Ref. Doc

# TECHNICAL JOB SPECIFICATION FOR ON-LINE TUBE CLEANING SYSTEM (OLTCS)

**PROJECT: 3.0 MT/YR INTEGRATED STEEL PLANT NAGARNAR, CHHATTISGARH.**

**CUSTOMER: NATIONAL MINERAL DEVELOPMENT CORPORATION (NMDC),NAGARNAR, CHHATTISGARH.**

**CONSULTANT: MECON LIMITED, RANCHI – 834002**

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# INDEX

# SECTION – A
# (SCOPE OF ENQUIRY)

**1.0.0 SCOPE**

This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his subcontractors works properly packed for delivery, Supervision of erection, commissioning of the items as follows:

**1.1.0 Condenser On Line Tube Cleaning system:**

Condenser ON Line Tube Cleaning System (OLTCS) complete with all accessories as per the requirement specified in different sections of this specification for:

- **TURBO BLOWER STATION , NMDC LIMITED**

The bidder's scope also includes installation checks, commissioning, trial runs & PG testing at site of ON Line Tube Cleaning System.

**2.0.0 GENERAL TECHNICAL INSTRUCTION:**

2.1.0 It is not the intent to specify herein all the details of design and manufacture. However the equipment shall conform in all respect to high standard of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/ owner, who will interpret the meaning of drawing and specification, and shall be entitled to reject any component or material, which in his judgment is not in full accordance herewith.

2.2.0 The omission of specific reference to any component/ accessory necessary for the proper performance of the equipment shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of the equipment at quoted prices.

2.3.0 In case of any deviation from this Technical specification including all annexures/attachment the same shall be indicated in the schedule of deviations enclosed as part of this specification. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.

2.4.0 BHEL's/Customer's representatives shall be given full access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.

2.5.0 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/Customer.

2.6.0 Un-priced copy of price bid shall be furnished along with the technical bid.

# SECTION – B
# (PROJECT INFORMATION)

## 1.0.0 General:

National Mineral Development Corporation (NMDC) is India's single largest iron ore producer and exporter. NMDC is involved in the exploration of wide range of minerals including copper, rock phosphate, lime stone, dolomite etc. It produces 30 million tons of iron ore from their fully mechanized mines.

NMDC is going to set up a new integrated steel plant of capacity 3.0 MTPA at Nagarnar, in the state of Chhattisgarh, India.

MECON Limited has been retained by NMDC as consultant to provide Detail Engineering and Consultancy services.

The Turbo Blowers shall provide required cold blast to the stoves of proposed blast furnace. The proposed Turbo Blowers shall be located inside the Power and Blowing Station building.
The Tenderer shall ensure the completeness of the system, its proper installation and performance at site.

The Tenderer has to agree and adhere to all the terms and conditions mentioned in the tender documents (GCC, GTS etc.) and deviation, if any, from them shall have to be categorically stated in writing during submission of tender.

## 2.0.0 Cooling water

The system shall be designed to suit the industrial water quality indicated below:

| Quantity | Units | Circulating water quality (with C.O.C 6) |
|---|---|---|
| Quantity of Water per hr. basis | m3/hr | -- |
| Fraction | | -- |
| | | |
| Ca as CaCO3 | ppm | 325.2 |
| Alkalinity as CaCO3 | ppm | 686.1 |
| Total Suspended Soilds | ppm | 50* |
| TDS | ppm | 1686.0 |

* expected TSS in circulating water is 50ppm

**Cooling water inlet Parameters**

Quantity: 3125 m3/hr (through each pass of condenser).
Pressure: 1.7 kg/cm$^2$g
Temperature: 35 $^0$C
Temperature rise: 9 $^0$C (max).

# SECTION-C
# (SPECIFIC TECHNICAL REQUIREMENTS)

## C1- MECHANICAL

### 1.0 GENERAL

The Condenser on Line Tube Cleaning System, complete with all accessories shall conform to the standard technical specifications PY-51142, Data Sheet-A and all the annexure enclosed herewith. However, wherever the details given in PY-51142 and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-C & PY-51142, Section-C shall prevail.

