, operation is taken over manually from the panel through push button or selector switch, the sequential operation shall start with the manual initiation for each of the steps.
c.)	The control system shall provide the (as minimum) alarms, "High Reactivation air temperature", "Low Reactivation air temperature", "Low cooling water flow", "Low air pressure at the outlet of ADP" and "High dew point at the outlet of ADP". Adequate number of temperature elements etc. shall be provided for measurement and monitoring of the same.

d.)	For rotary drum type Air drying plant, control philosophy as per manufacture's standard and proven practice is also acceptable.
22.0	For Centrifugal compressors, as per OEM recommendation, Start-up air compressor and air dryer along with piping, valves, instruments etc. shall be provided by CAS supplier. Additionally, tapping from instrument air main header shall also be taken and connected to the start-up compressor outlet piping along with valves and instruments and shall be used in case of outage of start-up compressor / dryer.
23.0	CAS supplier to note that RTD/BTD of HT motor of air compressor shall be terminated to temperature scanner / microprocessor (one for each compressor to be provided by CAS Supplier) mounted on compressor itself. Interlocks and protection for RTD/BTD of compressor motor has to be provided from compressor panel itself.
24.0	Control and Instrumentation – Individual compressor control shall be through compressor mounted microprocessor based control panel. Each compressor shall be interfaced with DCS through gateway / convertor for start, stop, load and unload from common control room (CCR) including giving input for developing software at DCS (by BHEL EDN) and hardware link for status monitoring, start/stop, load/unload from CCR. Interface module for the overall control of compressed air system through DDCMIS shall be provided by CAS Supplier.
25.0	Sequential panel for ensuring equal no. of running hours of each IA & SA set of compressors shall be povied by CAS Supplier.
26.0	Junction Box for cable termination purpose shall be provided by CAS Supplier.
27.0	HT motors for Instrument Air and Service Air Compressors, which are not in bidder's scope of supply, bare motors only shall be supplied as free issue by BHEL to successful bidder at its Works. HT motors shall be of BHEL make. The responsibility for satisfactory operation for combined performance of compressors & motors shall rest with the bidder only as if, the drive motors also have been supplied by the bidder. Also, once the motors are delivered at successful bidder's works / factory, any damage to motor shall be bidders' responsibility and rectification work shall be carried by bidder at its own cost. Further insurance of these motors after delivered at bidder's works shall be in bidder scope in line CAS package insurance, as per insurance terms & conditions defined under GCC.
28.0	Foot cum flange mounted motors shall be of 1500 RPM only. While foot mounted motors shall be 3000/ 1500 RPM.
29.0	Couplings, base plate, foundation bolts, any other fittings, etc. as required shall be supplied by the bidder only. BHEL shall supply motors to successful bidder works for shop testing of compressors with job motors.
30.0	CAS supplier scope also includes - Pipe supporting structure over the insert plate for pedestal supported pipe, wall supported pipe, insert plate and supporting structure for floor supported pipe. All MS structures for cross overs, valve, instrument, equipment operating and maintenance platform; approach ladder for access to pit/ trench.All Equipment base plate, foundation anchor bolts.
31.0	Paint required for painting of all items under the package for corrosion protection and to meet color coding required by customer.
32.0	SCOPE OF SERVICES: Scope of services by CAS supplier shall include but not necessarily limited to the following: 1.) Erection & Commissioning of Compressed Air System (Refer Annexure-C). 2.) Unloading, Storage, handling and transportation at site. 3.) Pre commissioning & Commissioning activities for Compressed Air System. 4.) Trial operation, PG Test & handovrer of Compressed AIr System.
33.0	CAS supplier shall terminate compressed air piping at common IA header and common SA header downstream of air receiver closer to pipe rack/pedestal (around 5.0 m from compressor house building).
34.0	Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.
35.0	Piping material - Compressed air (Instrument & service air) - ASTM A-53 type E Gr. B galvanized/ IS 1239 Gr heavy galvanized/IS 3589 Gr 410 galvanized. Galvanized shall be to IS- 4736 or equivalent.
36.0	Piping material - Equipment cooling water - IS-2062 Gr.-E-250B/ASTM A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410 /IS-1239 Heavy.
37.0	Valve material - Compressed air & Cooling water application - Valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.
38.0	Refer P&ID of CAS attached under compliance dwgs.
39.0	Operational spares for CAS as specified below: a.) Lube oil (Qty. for 1 Lot in Ltr. shall be as per oil tank capacity for One Compressor) - 7 Lot b.) Lube oil filters with seals - 14 Nos. c.) Air filters with gaskets - 14 Nos. d.) Service kit including seals, washers and rings for inter cooler & after cooler - 7 Nos.
40.0	AMC (Annual Maintenance Contract) for one (1) years from the date of successful commissioning of CAS is in CA supplier scope.
41.0	Performance test for compressors shall be carried out at shops with job motor only.

ANNEXURE-C

INSTRUCTION MANUALS

The vendor shall submit Instruction Manuals for all the equipments covered under the Contract. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of a particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tools, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) <u>Chapter 1 - Plant Description</u>: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment along with the intended system. (This to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment along with its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) <u>Chapter 2.0 - Plant Operation</u>: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment along with brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment along with the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices along with schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records.

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) <u>Chapter 3.0 - Plant Maintenance</u>- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings along with bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at

longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No., total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-D. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-D.

PLANT HANDBOOK AND PROJECT COMPLETION REPORT

PLANT HANDBOOK

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before startup and commissioning activities.

PROJECT COMPLETION REPORT

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

DRAWINGS

a) i) All the plant layouts shall be made in computerized 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-D. The soft copies shall also be submitted.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per Annexure-D.

b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the vendor (or their sub vendors) shall bear title block in addition to vendor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission in line with **Suggestive MDL.**

Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the

Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package. Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per Annexure D.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document as per Annexure-D. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specifications shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

S. No.	Description of Drgs./Docs.	No. of Prints	No. of Portable Hard Disk
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	3	-
	▪ Other Drawings/Documents (A0 & A1 sizes)	3	-
	▪ P&ID (All sizes)	3	-
	a) Final drawings/documents (Directly to site)	3	2
	b) "As Built" Drawing/Documents (Directly to site)	3	2
	c) Analysis reports of Equipments / piping / structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	3 sets	2
3	Operation & Maintenance manual i) First Submission	0	--
	ii) Final Submission (Directly to site)	3 sets	2
4	Plant Hand Book i) Final Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	3 sets	2

S. No.	Description of Drgs./Docs.	No. of Prints	No. of Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	1 sets	–
	ii) Approved Copies (Direct to Site)	3 sets	2
7	Project Completion Report (Directly to site)	3 sets	2

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure–I [Scope of Work (Electrical)].

2.0 Make of all electrical equipment/ items supplied shall be reputed make. Same shall be subject to approval of BHEL/customer after award of contract without any commercial implications. Tentative make list of various Electrical items (Motors/ lugs/glands) is attached.

3.0 All QPs shall be subject to approval of BHEL/ customer after award of contract without any commercial implication.

4.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

4.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated.

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

5.0 LIST OF ENCLOSURES

5.1 Electrical scope between BHEL & vendor (Annexure-I).
5.2 Technical specification - Motors (Annexure-II).
5.3 Datasheets –Motor (Annexure-III)
5.4 Quality Plan for motors. (Annexure-IV)
5.5 Load data format (Annexure-V).
5.6 Tentative make list for electrical items (motor, lugs, glands) (Annexure-VII)
5.7 Explanatory note for Cable routing & Cable schedule format (Annexure-VI)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: COMPRESSED AIR SYSTEM

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

PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	11 kV/ 6.6 KV / 3.3 KV / 415 V Switchgear	BHEL	BHEL	a) 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL as per load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. b) Emergency supply feeder provided (if required) shall be 3 phase 3 wire only. Any other voltage level (AC/DC/Single ph emergency AC) required will be derived by the vendor. c) 230 V AC UPS Power supply shall be provided by BHEL at a single point, All necessary hardware for deriving other power supply from given feeder shall be in Vendor's scope.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motors.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system. 100/50 mm cable trays/Conduits/Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs as per approved layout drawing during contract stage.
7	Cable glands, lugs & bimetallic strip for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
8	Conduit and conduit accessories for cabling between equipments supplied by vendor.	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	--

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: COMPRESSED AIR SYSTEM

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

PROJECT:

10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	--
12	Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/material/service required for completeness of system based on the system offered by vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	--
16	a. Input cable schedules (C & I) b. Cable interconnection detail for the above c. Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Cabling layout drawings	BHEL/ Vendor	-	a. In case of Compressor are HT motors, cable tray/trench layout inside compressed air building shall be prepared by BHEL. Vendor to furnish drawing (both in print form as well as in AUTOCAD) of compressor room layout clearly indicating all motors, panels, JB's etc. which require cabling alongwith their terminal box/location/ Foundation etc. b. In case of Compressor are LT motors, for ensuring cabling requirements are met, vendor shall prepare & submit cable tray/trench & equipment layout (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling for BHEL review & approval.
18	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of junction box arises on account of power cable size mismatch due to vendor engineering at later stage, vendor shall supply the junction box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

TECHNICAL DATA - PART - A

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Three phase induction motors :		IS15999, IEC:60034, IS: 12615, IS: 325
1.2	Single phase AC motors		IS:996, IEC:60034
1.3	Energy Efficient motors		IS 12615, IEC:60034-30
1.4	Crane duty motors		IS:3177, IS/IEC:60034
1.5	Mechanical Vibration of Rotating Electrical Machines with Shaft Heights 56 mm and Higher - Measurement, Evaluation and Limits of Vibration Severity		IS 12075/IEC 60034-14
1.6	Designation of Methods of Cooling of Rotating Electrical Machines		IS 6362
1.7	Designation for types of construction and mounting arrangement of rotating electrical machines		IS 2253
2.0	**DESIGN /SYSTEM PARAMETERS**		
2.1	Rated voltage	V	415
2.2	Frequency	Hz	50
2.3	Permissible variations for		
a)	Voltage	%	+/-10
b)	Frequency	%	(+)3 to (-)5
c)	Combined	%	10 (absolute sum)
2.40	System fault level at rated voltage for 1 sec	kA	50
2.4	Short time rating for terminal boxes for 0.25 sec	kA	50
2.5	Type of motors		a) Squirrel cage induction motor suitable for direct-on-line starting (for non- VFD motors). b) Motor operating through VFD shall be suitable for inverter duty with VPI insulation.
2.6	Efficiency class		*Continuous duty LT motors upto 50 KW Output rating (at 50 deg.C ambient temperature), shall be super Premium Efficiency class-IE4, 50-200 KW shall be of Premium Efficiency class – IE3,conforming toIS 12615, or IEC:60034-30.*
2.8	Rating		
a)	Motor duty		Continously rated-S1
b)	Design margin over continous max. demand of the driven equipment (min)		10%
3.0	**CONSTRUCTION FEATURES**		
3.1	Winding		Electrolytic grade Copper conductor
3.2	Enclosure Details		
a)	Degree of protection		
	i) Indoor motors		IP 55
	ii) Outdoor motors		IP 55

b)	Method of ventilation		Totally enclosed fan cooled (TEFC) or totally enclosed tube or ventilated (TETV) or Closed air circuit air cooled (CACA) type.
3.3	Insulation		Class 'F' with temperature rise limited to class 'B'. Non-hygroscopic, oil resistant, flame resistant Insulation.
3.4	Bearings		Grease lubricated ball or roller bearings for Horizontal motors Grease lubricated ball or roller bearings or combined thrust and guide beaing for Vertical motors.
3.5	Main terminal box		
a)	Type		-Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation. -Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame. - The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
b)	DOP		Same as motor
c)	Position when veiwed from the non driving end		Left hand side
d)	Rotation		90 Deg.
e)	Space heater		Motors rated 30KW and above shall have space heater suitable for 240V, 50 Hz single phase AC supply. Separate terminal box for space heaters & RTDs shall be provided.
f)	Cable glands and lugs		-Motor terminal box shall be furnished with Solder less crimping type heavy duty Lugs (aluminium lugs for aluminium cables and copper lugs for copper cables) and double compression Ni-Cr plated brass glands to match with cable used. -Gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes.
3.6	Earthing points suitable for conenction		Motor body shall be grounded at two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
3.7	Paint shade (Corrosion proof paints of colour shade)		RAL 5012 (Blue) The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However, in case electrostatic process of painting is offered. minimum paint thickness of 50 microns shall be acceptable for finish coat.Epoxy based paint with suitable additives shall be used.

3.8	The spacing between gland plate & centre of bottom terminal stud		UP to 3 KW As per manufacturer's practice. Above 3 KW - upto 7 KW 85 Above 7 KW - upto 13 KW 115 Above 13 KW - upto 24 KW 167 Above 24 KW - upto 37 KW 196 Above 37 KW - upto 55 KW 249 Above 55 KW - upto 90 KW 277 Above 90 KW - upto 125 KW 331 Above 125 KW-upto 200 KW 385/203 (For Single core cables only)
3.9	Minimum inter-phase and phase-earth air clearances with lugs installed		UP to 110 KW 10mm Above 110 KW and upto 150 KW 12.5mm Above 150 KW 19mm
4.0	**PERFORMANCE PARAMETERS**		
4.1	Starting requirement		
a)	Minimum permissible voltage as a percentage of rated voltage, at start to bring the driven equipment upto the driven equipment upto rated speed		a) Up to 85% of rated voltage for ratings below 110 KW b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW
b)	Maximum locked rotor current		as per IS 12615
c)	Starting duty		Two hot starts in succession, with motor initially at normal running temperature.
d)	The locked rotor withstand time under hot condition at highest voltage limit		a) atleast 2.5 secs. more than starting time(for motors with starting time upto 20 secs. at minimum permissible voltage during starting) b)atleast 5 secs. more than starting time(for motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting) c) more than starting time by at least 10% of the starting time(For motors with starting time more than 45 secs.at minimum permissible voltage during starting) Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
e)	The ratio of locked rotor KVA at rated voltage to rated KW		(a) Below 110KW : 10.0 (b) From 110 KW & upto 200 KW : 9.0
4.2	Torque (percent of full load torque)		1] Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque. 2]Pull out torque at rated voltage shall not be less than 205% of full load torque.
4.3	Noise level (max.)		85 dB(A)
4.4	Vibration shall be limited within the limits		as per IS:12075
5.0	**INSPECTION/TESTING**		
5.1	All type & Routine tests shall be as per IS 12615.		
5.2	The Contractor shall submit the type tests reports for the tests conducted on the equipment similar to those to be supplied under this contract and the test(s) should have been conducted at an independent laboratory not earlier than ten (10) years prior to supply under this contract.		

5.3	In case the contractor is not able to submit valid report of the type test(s) or in case type test report(s) are not found to be meeting the specification requirements, or not including all specified tests the contractor shall conduct all such tests under this contract. The cost of such test shall be deemed to be included in the price. The owner shall have right to witness the type tests.		
5.4	All routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.		

TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

SL.NO		UOM	DETAIL
1.0	**GENERAL**		
i)	Manufacturer & Country of origin.		
ii)	Equipment driven by motor)		
iii)	Motor type		
iv)	Country of origin		
v)	Quantity	nos.	
2.0	**DESIGN AND PERFORMANCE DATA**		
i)	Frame size		
ii)	Type of duty		
iii)	Type of enclosure and method of cooling		
vi)	Type of mounting		
vii)	Direction of rotation as viewed from DE END		
viii)	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard	(KW)	
ix)	(A) Derated rating for specified normal condition i.e. 50 deg. C ambient temperature	(KW)	
	(B) Rating as specified in load list	(KW)	
xi)	Rated speed at rated voltage and frequency	rpm	
xii)	At rated Voltage and frequency		
	a) Full load current	A	
	b) No load current	A	
xiii)	Power Factor at		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
	e) NO load		
	f) Starting.		
xiv)	Efficiency at rated voltage and frequrecy		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
xv)	Starting current*(inclusive of IS tolerance)* at		
	a. 100 % voltage	A	
	b. Minimum starting voltage	A	
xvi)	Starting time with minimum permissible voltage		
	a. Without driven equipment coupled	sec	
	b. With driven equipment coupled	sec	
xvii)	Safe stall time with 110% of rated voltage		
	a. From hot condition	sec	

	b. From cold condition	sec	
xviii)	**Torques :**		
	a. Starting torque at min. permissible voltage	(kg-mtr.)	
	b. Pull up torque at rated voltage.	(kg-mtr.)	
	c. Pull out torque	(kg-mtr.)	
	d. Min accelerating torque available	(kg-mtr.)	
	e. Rated torque	(kg-mtr.)	
xix)	Stator winding resistance per phase (at 20 Deg.C.)	Ohm	
xx)	GD^2 value of motors		
xxi)	Locked rotor KVA input (at rated voltage)		
xxii)	Locked rotor KVA/KW.		
xxiii)	**Bearings**		
	a. Type		
	b. Manufacturer		
	c. Self Lubricated or forced Lubricated		
	d. Recommended Lubricants		
	e. Guaranteed Life in Hours		
	f. Whether Dial Type thermometer provided		
	g. Oil pressure Gauge/switch		
	i. Range		
	ii. Contact Nos. & ratings		
	iii. Accuracy		
xxiv)	**Vibration**		
	a) Velocity	mm/s	
	b) Displacement	microns	
xxv)	Noise level	db	
3	**CONSTRUCTIONAL FEATURES**		
i	Stator winding insulation		
	a. Class & Type		
	b. Tropicalised (Yes/No)		
	c. Temperature rise over specified max.		
	i. Cold water temperature of 38 DEG. C.		
	ii. Ambient Air 50 DEG. C.		
	d. Method of temperature measurement		
	e. Stator winding connection		
	f. Number of terminals brought out		
ii	Type of terminal box for		
	a. stator leads		
	b. space heater		
	c. Temperature detectors		
	d. Instrument switch etc.		
iii)	For main terminal box		
	a. Location		
	b. Entry of cables		
	c. Recommended cable size		
	d. Fault level	MVA	
iv)	Temperature detector for stator winding		
	a Type		
	b. Nos. provided		
	c . Location		
	d. Make		
	e. Resistance value at 0 deg. C	ohms	

vi)	Paint shade		
vii).	Weight of(approx)		
	a. Motor stator (KG)		
	b. Motor Rotor (KG)		
	c. Total weight (KG)		
4	Relevant motor curves		

TECHNICAL SPECIFICATION OF CABLE GLANDS AND LUGS

Cable glands shall conform to BS:6121. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and Hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene or better synthetic material and of tested quality.

Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 50 KW (415V)	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6		7	8	9	D	M	C	N	
					M	C/ N								
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI		
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:	Kunal Gandhi	KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

QP FOR MOTORS ABOVE 50 KW

CLAUSE No. CHAPTER NAME

MOTOR

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-1/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y			Y		Y			Y							
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										
Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												

Accessories, RTD, BTD, CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

Note:

1. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalization. However, following methodology to be followed for Inspection Categorization:

Note for LT Motor:

i) Motor rating up to 50 KW: Inspection CAT- III : Acceptance of Motor up to 50 KW is based on COC of the Manufacturer and Main Contractor confirming as follows:
"It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage frequency variation, hot s
KVA/KW, temperature rise, distance between center of stud gland plate and tested in accordance with approved drawing /data sheets."

ii) Motor rating above 50 KW & less than 75 KW: Inspection CAT- II as per NTPC approved MQP: Acceptance of Motor rating above 50 KW & less than 75 KW is based on NTPC rev
report as per IS:12615 - 2018 (including latest revision) duly witnessed by main contractor along with COC of the Manufacturer and Main Contractor confirming as follows:
"It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage frequency variation, hot s
KVA/KW, temperature rise, distance between center of stud gland plate, space heater and tested in accordance with approved drawing /data sheets."

iii) Motor rating 75 KW & above: Inspection CAT-I: As per NTPC approved MQP.