### 2.0 DESCRIPTION OF EQUIPMENTS:

### 2.1 On Line Tube Cleaning Systems (OLTCS) for Condenser:

The condenser On Line Tube Cleaning System (OLTCS) is intended to prevent formation of various forms of fouling and scaling in the condenser tubes. The water analysis report is given in project information in section B.

### 3.0 SCOPE OF SUPPLY UNDER THE SPECIFICATION IN THE BIDDER'S SCOPE FOR COLTCS.

3.1 The scope of supply includes three sets of OLTCS (one for each condenser). However, each OLTCS skid shall be common for two passes of each condenser. The details are listed in the data sheet – A.

3.2 Each set of OLTCS shall comprise the following:

a) Two Nos. Ball Separators at Condenser CW outlet pipe (one for each pass).
b) One No. common Ball recirculation pump with drive motor for each condenser.
c) One No. common Ball collector for each condenser.
d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of OLTCS.

e) Differential pressure measuring system shall be provided for each ball separator. DP measuring system shall comprise of DPT + DPG. Instrument shall be with *Remote seal/Capacitance type* arrangement. Stubs for DPT and DPG shall be independent.

f) Ball monitoring system comprising of an independent balls recirculation monitor and an independent balls oversize monitor.

g) Complete Pipe work, including interconnection piping, valves, distributors and injection nozzles, support installation materials shall be in Bidder's scope.

i) The Electrical and C&I scope is detailed in the subsequent sections.

j) All the field instruments stipulated in this specification shall be in Bidder's scope.

n) Commissioning balls and other commissioning spares on "As required basis".

o) Set of mandatory spares as indicated in Data Sheet A.

p) Supporting arrangement complete with foundation plates, anchor bolts, nuts, sleeves, inserts, all Installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.

q) Finish paints for touch up painting of equipment after erection at site, in sealed containers.

r) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.

s) Various drawings, data test reports/ certificates, instruction manuals for erection, operation and maintenance etc. as specified.

Any item not specified but required to make OLTCS a complete package shall also be in bidder's scope.

## 4.0 SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE:

The bidder's scope also includes the following services at site.

a) Installation checks (Erection in BHEL/ Customer scope, supervision of erection is in vendor scope.)
b) Commissioning of equipment.
c) Trial run for requisite period
d) Performance Testing

Bidder shall quote per diem rates for erection supervision, commissioning and PG test and the no. of days for each service shall also be indicated.

- **For drawings/ documents approval**

  In the event of order, all drawings/ documents in soft as well as hard copy shall be submitted within 2 weeks of LOI for approval. Within one week of receipt of BHEL comments, bidder's engineer will visit BHEL office along with revised documents and finalize same herein for further submission to Customer.

  Further on receipt of Customer comments, if required bidder's engineer shall visit BHEL/ Customer along with soft copy to resolve all issues and incorporate comments in the soft copy for across the table finalization and Category-1 approval.

**5.0. EXCLUSIONS:**

The following are excluded from the bidder's scope.

5.1 Civil foundation works required for installation
5.2 Erection of Equipment at site.

**6.0 DESIGN CONSTRUCTION:**

6.1 The balls collecting strainer and the thickness of main flange of ball collecting strainer shall be suitable for forces/ moments of condenser. The thickness of counter-flanges is given in datasheet-A.

6.2 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.

6.3 Housing/body of OLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However in no case thickness of housing/body shall be less than connecting pipe thickness as specified in Data Sheet-A of OLTCS.

6.4 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.2 m/ sec. in other pipe work.

**7.0.0 Performance Guarantee and Testing:**

The Tube Cleaning Systems shall be guaranteed to meet the performance requirements specified in PY-51142 and also for trouble free operation after commissioning. Schedule of performance, guarantees duly filled and signed shall be furnished with the bid.
The Performance guarantees of equipment shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL Consultant/Customer. If the guarantee period specified in the Commercial Specification is higher, same shall prevail.