2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
3. Makes of major bought out items for HT motors will be subject to NTPC approval.
4. Y1 = for HT Motor / Machines only.
5. For LT Motors, stator core stack length & grade, no load loss and winding resistance w.r.t. type tested motor for IE2/IE3 shall be checked/verified in addition to Compliance of relevant standard IS:12615/IEC requirement. In case actual results are not within the tolerance limit as declared by manufacturer during QP submission, the motor shall be subjected to efficiency test.

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

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

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

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

	LOAD DATA (ELECTRICAL)	JOB NO.		ORIGINATING AGENCY		PEM (ELECTRICAL)	
		PROJECT TITLE		NAME		DATA FILLED UP ON	
		SYSTEM / S	CHLORINE DI OXIDE DOSING SYSTEM	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION		SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

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

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

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.

2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.

3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.

4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).

5. The cables shall be described as per the scheme listed below:

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

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

please refer below examples:

i) 3C x 120 sq. mm. (1.1kV) PVC FRLS, Unarmoured Aluminium cable, the voltage code shall be D03G120
ii) 3C x 2.5 sq. mm. (1.1kV) PVC FRLS, Unarmoured Copper cable, the voltage code shall be D03C2.5
iii) 3.5C x 120 sq. mm. (1.1kV) PVC non-FRLS, Armoured Aluminium cable, the voltage code shall be D3HF120

(A) SYSTEM VOLTAGE CODES:

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

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)
B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

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

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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

6. Once a cable list has been given to PEM for routing, any subsequent changes required in the cable list (which may be in the form of addition of cables, deletion of cables, change of type or size of cable, etc.) must be informed as specific changes (as a separate file MS Excel of the same format as the original file) to the cable list given earlier if the cable list has been routed and cable schedule generated. The routing status of the cable list shall be got confirmed from PEM by the agency that has prepared the cable list before the changes are intimated. In case PEM confirms that the cable list in question has not been taken up for routing, and the revised cable list is acceptable,

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

the same may be sent. Since cable routing through the program involves adding each cable list to the project cable schedule database, the original cable schedule shall not be furnished to PEM with revisions incorporated within.

7. For any assistance or clarifications, please contact mailto:praveendutta@bhelpem.co.in

TECHNICAL DATA SHEET-C&I

TECHNICAL DATA - PART - A

S.No.	DESCRIPTION	UOM	DETAIL
1.0	DESIGN CODES & STANDARDS		
1.1	Impulse pipes, tubes (material, rating)		ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
1.2	Valves (material, pr. Class, size)		ASTM A182/ASTM A105 as per ASME 16.34
1.3	Fittings (size, rating, material)		ANSI B31.1, ANSI B31.1a, ASME B16.11
1.4	Installation schemes		BS 6739-2009, ANSI/ISA 77.70
1.5	Actuator		EN15714-2
1.6	Fieldbus concepts		IEC 61158
1.7	Instruments and apparatus for pressure measurement		ASME PTC19.2
1.8	Electonic transmitters		BS-6447, IEC-60770
1.9	Bourdon tube pressure and vacuum gauges		IS-3624
1.13	Colors for ready mixed paints and enamels.		IS-5
1.18	Annunciator Sequences and Specification		ISA-18.1
1.21	Instrument and apparatus for temperature measurement		ASME PTC 19.3(1974)
1.22	Temperature measurement by electrical Resistance thermometers		IS:2806
1.23	RTD Sensor		IEC-751/ DIN-43760
1.24	Type of Enclosures		NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13)
1.25	Racks, panels and associated equipment		EIA : RS - 310 C- 1983 (ANSI C83.9 - 1972)
1.26	Protection class for enclosures, cabinets, control panels & desks		IS:2147 -1962
2.0	DESIGN /SYSTEM PARAMETERS		
2.1	DATASHEET - PRESSURE TRANSMITTER, DIFFERENTIAL PRESSURE TRANSMITTER, DP BASED FLOW AND LEVEL TRANSMITTER		
	Output		Profibus PA complying to IEC 61158, digital output
	Turndown ratio		50:1
	Accuracy	%	0.06%
	Stability (% of calibrated range)	%	+/-0.25% for 10 year
	Diaphragm seal material		Suitable for process fluid
	Diagram fill fluid		Inert liquid
	Wetted parts		All wetted parts upto diaphragm seal shall be suitable for process application.
	Housing		Metallic housing with durable corrosion resistant coating
	Protection		Weather proof IP-67
	Display		Integral digital display
	Diagonstic feature		Required
	Electrical connection		1/2" NPT (f)
	Manifold		2/3 valve non integral manifold for PT and 5 valve non integral manifold for DPT

2.2	DATASHEET - PRESSURE GAUGE, DIFFERENTIAL PRESSURE GAUGE		
	Sensing element		Bourdon for high pressure, diaphragm/bellow for low pressure
	Sensing element material		SS316
	Movement material		SS316
	Body material		SS316
	Dial size	mm	150mm
	End connection	inch	1/2 inch NPT (m)
	Accuracy		±1% of span
	Scale		Linear, 270° arc graduated in metric units
	Range selection	%	Cover 125% of max. of scale
	Over range test		Test pr. for the assembly shall be 1.5 to the max. Design pr. At 38°C.
	Diaphragm seal material		Suitable for process fluid
	Diaphragm fill fluid		Inert liquid
	Wetted parts		All wetted parts upto diaphragm seal shall be suitable for process application
	Housing		IP-55
	Zero/span adjustment		External
	Compatibility		fully compatible with RTDs
	Protection Class		IP-67
	Display		Integral digital display
	Diagonstic feature		self-indicating diagnostics
	Operating ambient temperature (with display)	DegC	70 deg C
	Operating ambient temperature (without display)	DegC	85 deg C
	Electrical Connection	inch	1/2” NPT(F)
	Composite Accuracy	%	RTD =<0.25% of 0-250 deg C span
	Changeover facility		Bump less changeover to second sensor in case first sensor fails with alarm facility.
	Composite accuracy Calculation		Accuracies of temperature transmitter for converting sensor input to output + temperature effect on these accuracies at ambient temperature of 50 deg C (based on the figure/ formula given in the standard product catalogue for span as specified for RTD).
	Emergency/failure Measures		In case of failure (open or burn-out) of RTD, transmitter shall provide low temperature output.
2.4	DATASHEET - RESISTANCE TEMPERATURE DETECTOR (RTD)		
	Type		Four wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
	No. of element		Duplex
	Housing		Diecast Aluminium
	Protection Class		IP-65
	Head		Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter
	Plug in connectors		Required
	Terminal head		Spring loaded for positive contacts with the thermo well
	Insulation and sheathing		Mineral (magnesium oxide) insulation and SS316 sheath
	Calibration and accuracy		As per IEC-751/ DIN-43760 Class-A for RTD
	Accessories		Thermo well and associated fittings

2.5	DATASHEET - THERMOWELL		
	Design		One piece solid bored type of step-less tapered design
	Material		SS316
2.6	SPECIFICATIONS - TEMPERATURE GAUGE		
	Body Material		Die-cast aluminium
	Material of bourdon/movement		316SS / 304SS
	End connection		3/4" NPT (M)
	Accuracy	%	± 1% of span
	Dial Size	mm	150 mm
	Scale		Linear, 270° arc graduated in °C
	Range selection	%	Cover 125% of max. of scale
	Over range test		Test pr. for the assembly shall be 1.5 to the max. Design pr. At 38°C.
	Housing		IP-55
	Zero/span adjustment		Required
	Accessories		SS Thermowell
2.9	DATASHEET - TEMPERATURE/ HUMIDITY INDICATOR		
	Sensor		RTD for(Pt 100) for temperature
			Capacitance Type for Humidity (specs for humidity and temperature shall be as mentioned above)
	Display		Combined enclosure with two three digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of at least 10 meters.
	Range		0-60 Deg C for temperature.
			0-95.0 % for Relative Humidity.
	Accuracy		Better than +/_0.5 % for Temperature
			Better than +/_2.5 % for Relative Humidity
	Mounting		Table Top/ wall mounting.
	Power supply		240 V AC, 50 Hz.
	Output		4-20 mA signal each for temperature.
	Qty.		15 nos. each of temperature & Humidity indicators (combined indicators for Humidity and temperature is also applicable).
2.10	DATASHEET - SOLENOID VALVE		
	Type		2/3/4 way SS 316/Forged Brass (depending on the application subject to Employer's approval during detailed Engg.)
	Power supply		24 V DC + 10%.
	Electrical connection		Plug and socket
	Insulation		Class 'H'
	IP Class		IP65
	Limit switches (for open/close feedback)		Required

2.11	**DATASHEET - LIMIT SWITCH**		
	Type		Inductive proximity type
	Mounting arrangement		Inside the enclosure
	Operating voltage Range	V	10-40 V DC
	Sensing system		Inductive Proximity type , 2 Wire
	Sensor Contact Type		NO
	Reverse polarity and short circuit protection		Yes
	IP Class-Sensor		IP67
	IP Class-Enclosure(Switch box)		IP67
	Cable entry-Enclosure(Switch box)		2 no-1/2" NPT
	Casing material-Sensor		Brass /SS
	Enclosure(Switch box) Housing material		FRP or SS
	Operating Ambient temp(sensors)	DegC	-5 to 70 deg C
	Max allowed Voltage Drop across sensor	V	5 V
	Standard applicable		EN 60947-5-2 or equivalent.
	Applicable for		Manual valves and solenoid operated on-off valves
2.12	**LOCAL INSTRUMENT ENCLOSURE AND LOCAL INSTRUMENT RACK**		
	Scope		LIE and LIR complete with all fittings, mountings & accessories, drains and utility lighting, cable & grounding cable etc.
	Construction		
	Rack	mm	1.6mm sheet plate
	Frame	mm	3mm thick channel frame of steel
	Free standing type		Yes
	Rack		Yes, >=3mm thick steel, extended beyond the ends of the rack.
	Degree of Protection		IP-55 for LIE & JB of LIE/LIR
	Junction Box		Applicable
2.13	**JUNCTION BOX**		
	No. of ways		12/24/36/48/64/72/96/128
	Material and Thickness		4mm thick Fiberglass Reinforced Polyester(FRP)
	Type of terminal blocks		Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm2. A M6 earthing stud shall be provided.
	Protection Class		IP- 55 min. for indoor & IP-65 min for outdoor applications.
	Grounding		To be provided
	Color		RAL 7035
	Spare Terminals		At least 20% unused terminals
2.14	**SPECIFICATIONS - FLOW SWITCH**		
	Type		Paddle/Piston/Disk
	Wetted part material		Stainless steel or Hastelloy for acidic application
	End connection		a) Threaded upto 1” line size with integral Tee b) Flanged for line size > 1 ½”
	Enclosure Material		Stainless Steel
	Enclosure		IP-55
	Switch Congfiguration		2 SPDT (5A, 240 V AC, 0.5A, 220 V DC)
	Repeatability	%	2%
	Cable connection		½”NPTF
	Accessories		a) Tee, Counter flange, nuts & bolts, suitable gasket etc b) 1 ½” NPT cable gland. c) Stainless steel nameplate with alpha-numeric engraved for

2.15	DATASHEET - LOCAL CONTROL PANEL(as applicable)		
2.15.1	**Construction**		
	Type		Skid mounted
	Construction		Folded
	Devices & equipments		Panel enclosure, secondary instruments, annuniciation system, selector switch, push buttons, indicating lamps/ led cluster, relays, MCBs, clamp on terminals, plug socket, panel light, space heater, nameplate, earth bus
	Enclosure sheet material		Cold rolled sheet steel
	Enclosure sheet thickness		Minimum 3.0 mm for load bearing sections (mounted with instruments)
			2.0 mm for doors
			Minimum 2.0 mm for other sections
	Height		Minimum 1100 mm
	Frame thickness		Minimum 3.0 mm
	Internal plate thickness		2.5 mm
	Gland plate thickness		3.0 mm
	Cable gland		Double compression
	Base channel		ISMC 100 with anti-vibration mounting & foundation bolts
	Class of protection		IP-55
2.15.2	**Doors**		
	Rear doors		Required with integral lockable handle
	Door locking		Door when locked shall be held at minimum three places.
	Type		Removable type with concealed hinges to facilitate maintenance work
	Suitable pocket inside the door		Required for keeping the drawings / documents
	Double door		Required with suitable glass windows as per the requirement.
2.153	**Power & control supply**		
	Input power supply		415V 3 phase AC
	No. Of feeders		Two
	Control supply		230V AC
	Additonal requirement for control supply		MCBs
			Supervisory relay along with a pilot lamp to indicate control supply 'on'
			Auto changeover unit mounted on panel
2.15.4	**Internal wiring**		
	Voltage	V	1100 V
	Material & size		PVC insulated copper multi strand wire /flexible of 1.5mm2, power cable 2.5sqmm
	Routing and runs		Through PVC troughs, AC & DC wires shall be kept separately
	Colour		Separate colours for AC & DC wires
	Ferruling		Cross ferruling

2.15.5	**Painting details**		
	Painting shade & thickness - exterior / interior (these details shall be finalised during detailed engineering)		RAL 5012 & minimum 85 microns / glossy white & minimum 70 microns
2.15.6	**Gasket**		
	At door & removable cover		Neoprene
2.15.7	**Ventilation system along with louvers**		
	Cooling fan		2 x 100%, covered with removable wire mesh
2.15.8	**Terminal block**		
	Type		Clip on, separate for AC & DC circuits
	Voltage		1100 V
	Tb points		Cage clamp
	Mounting height from finished floor	mm	>=250 mm
	Spare	%	20%
	Identification strip		To be provided
215.9	**Illumination**		
	Light		Led tubelight
	Shrouded cover	W	15W minimum
	Operating power supply		240V 50 Hz AC
	Operable through		Panel door switch
	Power receptacle		15 Amp, 3-pin
2.151	**Earthing studs**		
	Termination to main station earth		Internally with 10 mm bolts at extreme ends for connection
2.15.11	**Alarm annunciator system**		
	No. Of windows	Nos.	Minimum 20
	Facia		Solid state discrete
	Hooter		10W
	Annunciator spare (with electronics)		10% spare window or minimum 2nos. Whichever is more
	Lamp test provision		Required
2.15.12	**Mounting devices on panel**		
	On front side		All operable and indicating devices
	Inside panel		Aux. Relays, terminal, PVC trough, MCBs etc.
	Easy access for operation / maintenance.		Required

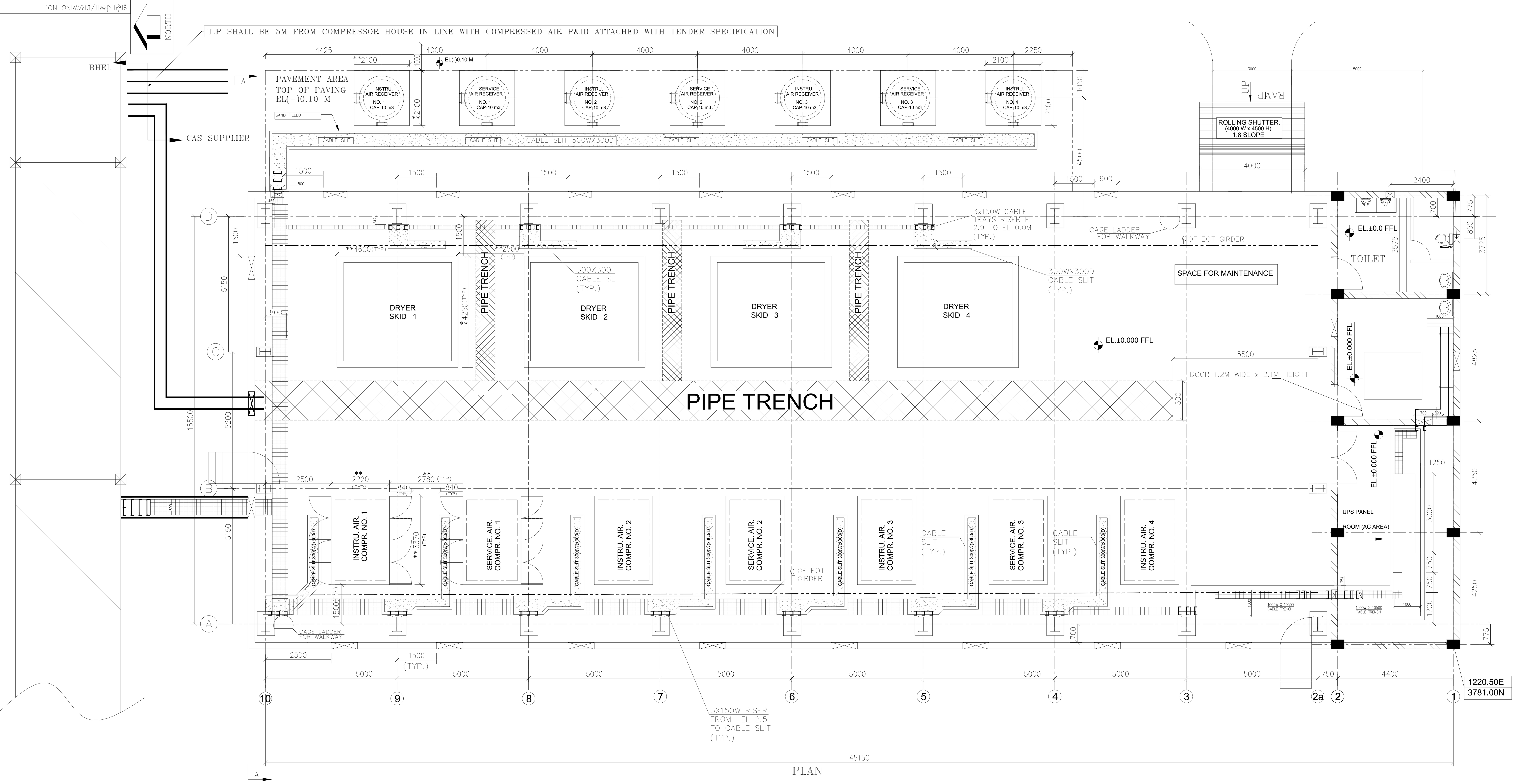
2.15.2	ROTAMETERS	
	TYPE	VARIABLE AREA METAL TUBE
	FLUID MEDIA	WATER/OIL
	TUBE BODY	SS316
	MATERIAL OF FLOAT	SS316
	INDICATOR	LINEAR SCALE
	ACCESSORIES	FLANGE, ORIFICE IN CASE OF BYPASS ROTA METER (FOR LINE SIZE ABOVE 100 MM)
	HOUSING PROTECTION CLASS	IP-55
	ACCURACY	+/- 2% OF MEASURED VALUE
2.15.3	DEW POINT METER	
		Sensor
	Type	Capacitance type with change in output proportional to moisture present.
	Service	Dry Air
	Range	SS316
	Sensor Accuracy	Better than +/- 0.5%
	Operating Temperature	0 to 50 degree C.
	Operating Pressure	0-10 Kg./Cm2, suitable for process application.
	HOUSING PROTECTION CLASS	IP-55
	ACCURACY	+/- 2% OF MEASURED VALUE
	Analyser	
	Input	Change in capacitance from dew point sensor.
	Display	Combined enclosure with two three-digit seven segments LED display with decimal point after two digits. LED height shall be 4 inches, clearly legible from a distance of atleast 10 meters.
	Range	SS316
	Display Accuracy	Better than +/- 2 Dehree C
	Mounting	Table top/Flush mounting, to be finalised during detailed engineering.
	Power Supply	240V AC, 50 Hz to be arranged by the contractor.
	Output	IP-55
	ACCURACY	5-20 mA DC capable of driving a load impedance of 500 ohms minimum
2.29.5	SIGHT FLOW GLASS	
	Type	Flapper nozzle type
	Body Material	SS304
	Flapper Material	SS316
	Cover plate Material	SS304
	Sight Glass/Window	Toughened Borosilicate
	Gasket	Neoprene
	End Connection	Flanged type(with nut and bolt)
	Flange Material	SS304
	Mating Flange	To be provided by bidder
	Material of Mating Flange	SS304

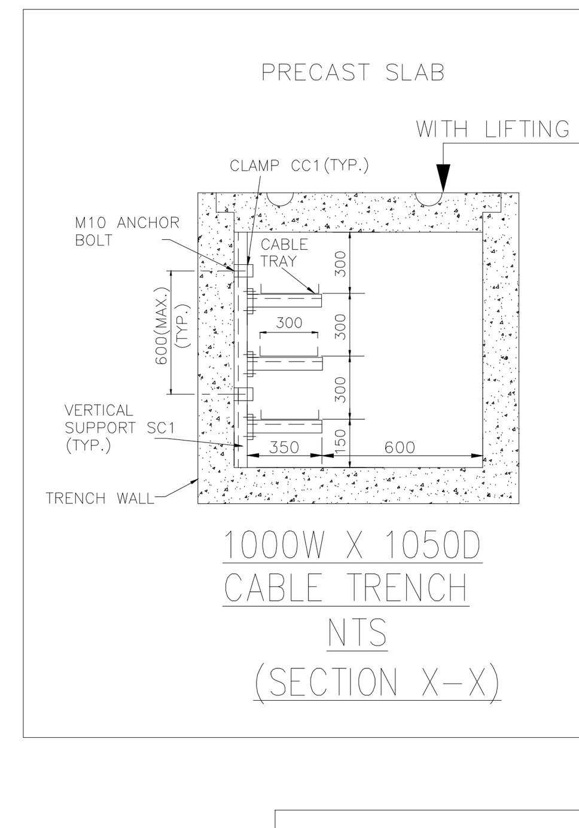
TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

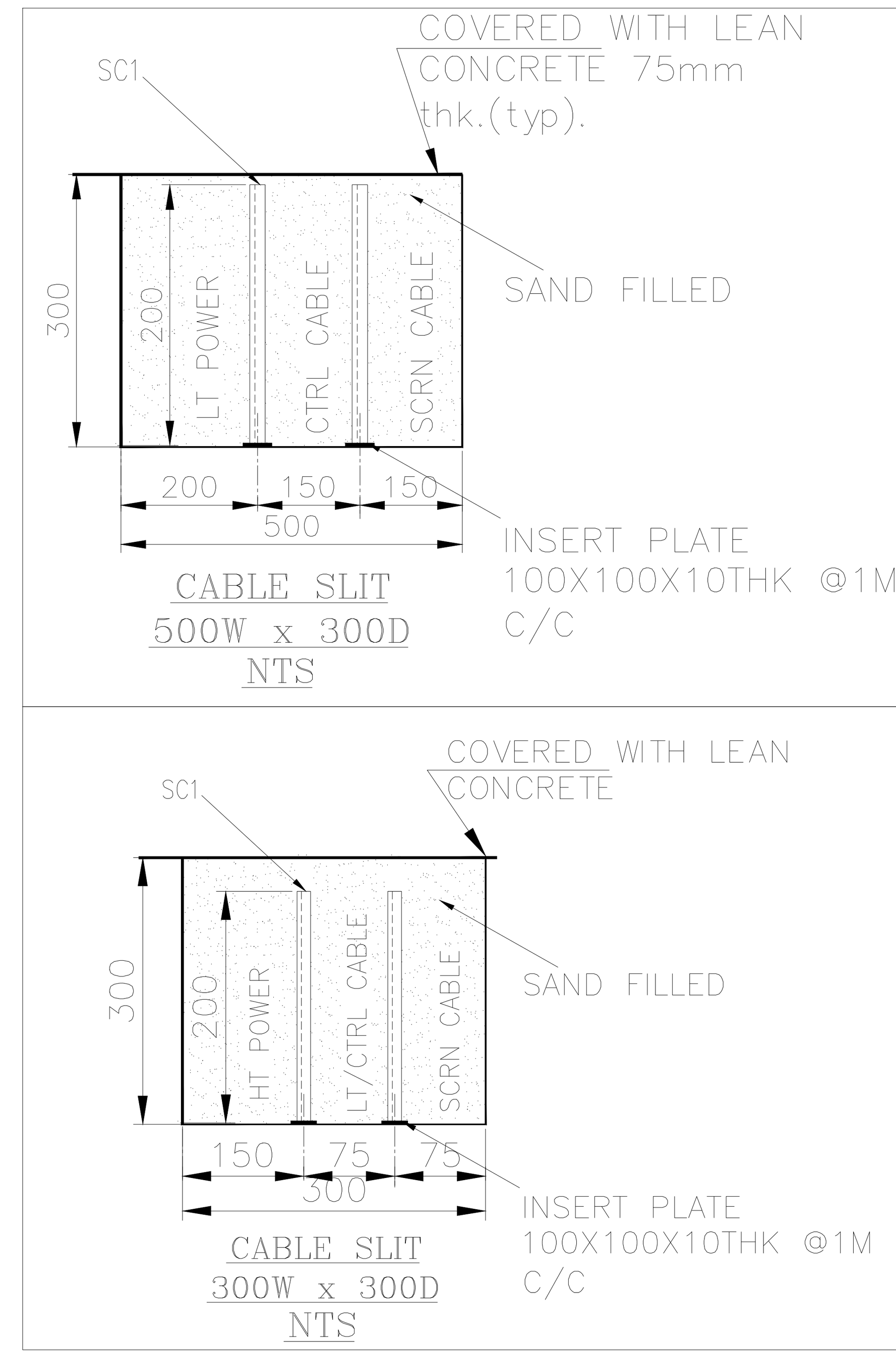
S.NO	DESCRIPTION	UOM	DETAIL
	FOLLOWING DATA SHALL BE FILLED UP BY VENDOR FOR EACH INSTRUMENT.		
1.0	MAKE		
1.1	MODEL		
1.2	TAG NO. / KKS NO.		
1.3	SERVICE		
1.4	QUANTITY		
1.5	OPERATING PRESSURE		
1.6	OPERATING TEMPERATURE		
1.7	DESIGN PRESSURE		
1.8	DESIGN TEMPERATURE		
1.9	RANGE		

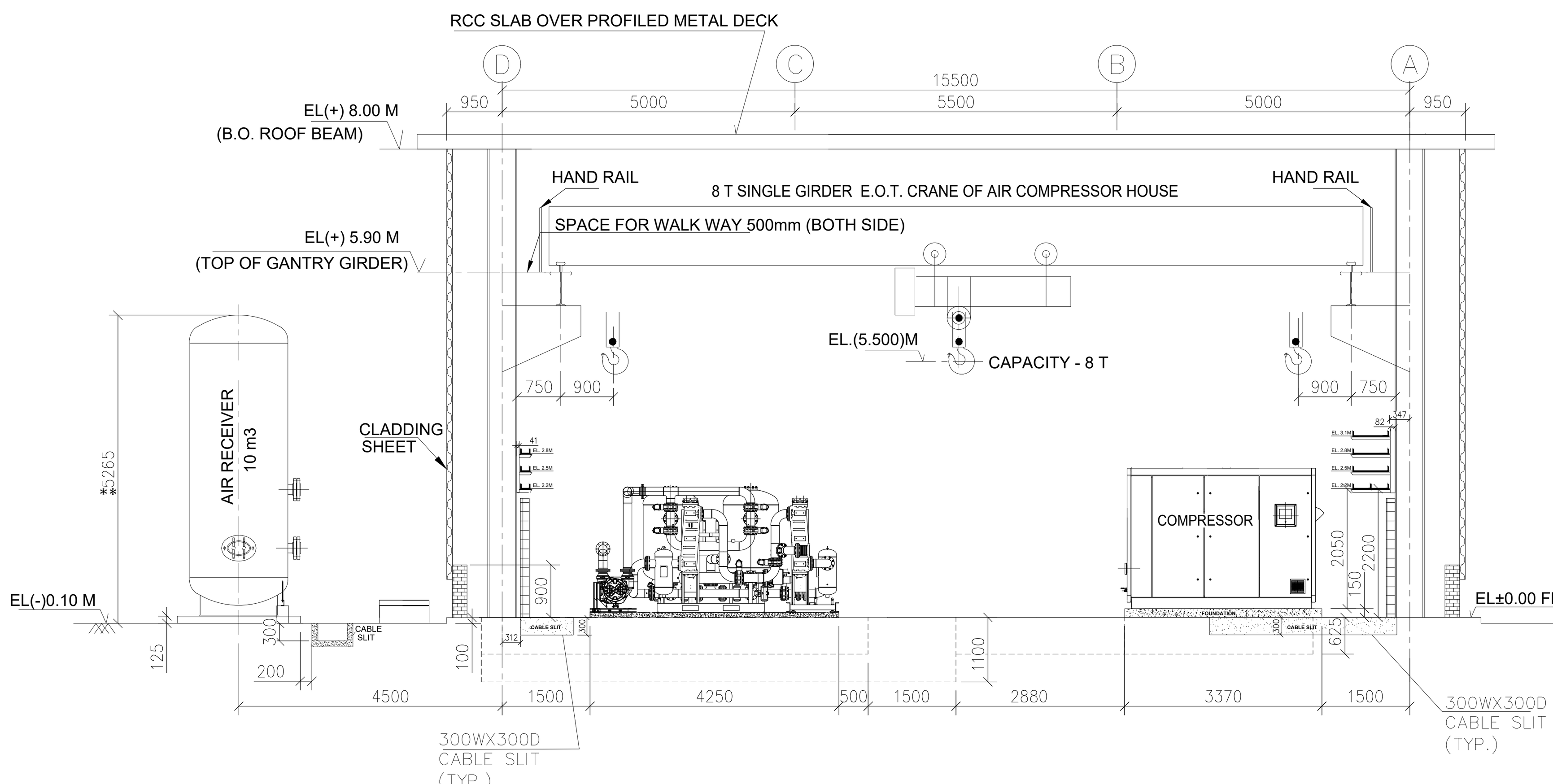
COMPLIANCE DRAWINGS

1. COMPRESSOR HOUSE LAYOUT: PE-DG-508-555-A015
2. COMPRESSED AIR SYSTEM P&ID: PE-DG-508-555-A001
3. GA OF AIR RECEIVER- 10M3
4. GA OF AIR RECEIVER- 2M3
5. ELECTRICAL LOAD DATA FOR CAS



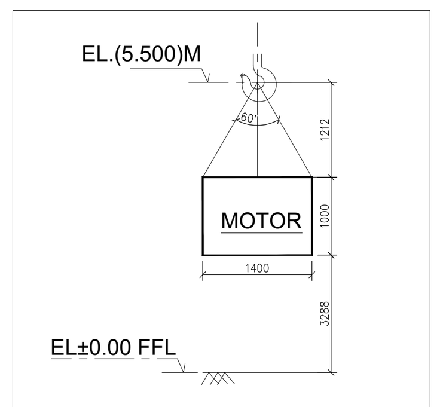






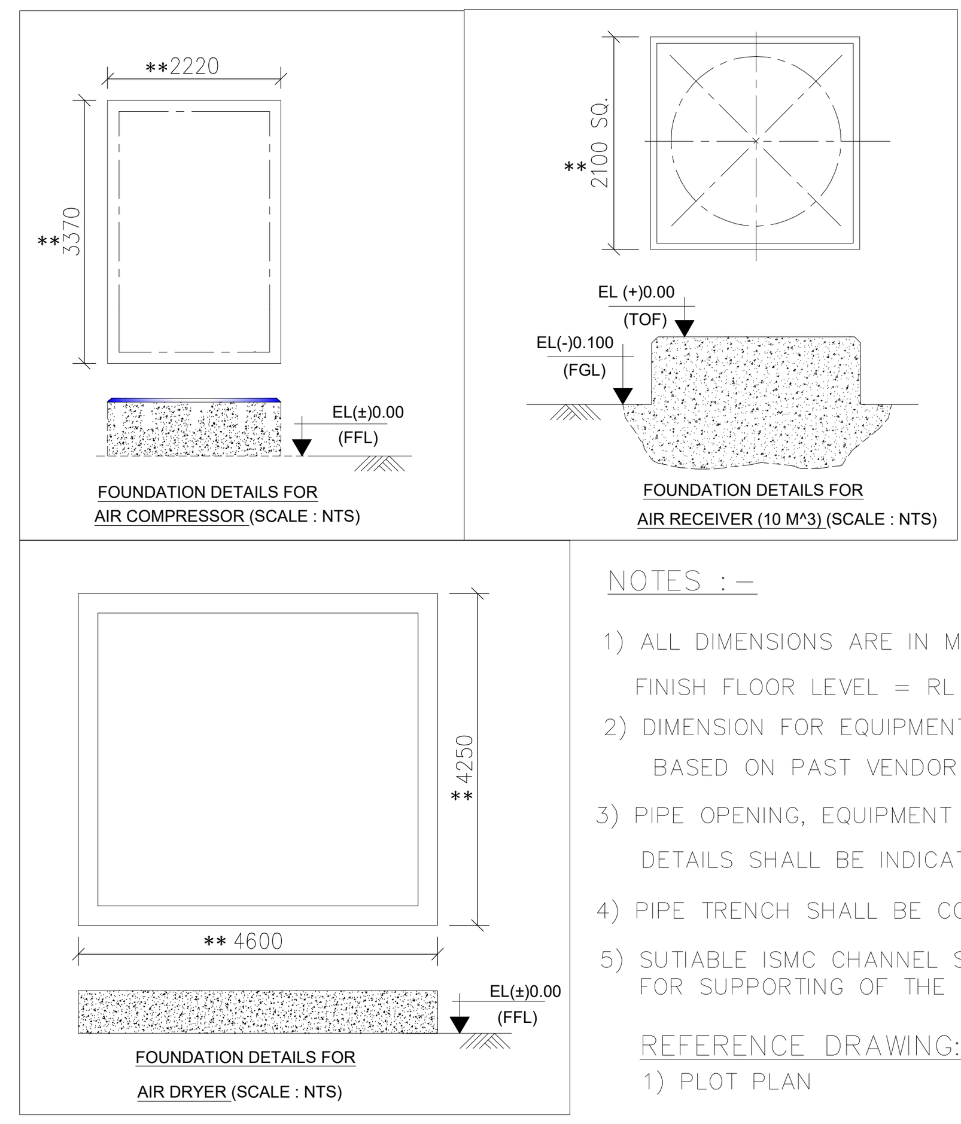
SECTION A-A (ELEVATION)

LOAD DATA **				
S.No.	DESCRIPTION	QTY	LOAD/ UNIT (APPROX) IN Kg	HEAVIEST WEIGHT(Motor)
1	COMPRESSOR	7	9900	4250Kg
2	AIR DRYER	4	15100	
3	AIR RECEIVER	7	3150	



HANDLING ARRANGEMENT

FOR TENDER PURPOSE ONLY



FOUNDATION DETAILS FOR AIR COMPRESSOR (SCALE : NTS)

FOUNDATION DETAILS FOR AIR RECEIVER (10 M^3) (SCALE : NTS)

FOUNDATION DETAILS FOR AIR DRYER (SCALE : NTS)

NOTES :-

1) ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METERS. EL(+) 0.000 M.
   FINISH FLOOR LEVEL = RL (+)209.50 M, CORRESPONDS TO PLANT EL 0.0M (GROUND FLOOR OF TG BUILDING).
2) DIMENSION FOR EQUIPMENT AS INDICATED ** IN COMPRESSOR HOUSE HAVE BEEN CONSIDERED BASED ON PAST VENDOR DATA AND SAME SHALL BE VALIDATED BY THE EQUIPMENT SUPPLIER.
3) PIPE OPENING, EQUIPMENT DETAILS, FOUNDATION DETAILS, EQUIPMENT LOAD ,PIPING, VALVES, PIPE AND CABLE SLIT DETAILS SHALL BE INDICATED AFTER FINALIZATION OF CAS SUPPLIER.
4) PIPE TRENCH SHALL BE COVERED WITH PRE-CAST COVER.
5) SUTIABLE ISMC CHANNEL SHALL BE PROVIDED ALL AROUND THE VENTIALTION FAN OPENING BY BHEL-CIVIL FOR SUPPORTING OF THE FAN IN CLADDING STRUCTURE

REFERENCE DRAWING:-

1) PLOT PLAN

ग्राहक ड्राइंग संख्या / CUSTOMER DRAWING NO.	
बीएचईएल ड्राइंग संख्या / BHEL DRAWING NO.	PE-DG-508-555-A015
ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
कार्य संख्या- JOB NO.	508
स्थिति STATUS	CONTRACT
परियोजना PROJECT	2X800 मेगावाट लारा थर्मल पावर परियोजना लिमिटेड चरण-II 2X800MW LARA THERMAL POWER PROJECT LTD. STAGE-II
मुद्रण स्केल मीटर में / PRINT SCALE IN METRE	0 2 4 6 8 10 20 30 40 50

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
BHARAT HEAVY ELECTRICALS LTD
पावर सेक्टर/POWER SECTOR
परियोजना अभियांत्रिकी प्रबंधन
PROJECT ENGINEERING MANAGEMENT
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

DEPT CODE: E

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DRN	LKG	-s/d-	27.03.2024
डिजाइनकर्ता/DESN	AKG	-s/d-	26.03.2024
जांचकर्ता/CHD	SR	-s/d-	29.03.2024
अनुमोदनकर्ता/APPD	SR	-s/d-	29.03.2024

दिनांक DATE	परिवर्तितकर्ता ALTD	जांचकर्ता CHD	अनुमोदनकर्ता APPD

शीर्षक/TITLE: COMPRESSOR HOUSE LAYOUT INCLUDING FOUNDATION DETAILS OF VARIOUS EQUIPMENTS

एमपीएल MPL	सिविल CIVIL	इलेक्ट्रिकल ELEC	सीएण्डआई C&I	एमएसई MSE	मैक्स MAX	विभाग DEPT.
						हस्ताक्षर SIGN दिनांक DATE

स्केल - SCALE- NTS

ड्राइंग संख्या / DRAWING NO.