**8.0.0 Performance Guarantee and Bid Evaluation criteria for Condenser ON Line Tube Cleaning System.**

8.1.0 Condenser on Line Tube Cleaning Systems

8.1.1 Performance Parameters to be guaranteed by bidders for OLTCS shall be as under:

i) Pressure drop in ball separator in clean condition viz. after back washing (0.15mwc).

ii) Percentage recovery of balls (min. 95% recovery)

iii) Life of Sponge Rubber Ball (Min. 4 weeks)

8.1.2 Bidder to note that bids shall be evaluated on account of pressure drop across ball collecting strainer (in clean condition) and liquidated damages on account of not meeting the same during PG test shall be in accordance with following:

A) Bid Evaluation Criteria & Liquidated Damages:

The bids received shall be evaluated for Pressure drop across balls collecting strainers:

- The permissible limit of pressure drop across balls collecting strainers in clean condition shall be 0.15 MWC.
- However no advantage shall be given for pressure drops quoted less than above permissible limit.
- The maximum acceptable limit for pressure drop across balls collecting strainer shall be 0.15 MWC. The bids will be technically rejected for pressure drops quoted higher than above maximum limit.

8.1.3 Other Guaranteed Par meters to be demonstrated at site:

i) Life of sponge rubber balls shall be minimum 4 weeks.
ii) Percentage recovery of balls shall be minimum 95%.

Any deviation to above balls life and percentage recovery will not be accepted.

Bidder to indicate the life of sponge rubber ball and nos. of balls lost during 1000 hours of plant operation in the Guarantee schedule and shall demonstrate same at site.

In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchaser's approval.

In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried out by him at site, the purchaser has the right to reject the equipment out rightly.

## 9.0.0 SPARES:

9.1.0 **Recommended Spares:**

The list of spares recommended by the manufacturer for two (2) years of reliable operation and maintenance of OLTCS shall be provided. The unit price of such spares shall not be included in base price but indicated separately in the schedule of prices for recommended spares.

9.2.0 **Mandatory Spares**

The list of mandatory spares to be quoted by the bidder is indicated in Data Sheet-A, prices for same shall be included by bidder in the equipment base price itself.

**10.0.0 Quality Plan**

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 and 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. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself.

**11.0.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE:**

a. Delivery of Equipment shall be as per NIT.

b. The drawings to be submitted by bidder in event of award of contract shall be as follows:

- Technical Data Sheets, P&ID, Installation Plan, for OLTCS.
- GA drawings, Details of BR Skid and C&I Document.
- Quality Plan.
- O & M Manual.

c. Drawings submission schedule as follows:

- 1st submission of following drawings from date of LOI
  - Technical Data Sheets, P&ID, GA Drawings, Details of BR Skid and C& I Document (Design Phy/ Write-Up) and Quality Plan - 2 weeks
  - Installation Plan - 4 weeks
- Every revised submission incorporating comments- within 10 days.

**12.0.0** The makes of various bought out items shall be subjected to purchaser's

approval in the event of order.

**13.0.0** It is mandatory for the bidders to submit along with the bid the deviations if any whether major or minor in the schedule of deviations only. **In the absence of deviations listed in the schedule of deviations the offer shall be deemed to be in full conformity with the specification "non-withstanding" anything else stated elsewhere in bidder's offer, data sheets etc. The implied/indirect deviations in data sheets etc. Shall not be binding on the purchaser.**

# C2 - ELECTRICAL

## 1.0 EQUIPMENTS AND SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER:

1.1 The scope of supply of electrical includes motor, drives/actuators, cable trays (within the skid for power, control and signal cables) and accessories such as lugs and glands at terminals for vendor supplied equipment.

1.2 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package is detailed in annexure-I.

1.3 Make of various equipment/ items in the scope of bidder shall be approval of owner during detailed engineering stage without any commercial implications.

1.4 Bidder shall furnish all AC as well as DC loads required for the system at different voltage level (e.g. 415VAC, 240 VAC, 220 VDC etc.) of all types, such as motor feeders, supply feeders in PESD format along with the offer.