शीट SHEET 1 OF 1 — पुनरीक्षण REV. 00

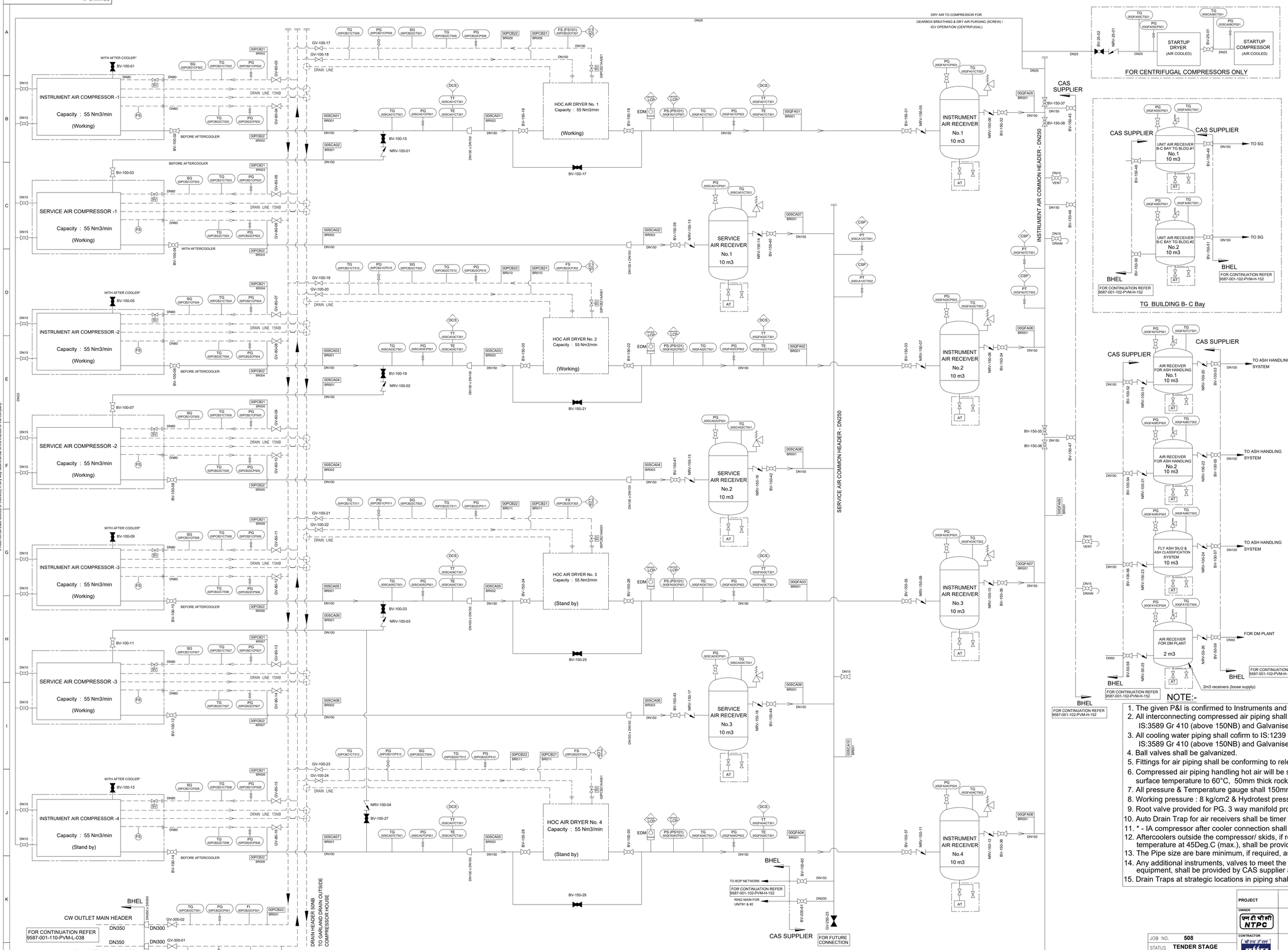
फॉर्मेट साइज A0
FORMAT SIZE A0

DRAWING No. PE-DG-508-555-A001

CUSTOMER'S DRAWING No. -

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



LEGEND

	GATE VALVE
	BALL VALVE
	BALL VALVE (Normally Closed)
	NON RETURN VALVE
	ISOLATION VALVE (Normally Closed)
SV	SOLENOID VALVE (ELECTRICAL)
	SAFETY VALVE
AT	AUTO DRAIN VALVE - TIMER BASED
PG	PRESSURE GAUGE
TG	TEMPERATURE GUAGE
SG	FLOW INDICATION (SIGHT GLASS TYPE)
FI	FLOW INDICATION (ROTOMETER TYPE)
PT/ TT	PRESSURE/ TEMP. TRANSMITTER
FS/ PS	FLOW / PRESSURE SWITCH
EDM	ELECTRONIC DEW METER
CSP	COMMON SEQUENTIAL PANEL
	WATER LINE
	AIR LINE

AIR VELOCITY : 15 Meters/ sec. (max)
WATER VELOCITY : 2.1 to 2.5 Meters/ sec.

S.No.	DESCRIPTION	SIZE	QTY
01	Gate valve	300 NB	02
02	Gate valve	250 NB	02
03	Gate valve	100 NB	08
04	Gate valve	80 NB	14
05	Ball valve	150NB	38
06	Ball valve	100 NB	24
07	Ball valve	200 NB	01
08	Ball valve	50 NB	02
09	Ball valve	25 NB	02
10	Ball valve	15 NB	98
11	Non Return Valve	150 NB	14
12	Non Return Valve	100 NB	10
13	Non Return Valve	50NB	02
14	Non Return Valve	25NB	01
15	Auto Drain Valve assembly	15 NB	13
16	Safety valve	40 NB	13
17	Flow Indicator (Rotometer)	300 NB	02
18	Flow Indicator (SG)	100 NB	04
19	Flow Indicator (SG)	80 NB	07
20	Temperature gauge	15 NB	47
21	Pressure gauge	15 NB	47
22	PT (PROFIBUS)	15 NB	04
23	TE (PROFIBUS)	15 NB	08
24	TT (PROFIBUS)	15 NB	08
25	Solenoid valve	100 NB	04
26	Flow switch	-	04
27	EDM	-	04
28	Pressure switch	-	04

NOTE:-

1. The given P&I is confirmed to Instruments and piping for compressor house area only
2. All interconnecting compressed air piping shall cofirm to IS:1239 (Heavy grade) upto 150NB and IS:3589 Gr 410 (above 150NB) and Galvanised as per IS:4736.
3. All cooling water piping shall cofirm to IS:1239 (Heavy grade) upto 150NB and IS:3589 Gr 410 (above 150NB) and Galvanised as per IS:4736.
4. Ball valves shall be galvanized.
5. Fittings for air piping shall be conforming to relevant BIS/ ASTM standard.
6. Compressed air piping handling hot air will be suitably insulated so as to restrict surface temperature to 60°C, 50mm thick rock wool / glass wool will be provided.
7. All pressure & Temperature gauge shall 150mm dial type.
8. Working pressure : 8 kg/cm2 & Hydrotest pressure : 16 kg/cm2
9. Root valve provided for PG. 3 way manifold provided for PT.
10. Auto Drain Trap for air receivers shall be timer based.
11. * - IA compressor after cooler connection shall be connected to SA compressor after cooler line.
12. Aftercoolers outside the compressor/ skids, if required, to maintain compressed air outlet air temperature at 45Deg.C (max.), shall be provided along with valves & instruments.
13. The Pipe size are bare minimum, if required, as per OEM, higher pipe size shall be provided.
14. Any additional instruments, valves to meet the system requirement & safe operation of the plant & equipment, shall be provided by CAS supplier at no additional cost.
15. Drain Traps at strategic locations in piping shall be provided to avoid back flow of moisture.

REFERENCE DRAWINGS :

1. P & I DIAGRAM OF AIR COMPRESSOR
2. P & I DIAGRAM OF AIR DRYER
3. TDS & GA AND P&ID OF AIR COMPRESSOR
4. TDS & GA AND P&ID OF AIR DRYER
5. CONTROL SYSTEM WRITE UP & CONFIG DRG/ FOR COMPRESSED AIR SYSTEM
6. COMPRESSOR HOUSE LAYOUT INCLUDING FOUNDATION DETAILS OF VARIOUS EQUIPMENTS

PROJECT	LARA SUPER THERMAL POWER PROJECT STAGE II (2 x 800 MW) EPC PACKAGE
OWNER	NTPC Limited (A GOVT. OF INDIA INTERPRISE) ENINEERING DIVISION
CONTRACTOR	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

JOB NO. 508
STATUS TENDER STAGE
DISTRIBUTION

CAS SUPPLIER

REV.	DATE	ALTD	CHD	APPD

CAS SUPPLIER DRAWING No.
REV. - SHEET - OF -

	NAME	SIGN	DATE
DRN	LKG		27.03.24
DESN	LKG		27.03.24
CHD	AKC		29.03.24
APPD	SR		29.03.24

PACKAGE: COMPRESSED AIR SYSTEM

TITLE **P&ID DIAGRAM OF COMPRESSED AIR SYSTEM WITH IN COMPRESSOR HOUSE**

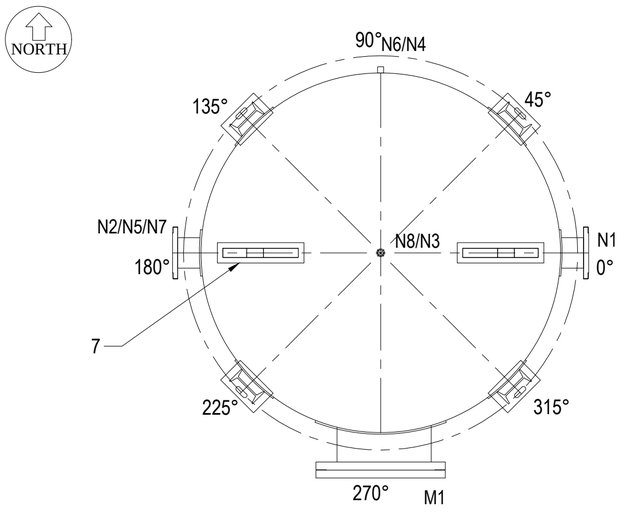
DEPT. SCALE SIGN

BHEL DRAWING NO. **PE-DG-508-555-A001**

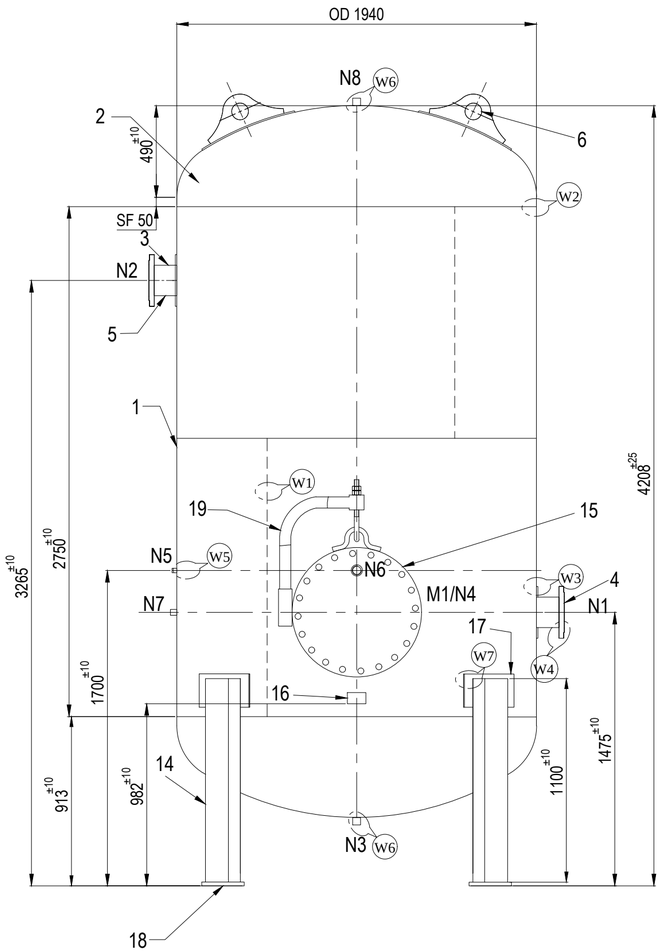
SHEET 1 OF 1 REV. 00

SIZE-A0

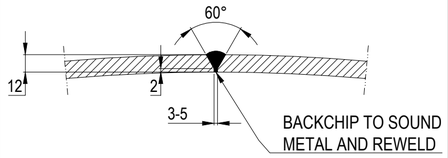
COMPUTER FILE NAME :



NOZZLE ORIENTATION

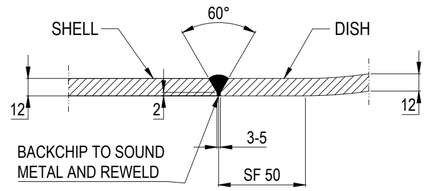


FRONT VIEW



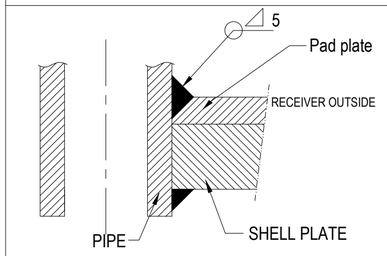
DETAIL - W1

(FOR SHELL TO SHELL)



DETAIL - W2

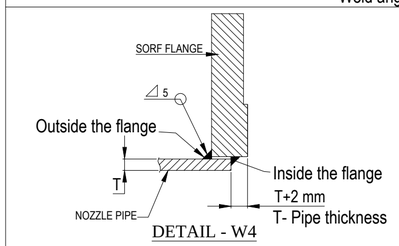
(FOR SHELL TO DISH)



DETAIL - W3

(FOR PIPE TO SHELL)

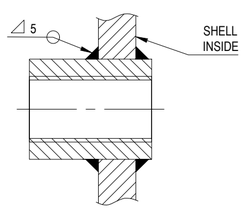
Weld angle: 90°



DETAIL - W4

(FOR NOZZLE PIPE TO FLANGE)

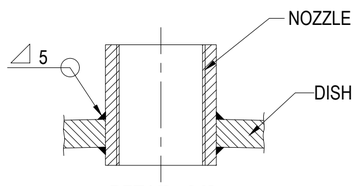
Weld angle: 90°



DETAIL - W5

(FOR SHELL WITH SOCKET)

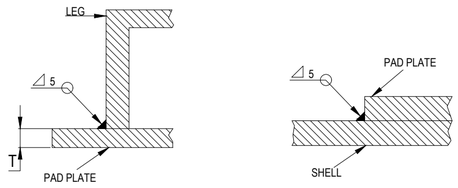
Weld angle: 90°



DETAIL - W6

(FOR DISH WITH SOCKET)

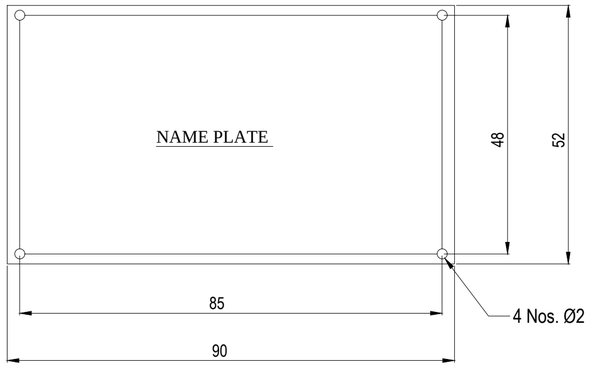
Weld angle: 90°



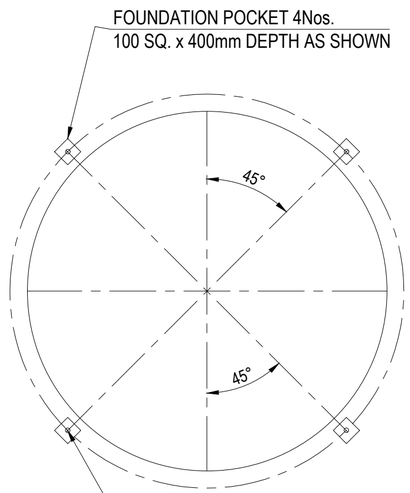
DETAIL - W7

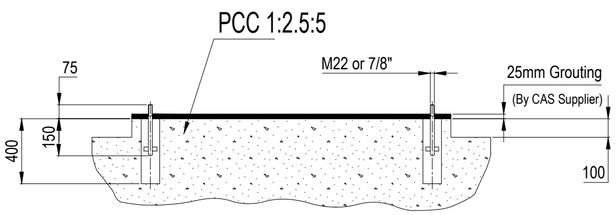
(FOR LEG)

Weld angle: 90°



NAME PLATE





FOUNDATION POCKET DETAILS

DESIGN DATA

DESIGN CODE		ASME SEC VIII DIV. 1
WORKING PRESSURE	Kg/cm2g	8
DESIGN PRESSURE	Kg/cm2g	10
TEST PRESSURE (HYDRAULIC)	Kg/cm2g	13
DESIGN TEMPERATURE	°C	100
JOINT EFFICIENCY		85 %
CORROSION ALLOWANCE	mm	1.6
RADIOGRAPHY		10% FOR CIRCUM. SEAM OF SHELL & 100% FOR ALL T JOINTS
DISH THINNING ALLOWANCE		0.7 mm
STRESS RELIEF		As per ASME SEC VIII DIV. 1
FLUID CIRCULATING		AIR
PAINTING/SURFACE TREATMENT		SEE NOTE 4 & 5
INSPECTION BY		AS PER QAP
CAPACITY		10 m3
QUANTITY		2 Nos.

BILL OF MATERIALS

S.NO.	DESCRIPTION	QTY.	MATERIAL	SIZE
20	MAN HOLE PAD PLATE	1	IS 2062 Gr B	OD 650 x ID 500 x 10 THK
19	DAVIT ARM	1	Round rod	OD 50 mm
18	LEG BASE PLATE	4	IS 2062 Gr.B	250 x 150 x 20 THK
17	LEG PAD PLATE	4	IS 2062 Gr.B	275 x 225 x 10 THK
16	NAME PLATE	1	ALUMINIUM	90 x 52 x 0.5 mm THK
15	MAN HOLE	1	IS 2062 Gr.B	20" NB, ANSI B 16.5,150#
14	LEG	4	IS 808	ISMB 175, Length 1100
13	SOCKET N8 (SPARE)	1	IS 1239 Heavy Grade	1/2"
12	SOCKET N7 (UNLOADING)	1	IS 1239 Heavy Grade	1"
11	SOCKET N6 (TEMP. GAUGE)	1	IS 1239 Heavy Grade	1/2"
10	SOCKET N5 (SAFETY VALVE)	1	IS 1239 Heavy Grade	1 1/2"
9	SOCKET N4 (PR. GAUGE)	1	IS 1239 Heavy Grade	1/2"
8	SOCKET N3 (DRAIN)	1	IS 1239 Heavy Grade	1/2"
7	PAD PLATE (LIFTING HOOK)	2	IS 2062 Gr. B	480 X 190 X 10 THK.
6	LIFTING HOOK	2	IS 2062 Gr. B	430 x 190 x 20 THK
5	PAD PLATE FOR N1, N2	2	IS 2062 Gr. B	230 OD X 10 THK.
4	NOZZLE FLANGE- N1, N2	4	IS 2062 Gr. B	6" NB 150#, SORF
3	NOZZLE PIPE- N1, N2	2	IS 1239 Heavy Grade	6" NB
2	DISHED END	2	IS 2062 Gr. B	1940 OD x 12 mm THK
1	SHELL	1	IS 2062 Gr. B	1940 OD x 12 mm THK

General notes :

1. All dimensions are in mm, unless otherwise specified.
2. Long Seam & Cirm. seam shall be provided in shell as per the size of plate available.
3. Radiography for Shell shall be 10 % and Dish 100% for all T-Joints
4. Surface preperation : Sa 2-1/2
   Primer coat : Epoxy resin based Zinc phosphate – 100 microns
   Intermediate coat : Epoxy resin based paint pigmented with Titanium dioxide – 100 microns
   Top coat : Epoxy paint ,Glossy finish, Sky blue RAL 5015 – 75 microns
   Additional finishing : Polyurethane paint, Sky blue RAL 5015 – 25 microns
5. Air Receiver Shall be provided with mating flanges,bolts,nuts & foundation bolt.
6. Foundation bolt slot size is 24 x 50 mm length.
7. The dwg. represents the minimum requirement to be provided.