1.5 All electrical equipment shall be suitable for the power supplies, fault levels and climatic condition indicated in project information enclosed with the specification.

1.6 All drawings, Datasheets, Quality plans, calculations, test reports, test certificates, etc. shall be submitted during detailed engineering stage as per format enclosed. The same shall be subject to approval without any commercial implications.

1.7 Technical requirements shall be as per Clause 3.0: List of enclosures.

## 2.0 DOCUMENT TO BE SUBMITTED ALONG WITH BID

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

a) A copy of this sheet “Electrical Equipment Specification for OLTCS” and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
b) List of erection and Commissioning spares.
c) List of erection & maintenance tools & Tackles.
d) Electrical Load requirement in the load data format.
e) Motor Data sheets
f) QPs

2.2 No technical submittal such as copies of datasheets, drawing, write-up, quality plans, type test certificates, technical literature, etc. is require during tender stage. Any such submission even if made, shall be considered

as part of offer.

## 3.0 LIST OF ENCLOSURES

3.1 Electrical scope between BHEL & Vendor (Annexure-I)
3.2 Technical specification for 415V Electric Motors.
3.3 Quality Plan for motors
3.4 Load data format

## SPECIFIC ELECTRICAL REQUIREMENT

| Sl no | Parameters | Unit | NMDC-TB-5 | REMARKS |
|---|---|---|---|---|
| | Motor | | | |
| 1 | DESIGN AMBIENT TEMP | Deg.C | | |
| 2 | VOLTAGE SUPPLY AND VARIATION | VOLT | | |
| 3 | FREQUENCY WITH VARIATION | Hz | | |
| 4 | COMBINED VOLTAGE & FREQUENCY VARIATION | | | |
| 5 | MAX ACCEPTABLE RATING OF MOTOR AT 415 V | KW | | |
| 6 | SYSTEM FAULT LEVEL AND ITS DUARTION | KA | | |
| 7 | SUTABILITY OF TERMINAL BOX FOR FAULT LEVEL AND DURATION | | | |
| 8 | CLASS OF INSULATION & TEMP RISE LIMITED TO | | | |
| 9 | MIN. STARTING VOLTAGE | | | |
| 10 | MOTOR RATING FOR SINGLE PHASE SUPPLY | | | |
| 11 | MAXIMUM LOCKED ROTOR CURRENT | %OF FLC | | |
| 12 | NOISE LEVEL | DB | | |
| 14 | DOP OF ENCLOSURE | | | |
| 15 | SPACE HEATER provided | | | |
| 16 | PAINT SHADE | | | |
| 17 | SPECIAL REQUIREMENT, if any | | | |

# ANNEXURE-I

## ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

| SL NO. | DATAILS | SCOPE SUPPLY | SCOPE OF ERECTION | REMARKS |
|---|---|---|---|---|
| 1 | MCC Panel | BHEL | BHEL | 1. Power supply to the individual drive shall be by BHEL. |
| 2 | Local Push Button Station (for motors) | BHEL | BHEL | Located near the motors. |
| 3 | Power cables and control cables for<br>a) Both end equipment in BHEL scope<br>b) Both end equipment in vendor's scope<br>c) One end equipment in vendor's scope | BHEL / Customer<br>Vendor<br>BHEL / Customer | BHEL / Customer<br>BHEL<br>BHEL / Customer | 1. Termination at BHEL equipment terminals by BHEL.<br>2. Termination at Vendor equipment terminals by Vendor. |
| 4 | Any special type of cable like compensating, co-axial, prefab, MICC, fiber optical etc. | Vendor | BHEL | |
| 5 | Cable trays, accessories & cable trays supporting system | Vendor (within the skid) and BHEL (outside the skid area) | BHEL | |
| 6 | Cable glands and lugs for equipments supplied by Vendor | Vendor | BHEL | 1. Tinned brass, double compression cable glands.<br>2. Solder less crimping type heavy duty tinned copper lugs for power cables<br>3. Solder less crimping type<br>4. Heavy duty copper lugs for control cables. |
| 7 | Conduit and conduit accessories for cabling between equipments supplied by vendor | Vendor | BHEL | Conduits shall be medium duty, hot dip galvanized cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer/ |
| 8 | Lighting | BHEL / Customer | BHEL / Customer | |
| 9 | Equipment grounding & lightning protection | BHEL / Customer | BHEL/ Customer | |
| 10 | Below grade grounding | BHEL / Customer | BHEL / Customer | |
| 11 | Lt Motors with base plates and foundation hardware | Vendor | BHEL | Make shall be subject to customer/BHEL approval |
| 12 | Mandatory Spares | | -- | Vendor to quote as per specification. |