Manhole Details:

Nozzle	: Flange, ANSI B 16.5, IS 2062, Sorf, Class 150, NB 500
Cover plate	: Flange, ANSI B 16.5, IS 2062, Blind, Class 150, NB 500
Bolts	: M 30 x 20 No's.
Nozzle Thickness	: 10 mm
Manhole size	: 500 NB x L180 mm
Handle	: Round rod, 20 mm

NOZZLE MARK	SIZE	SCH.	PROJ.	QTY.	RATING	FLANGE TYPE	FACING	SERVICE	PAD PL	REMARKS
M1	500 mm	---	180	1	IS 2062			MAN HOLE	OD 650	---
N8	BSPF ½"	---	25	1	#3000, FULL COUPLING			SPARE	NA	---
N7	NPTF ½"	---	25	1				UNLOADING	NA	---
N6	NPTF ½"	---	25	1				TEMPERATURE GAUGE	NA	---
N5	BSPF 1 1/2"	---	25	1				SAFETY VALVE	NA	---
N4	BSPF ½"	---	25	1				PR. GAUGE	NA	---
N3	BSPF ½"	---	25	1				DRAIN	NA	---
N2	150 NB	---	150	1	SORF,ANSI B16.5, CLASS 150			OUT LET	OD 230	---
N1	150 NB	---	150	1				INLET	OD 230	---

Nozzle Details:

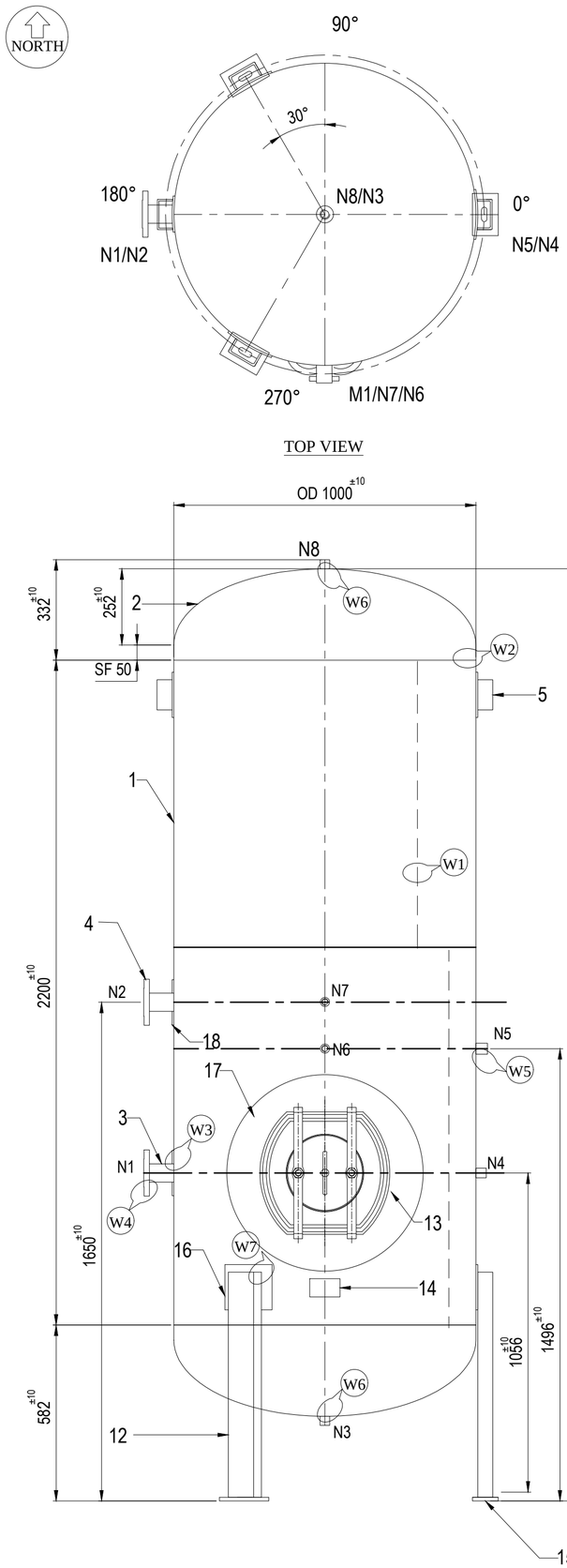
MANUFACTURER :

	NAME	SIGN.	DATE
DRAWN			
CHECKED			
APPVD.			

TITLE : General Assembly Drawing of Air Receiver Vertical

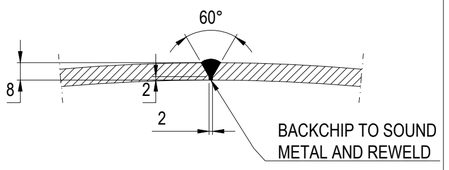
DWG. NO.	REV. R00	SHEET No. 1 OF 1
MODEL NO.		
ENQ. NO.	SCALE: 1:1	SIZE : A0

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE



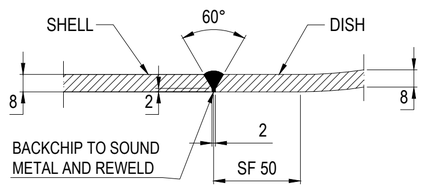
TOP VIEW

FRONT VIEW



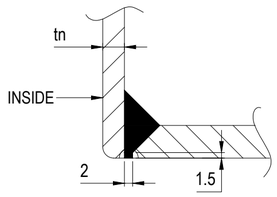
DETAIL - W1

(FOR SHELL TO SHELL)



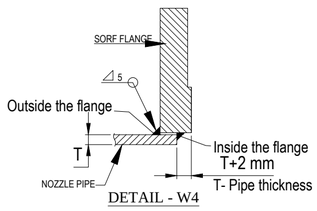
DETAIL - W2

(FOR SHELL TO DISH)



DETAIL - W3

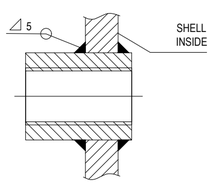
(FOR PIPE WITH SHELL) Weld angle: 90°



DETAIL - W4

(FOR NOZZLE PIPE TO FLANGE)

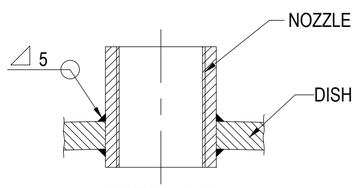
Weld angle: 90°



DETAIL - W5

(FOR SHELL WITH SOCKET)

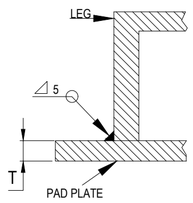
Weld angle: 90°

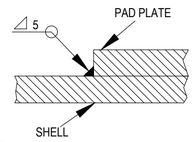


DETAIL - W6

(FOR DISH WITH SOCKET)

Weld angle: 90°

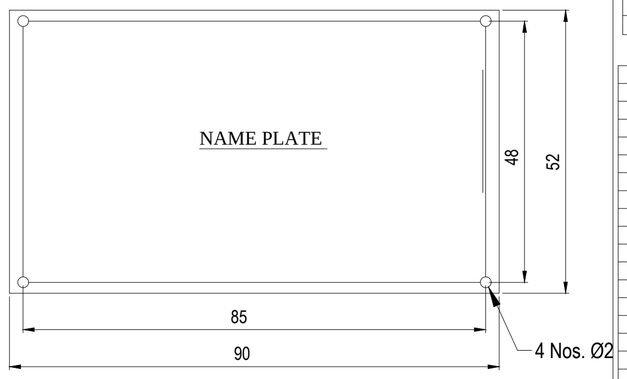




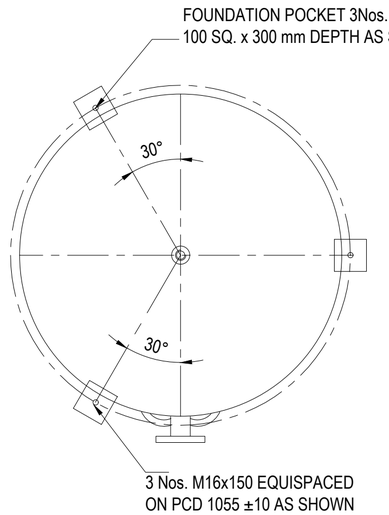
DETAIL - W7

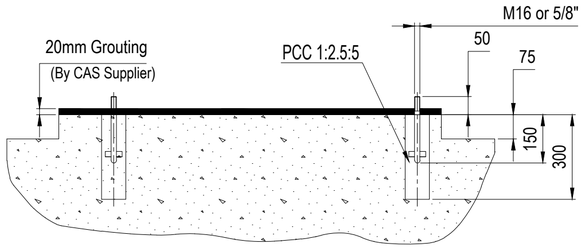
(FOR LEG)

Weld angle: 90°



NAME PLATE





FOUNDATION POCKET DETAILS

DESIGN DATA

DESIGN CODE		ASME SEC VIII DIV. 1
WORKING PRESSURE	Kg/cm2g	8
DESIGN PRESSURE	Kg/cm2g	10
TEST PRESSURE (HYDRAULIC)	Kg/cm2g	14.4
DESIGN TEMPERATURE	°C	100
JOINT EFFICIENCY		85 %
CORROSION ALLOWANCE	mm	2
RADIOGRAPHY		10% FOR CIRCUM. SEAM OF SHELL & 100% FOR ALL T JOINTS
DISH THINNING ALLOWANCE		1
STRESS RELIEF		As per ASME SEC VIII DIV. 1
FLUID CIRCULATING		AIR
PAINTING/SURFACE TREATMENT		SEE NOTE 5 & 6
INSPECTION BY		AS PER QAP
CAPACITY		2 m3
QUANTITY		1 No.

S.NO.	DESCRIPTION	QTY.	MATERIAL	SIZE
18	NOZZLE PAD PLATE – N1 & N2	1	IS 2062 Gr.B	OD 150 x 6 THK
17	MAN HOLE PAD PLATE	1	IS 2062 Gr.B	OD 650 x 6 THK
16	LEG PAD PLATE	3	IS 2062 Gr.B	150 x 150 x 6 THK
15	LEG BASE PLATE	3	IS 2062 Gr.B	85 x 140 x 16 THK
14	NAME PLATE	1	ALUMINIUM	90 x 52 x 0.5 mm THK
13	MAN HOLE	1	IS 2062 Gr.B	600mm, Ellipsoidal
12	LEG	3	IS 808	6" ISMC
11	SOCKET N8 (SPARE)	1	IS 1239 Heavy Grade	1/2"
10	SOCKET N7 (UNLOADING)	1	IS 1239 Heavy Grade	1"
9	SOCKET N6 (TEMP. GAUGE)	1	IS 1239 Heavy Grade	1/2"
8	SOCKET N5 (SAFETY VALVE)	1	IS 1239 Heavy Grade	3/4"
7	SOCKET N4 (PR. GAUGE)	1	IS 1239 Heavy Grade	1/2"
6	SOCKET N3 (DRAIN)	1	IS 1239 Heavy Grade	1/2"
5	LIFTING HOOK	2	IS 2062 Gr. B	4" x 2", ISMC
4	NOZZLE FLANGE– N1, N2	4	IS 2062 Gr. B	2" NB 150#, SORF
3	NOZZLE PIPE– N1, N2	2	IS 1239 Heavy Grade	2" NB
2	DISHED END	2	IS 2062 Gr. B	1000 OD x 8 mm THK
1	SHELL	1	IS 2062 Gr. B	1000 OD x 2200 H x 8 mm THK

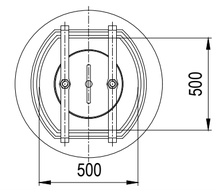
General notes :

1. All dimensions are in mm, unless otherwise specified.
2. Long Seam & Cirm. seam shall be provided in shell as per the size of plate available.
3. Radiography for Shell shall be 10 % and Dish 100% for all T-Joints
4. Primer coat : Epoxy resin based zinc phosphate – 100 microns
   Intermediate coat : Epoxy resin based paint pigmented with Titanium dioxide – 100 microns
   Top coat : Epoxy paint ,Glossy finish, Sky blue RAL 5015 – 75 microns
   Additional finishing : Polyurethane paint, Sky blue RAL 5015 – 25 microns
5. Cleaning Procedure as per SSPC –SP–2–Hand Tool Cleaning.
6. Air Receiver Shall be provided with mating flanges,bolts,nuts & foundation bolt.
7. The dwg. represents the minimum requirement to be provided.

NOZZLE MARK	SIZE	SCH.	PROJ.	QTY.	RATING	FLANGE TYPE	FACING	SERVICE	PAD PL	REMARKS
M1	500mm	---	150	1	IS 2062			MAN HOLE	650	---
N8	BSPF ¼"	---	25	1				SPARE	NA	---
N7	BSPF 1"	---	25	1				UNLOADING	NA	---
N6	NPTF ½"	---	25	1	#3000, FULL COUPLING			TEMPERATURE GAUGE	NA	---
N5	BSPF 3/4"	---	25	1				SAFETY VALVE	NA	---
N4	BSPF ½"	---	25	1				PR. GAUGE	NA	---
N3	BSPF ½"	---	25	1				DRAIN	NA	---
N2	50 NB	---	100	1	SORF,ANSI B16.5, CLASS 150			OUT LET	OD 125	---
N1	50 NB	---	100	1				INLET	OD 125	---

Nozzle Details:

MAN HOLE DETAILS



MANUFACTURER :

	NAME	SIGN.	DATE
DRAWN			
CHECKED			
APPVD.			

TITLE : General Assembly Drawing of Air Receiver Vertical

DWG. NO.

REV. R00

SHEET No. 1 OF 1

MODEL NO.

SCALE: 1:1

SIZE : A0

ENQ. NO.

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

LOAD TITLE FINAL	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	Eqpt/Item.	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY									SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10		11	12	13	14	15	16	17	18	19
INSTRUMENT AIR COMPRESSOR	500kw	500kw	S	3	1	C	U	Y	C	Motor	15-20 sec	CAS						Refer notes (i), (ii) and (iii).	
SERVICE AIR COMPRESSOR	500kw	500kw	S	3	0	C	U	Y	C	Motor	15-20 sec	CAS							
INSTRUMENT AIR DRYER AUXILIARY SUPPLY	2kW	-----	S	3	1	E	D	Y	C	Panel	-----	CAS						230VAC	
INSTRUMENT AIR COMPRESSOR AUXILIARY SUPPLY	7.5kw	-----	S	3	1	D	S	Y	C	Panel	-----	CAS						415VAC DG SUPPLY	
SERVICE AIR COMPRESSOR AUXILIARY SUPPLY	7.5kw	-----	S	3	0	D	S	Y	C	Panel	-----	CAS						415VAC DG SUPPLY	
INSTRUMENT AIR COMPRESSOR AUXILIARY SUPPLY	1kw	-----	S	3	1	E	S	Y	C	Panel	-----	CAS						230VAC UPS	
SERVICE AIR COMPRESSOR AUXILIARY SUPPLY	1kw	-----	S	3	0	E	S	Y	C	Panel	-----	CAS						230VAC UPS	
RECEIVER DRAIN ADT	0.5kw	-----	S	13	0	E	S	Y	I	ADT	-----	CAS						230VAC	
AFTER COOLER DRAIN ADT	0.5kw	-----	S	4	0	E	S	Y	I	ADT	-----	CAS						230VAC	
UTILITY COMPRESSOR	9kW	9kw	S	1	0	D	S	Y	I	Motor	5 SEC	CAS						415VAC	
UTILITY DRYER	1kW	-----	S	1	0	E	S	Y	I	Panel	-----	CAS						230VAC	
SEQUENCIAL CONTROL PANEL	0.5 kW	-----	S	2	0	E	S	Y	C	Panel	-----	CAS						230VAC UPS	

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

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

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

	LOAD DATA (ELECTRICAL)	JOB NO.	508	ORIGINATING AGENCY		PEM (ELECTRICAL)	
		PROJECT TITLE	2x800 MW NTPC LARA STPP (STAGE-II)	NAME		DATA FILLED UP ON	
		SYSTEM / S	COMPRESSED AIR SYSTEM	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MAX	SHEET 1 OF 2	REV. 00	DE'S SIGN. & DATE	

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

NOTES:

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Suitable protection shall be included in the HT Switchgear logic to prevent frequent start stop of the compressor HT motors.

iv) UPS supply shall be given at one point. Distribution along with distribution board is in CAS supplier scope.

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

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

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	LOAD DATA (ELECTRICAL)	JOB NO.	508	ORIGINATING AGENCY		PEM (ELECTRICAL)	
		PROJECT TITLE	2x800 MW NTPC LARA STPP (STAGE-II)	NAME		DATA FILLED UP ON	
		SYSTEM / S	COMPRESSED AIR SYSTEM	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MAX	SHEET 1 OF 2	REV. 00	DE'S SIGN. & DATE	

PERFORMANCE GUARANTEES FOR CAS

CATEGORY-I GUARANTEES

Auxiliary Power Consumption for Compressed Air System

CATEGORY-II GUARANTEES

Noise level for Compressors

CATEGORY-III GUARANTEES

PERFORMANCE GUARANTEES TO BE DEMOSTRATED AT SITE	
S.N.	**DESCRIPTION OF TESTS TO BE PERFORMED**
i)	Parallel operation of air compressors
ii)	Dew point of air at the outlet of air drying plants of instrument air compressor.
iii)	Pressure drop across the air drying plants of air compressors.
iv)	Vibration level of air compressors, blowers of air drying plant
PERFORMANCE GUARANTEES TO BE DEMOSTRATED AT SHOP	
S.N.	**DESCRIPTION OF TESTS TO BE PERFORMED**
i)	Capacity and discharge pressure of each air compressor.

Category-I Guarantees

Accept the equipment/system/plant after levying Liquidated Damages as specified hereunder. The liquidated damages, for shortfall in performance indicated in clause 1.01.02 for this sub-section are on per unit basis and shall be levied separately for each unit, except for the rate indicated for auxiliary power consumption for station auxiliaries which is on station basis.

The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category - I' Guarantees.

Category-II Guarantees

In case the performance guarantee(s) are not met by the Contractor during demonstration test, the Contractor shall carry out all necessary modifications and/or replacements to comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. If, however, the demonstrated guarantee(s) are not met even after the above modifications / replacements within ninety (90) days, it will be concluded that, the equipment has failed to meet the guarantee(s). In such a case, Employer shall Reject the equipment/plant/system and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category - II ' Guarantees.

Conformance to the performance requirements under Category -II is mandatory.

Category-III Guarantees

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the EMPLOYER. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s) replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters/capacities shall be termed as category - III, guarantees.

Standard TG PG Test Procedure of Compressed air System

	Station Name--- Capacity	
1	OWNER	NTPC Limited (A Govt. of India Enterprise)
2	CONTRACTOR	Name----------
3	CONTRACT No.	
4	SUB-CONTRACTOR	
5	OWNER's Doc. No./Rev No	
6	CONTRACTOR's Doc. No. / Rev No.	/
7	SUB-CONTRACTOR's Doc No. / Rev. No.	/
8	DRG./DOC. Title	PG TEST PROCEDURE FOR Compressed air System
9	PURPOSE	FOR APPROVAL

REVISION STATUS FOR OWNER'S DOCUMENT

Revision No.	Date	Name (On behalf of Owner)	Comment	Date	Name On behalf of Contractor)	Comment	Remarks

OWNER's APPROVAL			CONTRACTOR's APPROVAL		
Authorized Representative	signature	Name	Authorized Representative	Signature	Name
Approved by			Approved by		
Checked by			Checked by		
Prepared by			Prepared by		

CONTENTS

Test Parties: -

a. Witness :- NTPC Limited (Herein after called NTPC)

b. Contractor: - ----------Name of organization

c. Sub- Contractor: - ----------Name of organization

This document provides the Performance Guarantee Test Procedure for ***Compressed Air System*** *Station Name----------, capacity------- to confirm that the following item meet the guarantee value as per* ***NTPC technical specification Functional Guarantee & Liquidated Damage (FGLD)*** *&* ***Attachment 10*** *(whichever is applicable).*

Scope: - PG test shall be Conducted as per Contract. The test procedure shall cover the performance test to be conducted at site for the Compressed air system and accordingly listed in this procedure. The test procedure shall cover the testing method for technical para meters, checking of ratings and performance requirements stipulated for various equipment covered in this procedure.