| | | | | |
|---|---|---|---|---|
| 13 | Recommended O&M spares, E&C spares, erection and maintenance tools and tackles | Vendor | -- | Vendor to submit the list. |
| 14 | Any other equipment/ material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system). | Vendor | BHEL | |
| 15 | a) Input cable schedules (C & I) | Vendor | -- | Cable listing for C&I cables for vendor supplied equipment (soft copies in the BHEL cable schedule format) shall be furnished during detail engineering by vendor. |
| 16 | Equipment layout drawings | Vendor | -- | For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable routing details. Electrical equipment layout drawing shall be furnished for BHEL approval. |
| 17 | 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 BHE/customer after award of contract without any commercial implication.
3. For skid mounted system, 3 nos. supply of 415 V, 3 phase, 3 wire AC shall be provided by BHEL.

# C3 – CONTROL & INSTRUMENTATION

| S.NO. | PROJECT | NMDC – TB-5 | REMARLS |
|---|---|---|---|
| 1. | CONTROL SYSTEM | DCS | By BHEL |
| 2. | PROCESSOR CONFIGURATION FOR PLC SYSTEM | NA | |
| 3. | LOCATION OF CONTROL SYSTEM | NA | |
| 4. | CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER) | BHEL | |
| 5. | HARDWIRED INTERFACE WITH DCS (Y/N) | N | |
| 6. | A) COMMAND FROM DCS (Y/N} | Y | |
| 7. | B) STATUS FEEDBACK TO DCS (Y/N} | N | |
| 8. | C) GROUP FAULT ALARM TO DCS(Y/N) | N | |
| 9. | SOFTLINK TO DCS (YIN) | N | |
| 10. | A) COMMAND INTERFACE WITH DCS(Y/N) | Y | |
| 11. | B) STATUS MONITORING IN DCS(YIN} | N | |
| 12. | PROTECTION CLASS FOR PLC / RIO PANEL | NA | |
| 13. | CONTROL FROM PB's ON LCPIOWS ON LCP | N | |
| 14. | ANNUNCIATION ON LCP (Y/N) IF Y, MIN NO. OF HARDWIRED ALARMS I INDICATIONS | N | |
| 15. | MIMIC ON LCP (Y/N) | NA | |
| 16. | CONTROL FROM DCS IN CCR(Y/N) | Y | |
| 17. | TYPE OF SOFTLINK (TP/OFC) | NA | |

| | | | |
|---|---|---|---|
| 18. | COMMUNICATION CABLE SCOPE (BIDDER/ PESD/ EDN/ CUSTOMER) | Vendor upto JB and from JB to DCS by BHEL | |
| 19. | POWER SUPPLY AVAILABLE FOR BALL MONITOR (2-tV DC /110 V AC UPS /230 V AC UPS) | | |
| 20. | && POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE,415 VAC/ 1PHASE,110VUPSI 1PHASE, 230 V UPS) | NA | |
| 21. | REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY | NA | |
| 22. | UPS BATTERY CONFIGURATION (1X100% /2X100%) | NA | |
| 23. | BATTERY TYPE(LEAD ACID/ Ni-Cd) | NA | |
| 24. | BATTERY BACK-UP TIME (in minutes) | NA | |
| 25. | ACTUATOR WITH INTEGRAL STARTER (Y/N) | NA | |
| 26. | PG/ DPG/ PSI DPS/ PT/ OPT per Balls Collecting Strainer | DPT = 1 nos.<br>PG = 2 nos.<br>DPG = 1 nos. | |
| 27. | PG/ DPG/ PSI DPS/ PT/ OPT per Debris Filter | NA | NA |
| 28. | REMARKS | | |