2. OBJECTIVE OF THE TEST: -

The objective of test is to be checking following parameters of air compressed system:

1. To check healthy condition of all equipment forming total compressed air system.
2. Operating parameters of the system to be logged for the complete cycle with online (calibrated) instruments at the time of test.
3. To check satisfactory operation of all safety switches and electrical interlocks for each individual equipment and for the complete system.
4. To check healthy condition of all electrical as well as instruments installed on air compressed system.
5. Operability test of balance system which cannot be operated/checked at the vendor's work/plant
6. Check parallel operation of working compressors
7. To check pressure, drop across ADP, capacity & outlet dew point of each ADP (Air Dryer Plant).
8. Noise level measurement, vibration/shock pulse measurement shall be conducted.
9. The capacity measurement & power consumption of the compressors shall be conducted either at the shop floor or test bed of vendor workshop. Signed Copies of the test reports by VENDOR & NTPC shall be furnished during the site PG test & it will be acceptable to both parties

VENDOR TO QUOTE/INCLUDE THE SUITABLE VALUE OF GUARANTEED PARAMETERS VALUE FOR SL NO, 6,7,8, 9 AS PER NTPC TECH SPECS (FGLD SHEET) ATTACHMENT 10 & APPROVED TECH DATA SHEET (WHICHEVER IS APPLICABLE)

3. Test conditions responsibility & prerequisites before the test NTPC

i. Conductance of PG test by representatives of Vendor and NTPC as per the approved PG test Procedure.

ii. Contractor shall be given permission to inspect the system in advance and make it ready for the test.

iii. To ensure Continuous run of plant for at least two hours for stabilization of the system before commencement of PG test.

iv. Availability of approved data sheets for the plant/system during the test.

v. To ensure Cleanliness of Plant/System, filters etc & uninterrupted power supply within specified parameters during the test.

vi. Availability of suitable fire protection system/firefighting equipment's to be ensured.

vii. Successful completion of trial operation of Compressors.

CONTRACTOR

I. Deputation of team to site to associate with the test to be ensured by the Contractor

II. Readiness of Formats as well instrument availability for Recordings of Parameters for PG test requirements.

III. Responsibility for conducting the test rests with Contractor.

IV. Calibration of all instruments used during the test in an approved NABL labs/ labs certified by NTPC & Hand over of all calibration certificates (in original) to NTPC at least 15 days before start of the PG test.

V. All the installation / commissioning protocols in respect of alarm/ annunciation/ control system, pipeline flushing, vibration & noise level measurement data of motors, fans & pumps during commissioning shall be made available during Guarantee Test.

VI. Readiness of all protections, interlocks and safety switches to be ensured. Joint protocol in this respect shall be signed before the Test.

VII. Sufficient skilled/ required Manpower availability & removal of Instruments as required/Instructed by NTPC.

The plant/ system shall be jointly inspected by NTPC and the contractor and a joint protocol shall be signed that the plant is fit for conducting guarantee Test

TEST INSTRUMENTS

All instruments required for the site performance test shall be provided/arranged by the Contractor. The instruments furnished below shall be used for the purpose of the PG. If additional instruments are required for the test, the same shall be arranged by supplier at the time of testing. **Calibration of all instruments used during the test in an approved NABL labs/ labs certified by NTPC & Hand over of all calibration certificates (in original) to NTPC at least 15 days before start of the PG test.**

- *Bearing Temperature* is to be measured using RTD by 0.5 % accuracy or better.
- *Pressure gauges* shall be used for recording the parameters of pumps. Accuracy 0.5 % or better.
- *Wattmeter* of + 0.5 % accuracy class or better shall be used for power consumption measurement.
- **Vibration & Noise level** of motors, fans & pumps shall be measured by calibrated instruments.
- **Manometer** to be used for measurement of pressure drop across filters.

- Voltage and current shall be measured using *tong tester/Clamp meter* of +/- 0.5 % accuracy class or better.

TEST METHODOLOGY

- **AIR DRYER**

DEW POINT

The demonstration of the Dew point temperature at atmospheric pressure at the rated full load to be carried out at site. The atmospheric Dew point temperature at the air dryer outlet shall be --------- deg C as per approved Dryer datasheet drawing no ----------specification. The graph showing the relation between Atmospheric dew point (ADP)

& Pressure dew point(PDP) shall be provided by Contractor.

- PRESSURE DROP ACROSS AIR DRYER

The pressure drops across the air dryer, while the dedicated Instrument air compressor and dryer combination is working together at the rated load shall be recorded.

- AIR COMPRESSOR

PROTECTION AND ALARM CHECK

Operation of protection interlocks, alarms shall be checked and recorded. However, the joint inspection reports / protocols, made before / during commissioning of the units duly signed by the site officials shall be verified and considered as official documents for this purpose.

- DISCHARGE AIR PRESSURE: -

The compressor air discharge pressure and current shall be recorded in the format for the site performance test. Performance of receiver drain traps shall be checked and recorded in the format for the site performance test.

NOISE LEVEL MEASUREMENT

The specified noise level is ------- dB (A) as per standard reference code preferably ISO 2151 code.

Noise level shall be measured by a calibrated portable instrument. It shall be measured at 1 metre distance from the equipment and at 1.5 metre above the floor level. The readings shall be taken at all four sides of the compressor unit.

For eventual noise, from the discharge line, accessories and /or ancillary equipment which are not included, a correction factor of Maximum 8 dB (A) shall be allowed for background & ambient noise.

This correction factor is based on the background noise in the air compressor room having multiple compressor units along with the canopy with sound absorbing foam.

The noise levels shall be recorded in the format for the site test.

- VIBRATION MEASUREMENT

The vibration measurements shall be as per international standard (VOi 3836, Group 2) or ISO 10816-3.

Based on the above reference, the limits of vibration in terms of velocity shall be :-

Acceptable velocity value = 10 mm / sec [RMS] or less

The readings shall be taken with the calibrated portable instrument and recorded in the format for the site test.

CAPACITY & POWER MESUREMENT OF COMPRESSOR

Capacity & power consumption test copy witnessed at shop floor /Test bed of Contractor shall be acceptable for this test.

Formats (Complete system) PROJECT: Station Name ----------, Capacity (-----
----) PACKAGE : *Compressed Air System* *Date :----------*

Compressor Model		Customer	
Compressor Make		O/A Number	
Compressor Sr. No		Consultant	
Main motor Sr. No		Main Motor Make	

- PERFORMACE TEST DATA OF COMPRESSOR & AIR DRYER

SL.NO	PARAMETER	UNIT	Reading 1	Reading 2
1.	Time	HR: MIN		
2.	Ambient Temperature	Deg C		
3.	Ambient Pressure	Bar A		
4.	Relative humidity	%		
5.	Compressor Discharge Pressure	Bar G		
6.	Cooling water inlet pressure	Bar G		
7.	Cooling water outlet pressure	Bar G		
8.	Cooling water inlet Temperature	Deg C		
9.	Cooling water outlet Temperature	Deg C		
10.	Main Drive motor Current	Amp		
11.	Auxiliary air compressor power	kW		
12.	Noise level	dBA		
13.	Vibration velocity	mm/sec		
	Air dryer			
14.	Atmospheric dew point	Deg C		
15.	Air Pressure drop	Bar G		
16.	Cooling water inlet	Bar G		
17.	Cooling water outlet	Bar G		
18.	Cooling water inlet	Deg C		
19.	Cooling water outlet	Deg C		
20.	Air outlet pressure	Bar G		
21.	Air outlet temperature	Deg C		
22.	Air dryer power	kW		

- **PERFORMANCE GUARANTEES**

SL.NO	PARAMETER	Unit	Test value /Observation	Remarks
1.	Parallel operation of air compressors	-		Yes / No
2.	Air dryer plant power consumption	kW		OK / Not OK
3.	Atmospheric Dew point at outlet of Air Dryer Plant	Deg C		OK / Not OK
4.	Pressure drops across air dryer plant	Bar G		OK / Not OK
5.	Compressor Noise level	dBA		OK / Not OK
6.	Vibration velocity (RMS)	mm/se c		OK / Not OK

- ***GENERAL PARAMETERS***

SL.NO	PARAMETER	Value/Observatio n	Remarks
1.	General observation on equipment installation		OK / Not OK
2.	General observation on Compressor system layout and Piping		As per approve d drawing /
3.	Approved engineering doc + Shop test reports		Yes / No
4.	Availability of instruments for performance test as per		Yes / No
5.	Availability of safety equipment's at site		Yes / No
6.	Start equipment as per start up procedure in instruction manual		Yes / No
7.	Leakages in Pipe Joints (Soap solution method)		OK / Not OK

8.	Smooth operation of valves (Hand operation)		OK / Not OK
9.	Field instruments working		OK / Not OK
10.	Protection and Alarms		OK / Not OK

Attachment (to be provided by Contractor)

1) NTPC Tech specifications sheet (FGLD) of Compressed Air system .

2) Attachment 10 or relevant document.

3) Approved data sheet if any.

4) Any transmittal received for this System.

5) ADP vs PDP graph to be provided by Contractor

6) Shop test reports of individual compressors showing FAD, DAP and specific power consumption

Following may be noted related to PG Test

1. PG test should be done at design coal GCV however for conductance of PG test coal GCV variance can be allowed from -10% to + 5% of design coal.
   Formula for applying correction shall be as per BSEN 12952-15 (2003).
2. PG test to be done irrespective of any shortfall from rated parameters if it is attributed to design issues.
3. During ramping and PG test, maximum metal temperature in the penthouse (as per MTM) shall not exceed the design metal temperature of the material for the boiler pressure parts as in Steam Generator technical specification of Part-B
4. Penthouse maximum & minimum MTM temperature difference should be within 40 deg.C. Necessary combustion tuning shall be done to ensure the same.
5. PG test will be conducted under normal operating conditions with cleaning of APH and Boiler by online cleaning device. CO should not exceed 100 PPM during PG test before air preheater.

QUALITY PLAN &
QUALITY ASSURANCE

CLAUSE NO.	QUALITY ASSURANCE
1.00.00	**AIR COMPRESSOR SYSTEM**
1.01.00	**AIR COMPRESSORS:** a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining, if applicable. The test pressure will be maintained for 30 minutes. b) All other parts including inter-connecting piping shall be hydraulically tested wherever possible, as per relevant codes. c) Ultrasonic testing shall be carried out on all forgings and shafts (if dia.> 40mm). MPI/DP test will be done on machined areas of the above components. d) Rotor shall be statically and dynamically balanced as per relevant standard.
1.01.01	**PERFORMANCE TEST (SHOP TEST) :** a) Performance test on the compressors shall be carried out in accordance relevant standard. The test shall also include demonstration of loading and unloading mechanism (Capacity control) and operation of safety valves. b) Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressor shall be measured. c) Vibration and noise level measurement will be done during shop performance test. d) Test shall be carried out on all compressors with contract drive motor where power consumption for compressors has been indicated as a guaranteed parameter
1.02.00	**AIR RECEIVER, HEAT EXCHANGERS, MOISTURE SEPERATORS, AIR DRYING PLANT:** a) Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes. b) NDT on weld joints shall be as per respective code requirements or the minimum as specified below: (i) 100 % DPT on root run of butt welds. (ii) 100% DPT on all finished butt welds and fillet welds (iii) 10% RT on butt welds which shall include all T- joints. c) Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards. d) Reactivation blowers shall be tested for FAD, temp. rise noise & vibration. Rotating parts shall be dynamically balanced. e) Completely assembled ADP shall be pneumatically tested at design pressure for a duration of 5 minutes. Functional and sequential operation testing of the completely assembled ADP shall be demonstrated at shop. Other accessories shall be tested as per relevant code and sections. Dew point measurement shall be done. FOR E.O.T. CRANE REFER QA CHAPTER EOT CRANES AND HOISTS, FOR PIPES, FITTINGS, VALVES & RE JOINTS REFER QA CHAPTERS OF LP PIPING.

LOW PRESSURE PIPING

PIPES, FITTINGS, BENDS, VALVES, COATING-WRAPPING, STRAINERS EXPANSION, JOINTS, TANKS, FASTENERS, LINING ETC.

	Tests/Check / Items / Components	Material Test	DPT/MPI / RT	Ultrasonic Test	WPS/ WQS/PQR	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operational Test	Other Tests	All Tests as per relevant Std	REMARKS
1	Pipes & Pipe Fittings	Y[a]	Y[b]			Y1			Y			Y	
2	Diaphragm Valves	Y[a]				Y[5]			Y		Y[6]		
3A	Cast Butterfly Valves (Low Pressure)					Y		Y	Y				
	Body	Y[a]	Y[b]										
	Disc	Y[a]	Y[b]										
	Shaft	Y[a]	Y	Y[c]									
3B	Fabricated Butterfly Valves	**REFER NOTE 14**											
4	Gate/ Globe/Swing Check / Ball Valves	Y[a]	Y[b]	Y[c]		Y[5]	Y	Y	Y	Y	Y[8]		
5	Dual Plate Check Valves	Y[a]	Y[b]	Y[c]		Y	Y	Y	Y	Y	Y[4]		
6	Rolled & Welded Pipes and Mitre Bends	Y[a]	Y[3]		Y	Y[3]			Y		Y[3&15]	Y	
7	Coating & Wrapping of Pipes	Y[2]									Y[2]		
8	Tanks & Vessels	Y[a]	Y[b]		Y	Y			Y		Y[16]		
9	Strainers	Y[a]	Y[b]		Y #	Y					Y[11]		#For Fabricated Strainer
10	Rubber Expansion Joints	Y[a]				Y[12]		Y	Y		Y[13]		
11	Internal Lining of Pipes	Y[a]							Y		Y[9]		
12	Site Welding		Y[10]		Y	Y							

NOTES (MEANING OF SUPERSCRIPTS)

a	One per heat/heat treatment batch/lot.
b	On machined surfaces only for castings and on butt welds.
c	For shaft/spindles > or = 40 mm
1	100% Hydraulic test shall be carried out. Weld joints not subjected to hydraulic test due to some unavoidable reasons, shall be subjected to 100% RT/PAUT.
2	Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91/ IS-10221 & IS 15337 as applicable.
3	Followings are the testing requirements for fabrication of pipes at site

TESTS	**QUANTUM OF CHECKS**
WPS, PQR, Welder Qualification Test	100% Welders and WPS shall be qualified as per ASME- section IX
DPT on root run	100% for pipes up to 1200 mm diameter
DPT after back gauging	100% for pipes above 1200 mm diameter
RT / UT by (TOFD/PAUT) Technique	5% (100% of T Joints)

	DPT on finished butt weld joints	10%
	Hydraulic Test	100%, 1.5 times the design pressure or 2 times the working-pressure whichever is higher.
4	Dry Cycle Test on Dual Plate Check valve spring for one lakh Cycles shall be carried out as a type test. If Dry Cycle test carried out earlier for same material & diameter, Test report shall be reviewed.	
5	Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.	
6	Tests on rubber parts shall be conducted per batch of rubber mix for tensile, Elongation, hardness, adhesion, spark test, bleed resistance test. In addition, type test for 50,000 cycles of each type of diaphragm shall also be conducted.	
7	Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with governing design standard in presence of owner / owner's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. For Proof of Design Test refer respective chapters of engineering portion in the technical specification.	
8	Blue matching, wear travel for gates, valves, pneumatic seat leakage, and reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes. Fire safe test for ball valve shall be done wherever specified. In case of already carried out, the test report shall be submitted for review and acceptance by owner / owner's representatives. Valves shall be offered for hydro test in unpainted condition.	
9	Tensile, Elongation, Hardness, Specific Gravity, Lining Thickness, Humidity Check, Pipe temperature check, Adhesion Test and Holiday Detection Test etc as per applicable standard shall be done for all lining material and application.	
10	10% of welds (Root and finished welds) shall be subjected to DPT. (100% DPT for compressed air line and boiler & deaerator fill line.).	
11	Pressure drop across the strainer for each type and size as a special test shall be carried out. In case of already carried out, the test report shall be submitted for review and acceptance by owner / owner's representatives.	
12	During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.	
13	Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149/IS 3400 Part 20 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.	
14	In addition of all tests as indicated for Cast Butterfly valve being applicable for fabricated butterfly valves, following test shall be done for Fabricated Butterfly Valve: a. UT as per ASTM A-435/IS 11630 & IS 4225 on plate material for body and disc shall be carried out for plate thickness 25mm and above. b. 100% RT and DPT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc. 10% DPT on other welds shall be done. c. Post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc. d. Welders and WPS shall be qualified as per ASME- section IX	
15	Maximum number of segments in segmental flanges shall be four (04) only. All butt weld joints in the segmental flanges shall be examined by RT/UT. Segmental flanges exceeding 37.5 mm thickness shall be stress relieved as per norms of ASME Section VIII after welding.	
16	For pressure vessel welds RT shall be done as per design code requirements.	

All Valves shall be offered for inspection in unpainted condition.

No repair welding is permitted on Cast Iron / Alloy Cast Iron Castings.

Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

MEASURING INSTRUMENTS

Item Components / Sub System Assembly	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (As applicable)(R)	Hydro Test(R)	Material Test certificate (R)
Pressure Gauge (IS-3624)	Y	Y	Y	Y	Y				
Pressure /Differential Pressure Switch(BS-6134)	Y	Y	Y	Y	Y	Y			
Electronic Transmitter(IEC-60770)	Y	Y	Y	Y	Y	Y			
Transducer (IS-14570)	Y	Y	Y	Y	Y	Y			

R-Routine Test A- Acceptance Test Y – Test applicable

PROCESS CONNECTION AND PIPING

Tests / Items	Visual & Dimensions ®	GA, BOM, Layout of component & construction feature, Paint Shade/thickness ®	Flattening,flaring,hydrotest,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability of TBs/Devices Illumination,ground ing ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydrulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y*		Y		Y	Y							
Impulse pipes and tubes	Y		Y			Y						Y		
Socket weld fittings ANSI B-16.11	Y					Y						Y		Y
Compression fittings	Y					Y					Y	Y	Y	
Instrument valves & Valve manifolds	Y					Y					Y	Y		
*-applicable for painted junction boxes														

®-Routine Test A-Acceptance Test Y – Test applicable

ELECTRICAL ACTUATOR

Test/Attributes Characteristics / ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Local/ Remote (Open-Stop-Close) Operation®	Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR with Integral Starter , Non- Intrusive Electrical Actuator (EN15714-2)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

® - Routine Test A - Acceptance Test Y - Test applicable

Note:

1) SIL 2 certificate

LOCAL CONTROL PANEL

Tests / Items	Pre Power on Check #) (R)	Post Power on Check (%) (R)	Internal cabling / Wiring checking(R)	Door Alignment, waviness, and Locking (R)	Louvers, Fans, wire mesh, Lifting arrangement (R)	HV / IR on wired panels (R)	Paint Shade, Thickness and illumination (R)	Hardware/Make as per BOM (R)	Dimensions, GA, layout (R)
Local Control Panel	Y	Y	Y	Y	Y	Y	Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

Note:

2) Pre power on check: - Wire dressing, looseness, Availability of Fuses and MCB, Modules are inserted properly, Earthing connection, Input Voltage checking.

3) Manufacturer also needs to include their practices and procedure in MQP along with relevant supporting documents.

Sub Vendor List

TECHNICAL SPECIFICATION
LARA STPP STAGE-II (2X800 MW) COMPRESSED AIR SYSTEM

SUB VENDOR LIST & INSPECTION CATEGORISATION

S. No.	Item	QP/ Insp.	Proposed Subvendor	Place of Manufacturer	Remarks
1	AIR DRYING PLANT (HOC TYPE)	I	ACIL	BELGIUM	
			MELLCON ENGRS PVT LTD	GR NOIDA	
			DELAIR INDIA LTD	GURGAON	
			SUMMITS HYGRONICS	COIMBATORE	
			INDCON	DELHI	
			TRIDENT PNEUMATIC PVT LTD	COIMBATORE	
2	MS/GI Pipes –ERW IS 1239 / IS 3589	III	SAIL	Rourkela	
			JINDAL SAW LTD	BELLARY	SAW UP TO 3632 OD THICKNESS 16 MM
			Surya Roshni	ANJAR	SAW UP TO 2032 OD
			PSL	Chennai/Vizag/Kutch/Daman	
			LALIT PIPES AND PIPES LTD	THANE	SAW 350 TO 1400 NB
			Samshi Pipes Industries	Vadodara	SAW 450 TO 2540 NB
			Mukut Pipes	Rajpura	SAW UPTO 1800 NB
			Mann Ind	Indore	SAW UPTO 1400 NB
			JCO PIPES	Chindwara	SAW UPTO 1600 NB
			Mukat Tanks and Vessels	Tarapur	SAW 200 TO 1200 NB
			Ratnamani	Kutch/Chhatral	SAW 600 TO 2600 NB SAW 400 TO 3600 NB
			Welspun	Anjar/Bharuch	SAW UPTO 2600 NB
			CAPACITE STRUCURES PVT LTD	THANE	406.4 MM TO 3874 MM OD
3	Forged/Formed fittings	III	EBY	Taloja	
			Siddarth & Gautam	Faridabad	
			Pipefit	Baroda	
			MS Fittings	Kolkata	
			Tube Products	Baroda	
			Bharat Forge	Pune	
			NL Hazra	Kolkata	
4	Ball Valve	II	Precision Engg	Nasik	upto 400NB 150 class
			SWIMS TECHNOLOGIES	HUBLI	
			Microfinish Valves Ltd	Hubli	
			Flow chem. Industries	Ahemdabad	upto 50 NB 800 Class: 350NB 150 class
			A V Valves	Agra	
			GM ENGINEERING PVT. LTD	Rajkot	
			L&T VALVES LIMITED	COIMBATORE	
			WELLCAST INDUSTRIES	AHMEDABAD	
			Belgaum Aqua Valve	Belgaum	

S. No.	Item	QP/ Insp.	Proposed Subvendor	Place of Manufacturer	Remarks
5	CS/FS Gate/Globe/Check valves	II	Foures Engg	Thane	
			L & T Valves	Coimbatore	
			LEADER VALVES LTD.	Jalandhar	
			KSB Pump Ltd	Coimbatore	
			Niton Valves India Pvt Ltd	Navi Mumbai/Aurangabad	
			BHEL	IVP GOINDWAL	
			HAWA ENGINEERS	AHMEDABAD	
			SWIMS TECHNOLOGIES	HUBLI	
			HITECH ENGG PVT LTD	AHMEDABAD	
6	Air Receiver	II	Integrated Engineers	Mumbai	
			Diamond Fabricators	Pune	
			Parkaire	Delhi	
			Temasme Vesselex	Noida	
			United Engineering Works	Nasik	
			PEERFINTUBES & ENGINEERING	Ambernath, Thane, MH	
7	After Cooler (Shell & Tube Type)	II	PEERFINTUBES & ENGINEERING	Ambernath, Thane, MH	
8	Safety Relief Valve	III	LEADER	JALANDHAR	
			SPIRAX MARSHALL	PUNE	
			FISCHER SANMAR	CHENNAI	
9	Pr./Vacuum/Dp Gauges	III	Auxitrol	U.K	
			Switzer (for DP gauge)	Chennai	
			Budenburg	U.K	
			A.N.Instruments	Kolkata	
			Bells Control	Kolkata	
			Manometer India	Mumbai	
			H Guru Industries	Kolkata	
			Ashcroft India	Kalol	
			General Inst.	Mumbai/Goa	
			Gluck India	Mumbai	
			BOSE PANDA INSTRUMENTS PVT.LTD.	Kolkata	
			Forbs Marshall	Hyderabad	
			Gauge Bourdon	Mumbai	
			H Guru Instruments	Bangalore	
			Baumer Technologies	Mumbai	
10	Pr./Vacuum/DP.switch	III	Barton Inst.system	USA	
			Indfoss	Ghaziabad	
			SOR	USA	
			Dressor	USA	
			Delta control	UK	
			Trafag	Ranipet	
			GIC(Gauges Bourdon)	Panvel	
			ASHCROFT INDIA PVT LTD.	USA/GERMANY	
			Switzer	Chennai	
11	Temperature Gauge	III	Budenburg	U.K	
			A.N.Instruments	Kolkata	
			Bells Control	Kolkata	
			H Guru Industries	Kolkata	
			General Inst.	Mumbai/Goa	
			H Guru Instruments	Bangalore	
			Forbs Marshall	Hyderabad	
			Goa Instruments	Goa	
			Goa Thermostatics Instruments Pvt. Ltd.	Goa	
			Gauge Bourdon	Mumbai	
			Baumer Technologies	Mumbai	
			Ashcroft India	Kalol	

S. No.	Item	QP/ Insp.	Proposed Subvendor	Place of Manufacturer	Remarks
12	Transmitters (PT, TT, DPT, LT)	III	ABB	Faridabad	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
			Yokogawa	Bangalore	
			Emerson	Mumbai	
			(ABB) -2600T series	Faridabad/Italy	
			Pune Techtrol Pvt. Ltd.	Pune	Only for capacitance Type Level Transmitter
			SIEMENS LIMITED	Mumbai	
			SMART INSTRUMENTS LTD, BRAZIL	Mumbai	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
			SBEM PVT. LTD.	Pune	Only for capacitance Type Level Transmitter
			TOSHNIWAL INDUSTRIES PVT. LTD.,	Ajmer	
			V. AUTOMAT & INTRUMENTS (P) LTD.	NEW DELHI	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS
			Honeywell Automation	NEW DELHI	
			Fuji	Japan	
			NIVO CONTROLS PVT. LTD.	Indore	For Capacitance type only
			Moore Industries International Inc.	CALIFORNIA, USA	Indian Associate - Chemtrol
			Endress + Hauser (India) Pvt. Ltd.,	NEW DELHI	TEMP TRANSMITTER ONLY
13	Transmitters Profibus type	I	ABB	Faridabad	
14	Flow Switch	III	Switzer	Chennai	
			Levecon	Kolkata	
			DK Instruments	Kolkata	
			Delta	UK	
			ITT Barton	USA	
15	Temp Sensor	III	Pyro Electric	Mumbai	
			Detriv	Mumbai	
16	Flow Indicator	III	Sigma	Mumbai	
			Eureca	Pune	
17	Auto Drain Trap	III	Pennant	Pune	
			Forbes Marshall	Pune	
18	Dew point meter	III	GE Sensing	Ireland	
			Michell Instruments	UK	
			XENTAUR	USA	
			Shaw	UK	
19	Flow Meter / Rota Meter	III	Trac	Hyderabad	
			Eureca	Pune	Rota Meter only
			Flow Star Engg.	Faridabad	Rota Meter only
			Flow Tech instruments	Vadodara	Rota Meter only
			Instruments Engineers Pvt. Ltd.	Hyderabad	Rota Meter only
			Scientific Devices (Bombay) Pvt. Ltd.	Mumbai	Rota Meter only
			Emerson Process Management	singapore	Vortex Type
			ABB Ltd.	India	Vortex Type
			Krohne Marshall Pvt. Ltd.	India	Vortex Type
			Endress + Hauser (I) Pvt. Ltd	India	Vortex Type
			Yokogawa Electric Corporation(other than high temp & h2 services)	japan	Vortex Type
			Krohne Messtechnik Gmbh & Co. Kg	Germany	Vortex Type
20	Solenoid Valve	III	HERION	GERMANY/ ITALY	
			ROTEX AUTOMATION LTD.	V V NAGAR/ BARODA	
			ASCO	CHENNAI	
			JEFFERSON	ARGENTINA	
			AVCON	MUMBAI	

S. No.	Item	QP/ Insp.	Proposed Subvendor	Place of Manufacturer	Remarks
21	Cable trays (max 300 meters)	III	INAR PROFILE	ANNAKAPALLI	
			ANAND UDYOG	THANE	
			MJ ENGG.	DELHI	
			INDIANA	MUMBAI	
			TECHNO ENGG	CHANDIGARH	
			JAMUNA METAL	DELHI	
			INDUSTRIAL PERFORATION	KOLKATA	
			VATCO	MUMBAI	
22	Cable Glands	III	SUNIL& COMPANY	KOLKATA	
			ARUP ENGG	KOLKATA	
			COMMET	MUMBAI	
			QUALITY PRECISION	KOLKATA	
23	Cable Lugs	III	DOWELLS	MUMBAI	
			CHETNA ENGG	NASIK	
			3D	VALSAD	
24	INSTRUMENT FITTINGS	III	AURA INCORPORATED	NEW DELHI	
			Astec Valves & Fittings Pvt. Ltd.,	Mumbai	
			Arya Crafts & Engineering Pvt. Ltd.	Mumbai	
			Comfit & Valve Pvt. Ltd.	Nandasan-Gujarat	
			FLUIDFIT ENGINEERS PVT. LTD.	Mumbai	
			Fluid Controls Pvt. Ltd.	Mumbai	
			HP VALVES & FITTINGS INDIA PVT. LTD.	Chennai	
			PRECISION ENGINEERING INDUSTRIES	Mumbai	
			Panam Engineers,	Mumbai	
			Perfect Instrumentation Control (India) Pvt. Ltd.	Mumbai	
			VIKAS INDUSTRIAL PRODUCTS	Noida	
25	Fibre Optic Cable	III	Birla Ericsson	Rewa	
			Finolex	Pune/Goa	
			Aksh Fibre	Bhiwadi	
			U M Cables Ltd	Silvassa (Daman)	
			KEC International Ltd	Mysore	
			Apar Industries Limited	Valsad (Gujrat)	
			HFCL	Goa	
			R&M	Switzerland	
			Molex	UK	
			Corning	USA	
26	Junction Box	III	AJMERA INDUSTRIAL & ENGINEERING WORKS	Mumbai	For galvanised & FRP Junction boxes
			FLEXPRO ELECTRICALS PVT. LTD.	Navsari, Gujarat	Metal type Junction boxes only
			K.S.INSTRUMENTS PVT.LTD.	Bangalore	
			SUCHITRA INDUSTRIES	Bangalore	`
			Shrenik & Company,	Ahemdabad	
27	PAINTS	III	Asian Paints (I) Ltd.	Mumbai	
			Berger Paints India Ltd	Delhi	
			Goodlass Nerolac	Mumbai	
			Jenson & Nicholson (I) Ltd	Gurgaon	
			CDC carboline (I) Ltd.	Delhi	
			Shalimar Paints Ltd.	Gurgaon	
			Addison Paints Ltd	Chennai	
			Grand Polycoat	Mumbai	
			Bombay Paints	Mumbai	
			Jotun Paints	Pune	
			Hemple Paints	Singapore	

NOTES:

1) INSP CAT I : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED BY CUSTOMER AND FINAL ACCEPTANCE WILL BE ON PHYSICAL INSPECTION WITNESS BY BHEL & CUSTOMER.

2) INSP CAT II : FOR THOSE ITEMS THE QUALITY PLANS ARE APPROVED BY CUSTOMER. HOWEVER NO PHYSICAL INSPECTION WILL BE DONE BY BHEL / CUSTOMER. THE FINAL ACCEPTANCE BY BHEL / CUSTOMER SHALL BE ON THE BASIS OF REVIEW OF DOCUMENTS AS PER QP.

3) INSP CAT III : FOR THOSE ITEMS FINAL ACCEPTANCE BY BHEL / CUSTOMER BASED ON BIDDER'S COC.

4) The sub vendor list enclosed is indicative only and is subject to approval / acceptance by customer (NTPC). Bidder to propose his sub vendor list with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any technical, commercial & delivery implications to BHEL/NTPC

PAINTING REQUIREMENT

ITEM	PAINTING REQUIREMENT
AIR COMPRESSOR	AS PER OEM STANDARD COMPLIANT TO INDUSTRIAL GR. PAINT
AIR DRYER	AS PER OEM STANDARD COMPLIANT TO INDUSTRIAL GR. PAINT
AIR RECEIVER	REFER COMPLIANCE DRAWINGS (GA OF AIR RECIEVER)
PIPING & VALVES	NA, AS GI MATERIAL BLUE SHADE STRIP ON PIPES @ 2M REGULAT INTERVAL

	PACKING REQUIREMENT
	COMMON GUIDELINES FOR PACKING
1	**GENERAL:**
1.1	The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.
1.2	All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.
1.3	The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement.
1.4	All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The CAS supplier shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The CAS supplier shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The BHEL's Inspector shall have right to insist for completion of works in shops before
1.5	Each package shall be accompanied by a packing note quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.
2.	**TYPES OF PACKING:**
	The following 5 types of packing have been standardized for packing of General Components/ Assemblies.
a	**OP**' - Open Type.
b	**PP**' - Partially Packed.
c	**CP**' – Crate/Box Packing - Components/Equipment requiring physical protection.
d	'**CQ**' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
e	**'CR'** - Case Packing – Electrical/Electronic 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**
3.2.1	Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene
3.2.2	Film. 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

3.4.1	Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel 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 with100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.
3.4.2	For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.
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 packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel.
4	**PREPARATION OF PACKING CASES**
4.1	**DIMENSIONS:**
a)	Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units/manufacturers.
b)	Width of all planks including the tongue shall be more than 125mm and after plaining it shall be minimum 100mm.
c)	Minimum number of planks shall be used for a shook.
d)	Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel.
e)	Width of binding planks shall be minimum 100mm.
f)	Distance between any 2 binding planks shall be less than 750mm.
g)	diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm.
h)	Distance of the outer edges of these planks from the edge of case shall be less than 250mm.
i)	Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.
4.2	**HOOP IRON STRIPS**
	These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust. If sufficient nailing is done for bigger boxes, strapping need not be done.
4.3	**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.
4.4	**MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM**
	100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film 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.
4.5	**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.
5	**MULTI LAYER CROSS LAMINATED POLY FILM WHILE PACKING OF CUBICLES/CASING**
5.1	The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 4.4) using blue nails wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.
5.2	The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film. 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.
5.3	The cubicles shall be covered with Multi-layer cross laminated poly film.
6	**PACKING OF LOOSE ITEMS/SPARES**
6.1	Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 5.4) using blue nails.
6.2	Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.

6.3	Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film. 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.
6.4	Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.
6.5	Silica gel held in cotton bags shall be kept at proper places in the box.
6.6	Packing slip kept in polyethylene bag shall be placed in the box.
6.7	Two numbers of hoop iron strips shall be strapped tightly on the case using clips.
6.8	Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
6.9	Loose items to be kept inside the cubicle/casing
	- Other items which are given loose in addition to cubicle shall be packed in separate boxes.
7	**TYPICAL PATTERN OF WOODEN BOX**

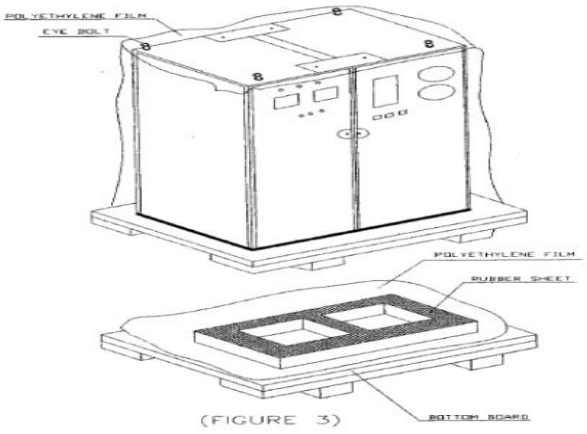


Figure 2

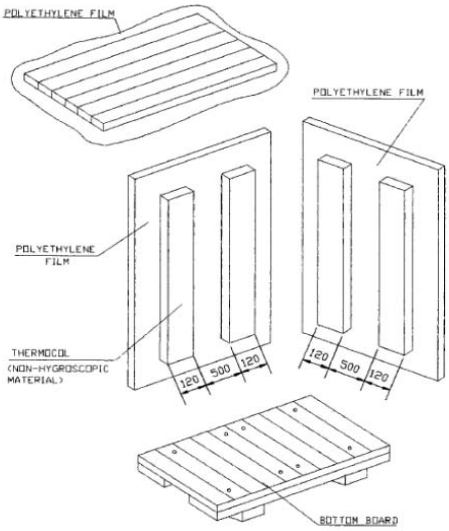
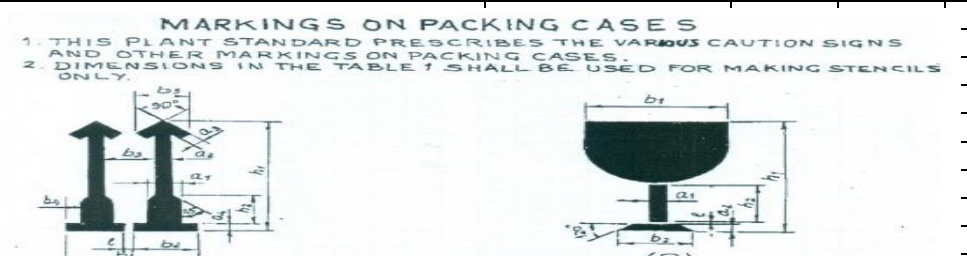


Figure 1

8	**SEALED PACKING:**
	Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.
9	**MARKINGS/STENCILINGS**
9.1	**"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".**
9.2	Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.
9.3	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.
9.4	Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.
9.5	Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.
9.6	In case the size of package is small for using the stencils, then hand written letters/figures shall be allowed.



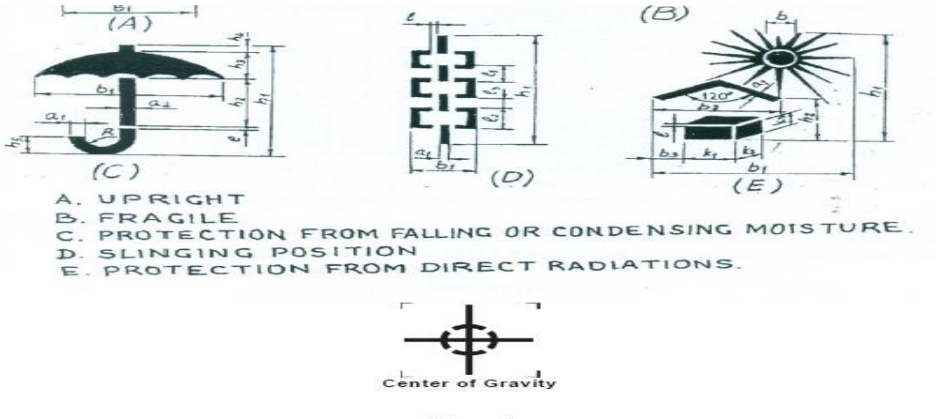


Figure 3

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

Figure 4 – TYPICAL MARKING PLATE (225 X 170)

Figure 5

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

10 STANDARD METHOD OF PACKING

Table 1 - Standard Method of Packing

S. No.	DESCRIPTION	CASE	CRATE	BUNDLE	BARE	DRUM
1	AIR COMPRESSORS	O				
2	AIR DRYERS	O				
3	AIR RECEIVERS				O	
4	PIPING				O	
5	FITTINGS, VALVES	O				
6	INSTRUMENTS	O				
7	PANELS	O				
8	UPS	O				
9	HOSES & AIR GUNS		O			
10	CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL,		O			
11	OPERATIONAL SPARES , MAINTENANCE TOOLS AND TACKLES	O				
12	ALL OTHER LOOSE ITEMS	O				

Note:

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.