**21.00 NOTES:**

1. As the system is DCS controlled, bidder to terminate all instrumentation and control elements in junction boxes for further cabling to DCS by BHEL/Customer. Bidder to provide input/output list, drives list, junction box schedule and termination details, recommended control logics *i* write-up etc. during detailed engineering.
2. Instrument rack and junction boxes shall be in bidder's scope of supply.
3. Bidder to furnish electrical load data during detailed engineering.
4. Alarm facia shall be under bidder's scope. no. of facia shall be decided during detailed engineering.

**LEGEND:**

DCS - DISTRIBUTED CONTROL SYSTEM

# DATA SHEET- A

## Condenser "ON Line Tube Cleaning System".

| Sl.No | Description | Unit | Performance/ Data |
|---|---|---|---|
| 1 | **GENERAL** | | |
| 1.1 | NOs. of tube cleaning systems sets required for station | NOS. | Three (03) skids. viz. One common skid for two pass of each condenser. |
| 1.2 | Liquid handled | | *Clarified Water/Industrial water as per Analysis* Attached along with project information in section B |
| 1.3 | Size of COLTCS | NB/Inches | *750 NB/ 30"* |
| 2.0 | **DESIGN** | | |
| 2.1 | Operating pressure at Condenser inlet flange | Kg/cm2 | Approx. 1.5 to 1.8 kg/cm2 (g) |
| 2.2 | Design Pressure for ball separator | Kg/cm2 | 3.5 kg/cm2 (g) & Vacuum 0.1 kg/cm2 (abs) |
| 2.3 | Design Mechanical Temperature | Deg. C | 65°C |
| 2.4 | Condenser Details | | |
| | a) Type of condenser | | Double Pass |
| | b) No. of Condenser sections | Nos. | 2 (Two) |
| | c) No. of passes per condenser section (viz. condenser half) | Nos. | 2 (Two) |
| | d) No. of tubes per condenser | | 5320 |
| | e) Tube Dia. OD x Thickness | | Ø 22 X 22 BMG |
| | • Top two rows - | | --- |
| | • Remaining- | | -- |
| | f) Length of tubes between ends. | mm | ------- |
| | g) Tube material | | SA 249 TP 304 |
| | h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser) | **MWC** | ***6.0 MWC, However the actual value can vary ±10%*** |
| 2.5 | CW flow rate through each ball separator | | |
| | - Normal | Cu.m/hr | 3125 |
| | - Maximum | Cu.m/hr | 3125 |
| 2.6 | Design differential pressure for ball separator strainer/screen | Kg/cm2(g) | 0.15 |
| 2.7 | Pressure drop across ball separator i.e. between inlet & outlet flanges in clean condition at normal flow. | MWC | 0.15 |
| 2.8 | Pressure drop across ball separator in chocked condition when strainer | MWC | Not to exceeds 0.30 |