BILL OF QUANTITY

S. No.	Description	Quantity & Unit
A	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for Supply part, Services part, Mandatory spares, Engineering Charges and AMC comprising of design (i.e. preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, mandatory spares along with spares for erection (as required), start-up spares (as required) and commissioning spares (as specified), forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site, carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff (if applicable) and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order.	**1 Lot**
1	Total lump sum firm price inclusive of all prevailing taxes, duties and other levies for **Supply part** comprising of manufacturing, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables alongwith spares for erection as required, startup and commissioning spares as required, forwarding, proper packing, **parts / spares required during warranty period** (against defects in design,materials,construction and workmanship) shipment and delivery at site, for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order. (Break-up as per Annexure-I)	1 Lot
2	Total lumpsum firm prices inclusive of all prevailing taxes, duties and other levies for **Services part** comprising of unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site and carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff (if applicable) and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order.	1 Lot
3	Total lumpsum firm price inclusive of all prevailing taxes, duties and other levies for **Mandatory spares** comprising of manufacture, fabrication, assembly, inspection / testing (as applicable) at vendor's & sub-vendor's works, painting, forwarding, proper packing, shipment, delivery at site & guarantee as per tender technical specification above, amendment & agreements till placement of order. (Price break up of mandatory spares is to be furnished as per Annexure- II)	1 Lot
4	Total lumpsum firm price for **ENGINEERING CHARGES** comprising of design (i.e Preparation & submission of drawings/documents including " AS BUILT" drawings and O&M Manuals and engineering as per tender technical specification above, amendment & agreements till placement of order.	1 Lot
5	Total lumpsum firm price inclusive of all prevailing taxes, duties and other levies for AMC (Annual Maintenance Contract) for one (1) years from the date of successful commissioning of Compressed Air System. (as per Section 7, Vol III of Technical Specification)	1 Lot
B	Break up of Supply items is as below	
1	Instrument air Compressors (Oil Free Screw / Centrifugal type) each of minimum 55 NM3/Min capacity @ 8.0 kg/cm2 (min.) discharge pressure with suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system, cable lugs, glands and other accessories (as required / as specified) **but excluding electric motor drive**.	4 Nos.
2	Air Drying Plants HOC **type (Twin Tower / Rotary Drum)** of minimum 55 NM3/min. capacity for Air Compressor with all instruments, control panels, including Electronic due point meter and other accessories as specified.	4 Nos.
3	Service air Compressors (Oil Free Screw / **Centrifugal** type) each of minimum 55 NM3/Min capacity @ 8.0 kg/cm2 (min.) discharge pressure with suction filter with silencer, inter cooler and after cooler with moisture separators, automatic drain traps, instruments, control system, cable lugs, glands and other accessories (as required / as specified) **but excluding electric motor drive**.	3 Nos.

4	Air Receivers required for Compressed Air System of minimum 10 Cu.M capacity each with instruments, relief valve, isolation valve, drain connection with automatic trap stations (zero purge air loss type) and other accessories as specified.	12 Nos.
5	Air Receivers required for Compressed Air System of minimum 02 Cu.M capacity each with instruments, relief valve, isolation valve, drain connection with automatic trap stations (zero purge air loss type) and other accessories as specified.	1 No.
6	Inter connecting cooling water, drain piping and compressed air piping as specified including fittings and valves etc. for complete Compressed air system.	1 Lot
7	Instruments as specificed.	1 Lot
8	Interface module(s), JB's for the overall control & monitoring of compressed air system through DDCMIS including common Sequencing Panel.	1 Lot
9	E-Learning Package: e-learning packages for each equipment & for complete compressed air system.	1 Lot
10	Operational spares (as per Annexure-VI) for Compressed air system.	1 Lot
a	Lube oil (Qty. for 1 Lot in Ltr. shall be as per oil tank capacity for One Compressor)	7 Nos.
b	Lube oil filters with seals	14 Nos.
c	Air filters with gaskets	14 Nos.
d	Service kit including seals, washers and rings for inter cooler & after cooler (as applicable)	7 Nos.
C	Break up of Mandatory Spares is as below:	
1.00.00	COMPRESSED AIR SYSTEM	
1.01.00	Oil free Screw Air Compressor (as applicable)	
(i)	Complete HP Stage with HP element.	1 No.
(ii)	Complete LP stage with LP element	1 No.
(iii)	Void	
(iv)	LP stage Pinion	1 No.
(v)	HP stage Pinion	1 No.
(vi)	Air Oil Filter Kit	4 Nos.
(vii)	After cooler Safety Valve (if applicable)	1 No.
(viii)	Inter Cooler Safety Valve (if applicable)	1 No.
(ix)	Oil Pump kit	2 Nos.
(x)	After cooler drain valve kit (if applicable)	1 No.
(xi)	Inter cooler drain valve kit (if applicable)	1 No.
(xii)	Air receiver drain/moisture trap	1 No.
(xiii)	‘O’ Rings for oil cooler	8 Nos.
(xiv)	Moisture separators for Aftercooler (if applicable)	2 Nos.
(xv)	Moisture separators for Intercooler (if applicable)	2 Nos.
1.02.00	Centrifugal Compressor (as applicable)	
1.02.01	Pinion Shaft Journal Bearing Assembly	2 Sets
1.02.02	Thrust Bearing Assembly	2 Sets
1.02.03	Shaft Seals for Air-Oil (All stages)	2 Sets
1.02.04	Gasket / O rings	3 Sets each type/size
1.02.05	Air Filter Elements	4 Sets each type/size
1.02.06	Lub Oil System	
1.02.06.1	Main oil pump complete	1 No
1.02.06.2	Aux. oil pump complete	1 No
1.02.06.3	Complete coupling for Main & Aux. oil pump, spacer	1 No
1.02.06.4	Cartridge filter elements with gaskets and seals	4 Sets
1.02.06.5	Motor Bearings	2 Sets
1.02.07	Drain / Moisture Trap	2 Set of each type/size.
1.02.08	Oil Cooler Gaskets & Seals	2 sets
1.03.00	AIR DRYING PLANT FOR IA SYSTEM (Twin tower Type) (As applicable)	
1	Pre filter element (Ceramic candle or as applicable)	2 sets
2	After filter element (Ceramic candle or as applicable)	2 sets
3	Heater element (if applicable)	1 sets
4	Blower bearing (if applicable)	1 sets
5	Blower motor bearing (if applicable)	2 sets
6	Valves & Valve Actuators (pneumatic/hydraulic)	2 sets
7	Heater coil for temperature stabilization (for HOC type) (as applicable)	2 sets
1.04.00	Valves (within the compressor house having actuators) along with actuator	2 Nos. of each type / rating / size

1.05.00	Void	NA
1.06.00	MEASURING INSTRUMENTS	
1	Electronic Transmitters	
(i)	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level, etc.)	2 Nos. of each type and model
2	Temperature elements	
(i)	RTD's of each type and length	2 Nos. of each type and length
(ii)	Thermocouples of each type like K-type, R-type, metal etc. and length	2 Nos. of each type and length
(iii)	Thermowell	2 Nos. of each type and length
(iv)	Temperature transmitters	2 Nos of each type
3	Process Actuated Switch Devices Includes all types of Pressure, differential pressure, flow, temperature, differential temperature, level switch Devices	2 Nos. of each type and model
4	Dew Point meters	1 No.
1.07.00	MICROPROCESSOR BASED/PLC BASED CONTROL/ELECTRONIC BASED CONTRAL PANEL (AS APPLICABLE)	
1	Fully programmed controller of electronic modules of each type (as applicable)	1 No.
2	Power supply module (if applicable)	1 No.
1.08.00	Rotary drum type Air drying plant for Instrument Air system (As applicable)	
	Drive assembly consisting of motor, gear boxes, drive shaft & coupling	1 set

DOCUMENTATION REQUIREMENT

	TECHNICAL SPECIFICATION **LARA STPP STAGE-II (2X800 MW)** **COMPRESSED AIR SYSTEM**	**PE-TS-508-555-A001** **Rev. No. 00** **Date: MAR. 2024**

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY ALL THE BIDDERS ALONG WITH THE BID

S. No.	DOCUMENT TITLE
1	Supporting Documents meeting PQR requirements.
2	Compliance cum Confirmation certificate with bidder's sign & stamp.
3	"No Deviation" Certificate duly Stamped and Signed.
4	Un-priced bid- clearly indicating 'QUOTED' and 'NOTQUOTED' against each item.
5	Filled, Signed & Stamped copy of Guaranteed Power Consumption for Compressed Air System.

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT ALONG WITH SUBMISSION SCHEDULE

S.No.	BHEL DRG/DOC No.	TITLE	BASIC ENGG DRG/DOC (Y/N)	SCHEDULED SUBMISSION, DAYS FROM LOI DATE
1	PE-V0-508-555-A001	QUALITY PLAN OF AIR COMPRESSOR FOR COMPRESSED AIR SYSTEM	Y	21
2	PE-V0-508-555-A002	QUALITY PLAN OF AIR DRYING PLANT FOR COMPRESSED AIR SYSTEM	Y	21
3	PE-V0-508-555-A003	QUALITY PLAN OF AIR RECEIVER FOR COMPRESSED AIR SYSTEM	Y	21
4	PE-V0-508-555-A027	QUALITY PLAN OF BOUGHT OUT ITEMS (BOI) FOR COMPRESSED AIR SYSTEM	Y	14
5	PE-V0-508-555-A029	SUB-VENDOR LIST WITH INSPECTION CATEGORISATION PLAN FOR COMPRESSED AIR SYSTEM	Y	15
6	PE-V0-508-555-A005	TDS & GA OF INSTRUMENT AIR & SERVICE AIR COMPRESSORS INCLUDING PERFORMANCE CURVES	Y	21
7	PE-V0-508-555-A006	TDS & GA OF AIR DRYING PLANT FOR COMPRESSED AIR SYSTEM	Y	21
8	PE-V0-508-555-A008	TDS & GA OF VALVES FOR COMPRESSED AIR SYSTEM	Y	42
9	PE-V0-508-555-A010	TDS & GA OF AIR RECIVER FOR COMPRESSED AIR SYSTEM	Y	28
10	PE-VO-497-555-A030	TDS & GA OF START UP COMPRESSOR &AIR DRYER FOR CENTRIFUGAL COMPRESSOR (IF APPLICABLE)	Y	28
11	PE-V0-497-555-A025	DATASHEET OF INSTRUMENT (INCLUDING, TEMPERATURE ELEMENTS, TRANSMITTERS AND LOCAL INDICATORS), I/O LIST, BOM AND MANDATORY SPARES FOR COMPRESSED AIR SYSTEM	Y	42
12	PE-V0-508-555-A015	COMPRESSOR HOUSE LAYOUT	Y	21
13	PE-V0-508-555-A016	P&I DIAGRAM OF AIR COMPRESSOR FOR COMPRESSED AIR SYSTEM	Y	21
14	PE-V0-508-555-A017	P&I DIAGRAM OF AIR DRYER FOR COMPRESSED AIR SYSTEM	Y	21
15	PE-V0-508-555-A018	P&I DIAGRAM OF COMPRESSED AIR SYSTEM WITHIN COMPRESSOR HOUSE	Y	21
16	PE-V0-508-555-A019	OPERATION, CONTROL PHILOSOPHY & I/O LIST OF COMPRESSED AIR SYSTEM OF COMPRESSED AIR SYSTEM	Y	42
17	PE-V0-508-555-A020	ELECTRICAL & INTERNAL WIRING DIAGRAM FOR COMPRESSOR & DRYER PANEL FOR COMPRESSED AIR SYSTEM	Y	50
18	PE-V0-508-555-A021	ELECTRICAL FEEDER LIST FOR COMPRESSED AIR SYSTEM	Y	21
19	PE-V0-508-555-A022	CONTROL CABLE SCHEDULE FOR COMPRESSED AIR SYSTEM	Y	60
20	PE-V0-508-555-A023	PG TEST PROCEDURE FOR COMPRESSED AIR SYSTEM	N	75
21	PE-V0-508-555-A024	O&M MANUAL-COMPRESSED AIR SYSTEM	N	90
22	PE-V0-508-555-A024A	E-LEARNING MODULE OF COMPRESSED AIR SYSTEM	Y	90

Notes:

1	Bidder to follow the following the drawing submission schedule: i.)Ist submission of drawings from date of LOI as per the submission schedule. ii.)Every revised submission incorporating comments – within 7 days.
2	Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

DRAWINGS & DOCUMENTS TO BE SUBMITTED AS FINAL/AS-BUILT DOCUMENT

S. No.	DOCUMENT TITLE	No. of prints (Sets)	No. of portable hard disk
1	APPROVED DOCUMENTS	3	0
2	AS BUILT DRAWINGS/ DOCUMENTS	3	Part of O&M Manual
3	O&M MANUAL	3	2
4	PERFORMANCE AND FURNTIONAL GUARANTEE TEST REPORTS	3	Part of O&M Manual

COMPLIANCE CERTIFICATE

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

1	The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under “exclusion and those resolved as per ‘Schedule of Deviations’, with regard to same.
2	There are no other deviations w.r.t. specifications other than those furnished in the ‘Schedule of Deviations’. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the ‘Schedule of Deviations’.
3	Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
4	All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
5	The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL decision shall be binding on the bidder whenever the deficiency is pointed out. For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.
6	The commissioning spares shall be supplied on ‘As Required Basis’ & prices for same included in the base price itself.
7	All sub vendors shall be subject to BHEL/CUSTOMER approval in the event of order.
8	Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions.
9	In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant’s comments. No extra claims shall be put on this account.
10	Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL’s office for across the table resolution of issues and to get documents approved in the stipulated time.

11	As built drawings shall be submitted as and when required during the project execution.
12	The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
13	Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component
14	Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
15	In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor’s account and shall not be used as a reason for extension in contract completion.

Signature of authorised Representative

Name and Designation:

Name & Address of the Bidder:

Date:

PRE-QUALIFYING REQUIREMENTS (TECHNICAL)

BHEL-PEM-MAUX
PRE-QUALIFICATION CRITERIA

	PROJECT: LARA STPP STAGE-II (2X800 MW) **PACKAGE: COMPRESSED AIR SYSTEM** **PRE-QUALIFICATION REQUIREMENT**	**PE-TS-508-555-A001**	
		DATE	**12/04/2024**
		Rev No.	**00**

1.	• The bidder should have designed, manufactured, supplied, erected/supervised erection and commissioned/supervised commissioning of at least one (1) number non-lubricated oil free screw type air compressor of minimum capacity 20 NM3/min or at least one (1) number centrifugal air compressor of minimum capacity 50 NM3/min and at rated discharge pressure of 8 kg/cm2 (g), which should have been in successful operation for minimum one (1) year as on 03.03.2023. • The Air Drying Plant (A.D.P) shall be supplied from such manufacturers who have manufactured and supplied at least one (1) number Air Drying Plant of capacity 50 NM3/min or more and the type same as offered, which should have been in successful operation.
2.	The Bidder has to submit following supporting documents meeting above mentioned pre-qualifying requirement: Copy of minimum one(1) performance certificate (in English) from end user along with copy of related Purchase Order (PO) or Letter of Intent(LOI) or letter of Award (LOA) or Work Order (WO).
3.	Bidder shall submit design documents to substantiate technical parameters specified in PQR, if the same is not mentioned in performance certificate / purchase order.
4.	Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.
5.	Notwithstanding anything stated above, CUSTOMER/BHEL reserves the right to assess the capabilities and capacity of the Bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of the Employer.
6.	Consideration of offer shall be subject to customer's approval of bidders, if applicable.
7.	After satisfactory fulfilment of all the above criteria / requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.
8.	The bidder shall meet PQR based on its own credentials. Bid from joint venture (JV) company / Consortium bid is not acceptable.

Sub : Sub-Qualifying Requirements for the Compressed Air System stipulated in Clause No. 4.7 of Sub-Section-IA, Part-A, Section-VI of Technical Specification of Bidding Documents.

Sl.No.	Item	Plant 1

A) Air Compressor

In line with the Sub-qualifying requirements stipulated in Clause 4.7 of Sub-Section-IA, Part-A, Section-VI, we / our sub-vendor confirm that we/our sub-vendor have designed, manfactured, supplied, erected /supervised erection and commissioned/supervised commissioning of atleast one (1) no. non-lubricated oil free screw type air compressor of minimum capacity 20 NM3/min each or atleast one (1) no. centrifugal air compressors of minimum capacity 50 NM3/min each and at rated discharge pressure of 8 Kg./cm2(g) which have been in successfull operation for atleast one (1) year.

1.	Name of the Project and its address where the system is installed	.....
2.	Name of the Client with address, name of Contact person(s) with tel.no. & fax no.	.....
3.	Order No. and date	
4.	Purchase order enclosed	Yes/No
5.	Name of the Manufacturer & Address	
6.	Date of commissioning of the compressors	
7.	No. of Compressors supplied	
8.	Whether the scope of work executed for the aforesaid compressors included the following	
	a) Designed	Yes/No
	b) Manufactured	Yes/No

Signature of authorized signatory.....

Sl.No.	Item		Plant 1
	c)	Supplied	Yes/No
	d)	Erected/supervised erection	Yes/No
	e)	Commissioned/supervised commissioning	Yes/No
9.	Brief Technical particulars of the Compressors (Bidder to fill)		
	a)	whether the compressor supplied was non lubricated oil free screw/centrifugal type air compressor	
	b)	Make & Model	
	c)	Capacity	
	i)	Flow (NM3/Min)	
	ii)	Discharge pressure [Kg/cm2/(g)]	
10.	Whether atleast **one (01)** compressor have been in successful operation for a period of not less than one (01) year.		
11.	Whether documentary evidence in support of above enclosed?		Yes/No

Signature of authorized signatory.....

B) Air Drying plant

We/our sub-vendor further declare that the Air Drying Plant (ADP) to be supplied under the package shall be sourced from manufacturer(s) M/s..... who have manufactured and supplied atleast one (1) no. Air Drying Plant each of capacity 50 NM3/min or more and the type same as offered, which have been in successful operation. The experience details of manufacturer are as follows :

Sl.No.	Item	Plant 1
1.	Name of the Project and its address where the system is installed	.....
2.	Name of the Client with address, name of Contact person(s) with tel.no. & fax no.	.....
3.	Order No. and date	
4.	Purchase order enclosed	Yes/No
5.	Name of the Manufacturer & Address	
6.	Date of commissioning of the Air drying unit	
7.	No. of Air drying unit supplied	
8.	Whether the scope of work executed for the aforesaid Air drying unit included the following	
	a) Manufactured	Yes/No
	b) Supplied	Yes/No
9.	Brief Technical particulars of the Air Drying unit (Bidder to fill)	
	a) Type	
	b) Flow (NM3/Min)	

Signature of authorized signatory.....

Sl.	Item	Plant 1
10.	Whether atleastone (01) air dryring plants have been in successful operation.	
11.	Whether documentary evidence in support of above enclosed?	Yes/No

Date :

(Signature).....

Place :

(Printed Name).....

(Designation).....

(Common seal).....

Signature of authorized signatory.....