| | | | |
|---|---|---|---|
| | back washing starts | | |
| 2.9 | No. of balls required for OLTCS per condenser section | Nos. | Minimum 10% of number of tubes |
| 3.0 | **CONNECTING PIPE DETAILS** | | |
| 3.1 | **Condenser inlet pipe** | | |
| | a) Material | | *Carbon Steel to* IS – *2062 Gr. B* |
| | b) OD X Thickness | mm | 750 x 14 |
| 3.2 | Condenser outlet pipe | | |
| | a) Material | | *Carbon Steel to* IS – *2062 Gr. B* |
| | b) OD X Thickness | mmXmm | 750 x 14 |
| 4.0 | **MATERIALS OF CONSTRUCTION** | | |
| 4.1 | BALL SEPARATOR | | |
| | a) Body / housing | | CS to IS-2062 Gr. B with Epoxy painted inside (with minimum housing thickness same as connecting pipe thickness) |
| | b) Screen / Strainer | | SS-316 |
| | c) Strainer shaft | | SS-316 |
| | e) Internal Hardware including nuts, bolts , etc. | | SS-316 |
| | f) Site Glass provision | | YES |
| 4.2 | BALL RECIRCULATING PUMP | | |
| | a) Casing | | Cl as per IS-210 FG 260 |
| | b) Impeller | | SS- 316 |
| | c) Shaft | | SS- 316 |
| 4.3 | BALL COLLECTOR | | |
| | a) Body / housing | | Carbon Steel: IS-2062 Gr. B with epoxy painted inside |
| | b) Screen / Strainer | | SS-316 |
| | c) Strainer/ shaft | | SS-316 |
| | d) Site glass provision | | YES |
| 4.4 | Differential pressure measuring system | | SS-316 |
| 4.5 | Injection nozzle | | SS-316 |
| 4.6 | **Valves** | | |
| | **1)** Check Valves | | |
| | a) Body & Bonnet | | ASTM A-216 Gr. WCB cast body |
| | b) Seating surface & | | 13% Cr. steel |

| | | | |
|---|---|---|---|
| | rings | | |
| | c) Disc for Check Valve | | ASTM A-216 Gr. WCB cast body |
| | d) Hinge Pin for Check Valve | | SS-316 |
| | e) Backseat for check valve | | 13% Cr. steel |
| | 2) BF Valves(65 NB & Above) | | |
| | Body & Disc | | ASTM A-216 Gr. WCB cast body |
| | Shaft | | SS-410 |
| | Seal | | Nitrite Rubber |
| | Sealing, Retaining segment & internals. | | 18-8-SS |
| | Bearings | | 18-8-SS |
| | Companion Flange | | IS 2062, Gr. B |
| | 3) Ball Valves | | |
| | i) Body | | SA 351 CF8M |
| | ii) Ball | | SA 351 CF8M |
| | iii) Stem | | SS-316 |
| 4.7 | Piping | | |
| | a) Up to 150 NB | | Carbon steel to IS 1239 (Heavy grade) |
| | a) 200 NB & Above | | Carbon steel to IS 2062, rolled and welded confirming to IS 3589 |
| 5.0 | COUNTER FLANGES for Ball Separator | | By Bidder |
| | a) Flanges | | *Carbon Steel to* IS *2062 Gr. B, for thickness / drilling / etc.* |
| | b) Fasteners | | A 193 & A 194 |
| | c) Gaskets | | 4 mm thick rubber |
| 6.0 | OTHER COUNTER FLANGES | | |
| 6.1 | MATERIALS | | |
| | a) Flanges | | Carbon Steel to IS 2062 Gr. B or eq. |
| | b) Fasteners | | A 193 & A 194 |
| | c) Gaskets | | 4 mm thick rubber |
| 7.0 | Material of Other components not specified above | | Suitable for intended duty & shall be subject to Purchasers approval during detailed engg. in the event of order |
| 8.0 | PAINTING | | |
| 8.1 | INTERNAL SURFACE | | |
| | a) Surface preparation | | SA- 2.5 of Swedish specn. |

| | | | |
|---|---|---|---|
| | | | SIS-05-59-00-1967 |
| | b) Primer | | Two coats of Epoxy based zinc phosphate (total dft of 60 micron) |
| | c) Final paint | | Adequate no. of coats of coal tar epoxy paint to achieve total dry film thickness of 200 to 250 microns |
| 8.2 | EXTERNAL SURFACE | | SA- 2.5 of Swedish specn. SIS-05-59-00-1967 |
| | a) Surface preparation | | Two coats of Epoxy based zinc phosphate (total dft of 60 micron) |
| | b) Primer | | Epoxy based TiO2 pigmented coat |
| | c) Intermediate coat | | Two coats of Polyamide cured High build epoxy (total dft of 150 microns) |
| | d) Final paint | | |
| 9.0 | Performance Guarantee & Bid Evaluation | | |
| 9.1 | Performance Parameters to be Guaranteed | | |
| | ∴ Pressure drop in ball separator in clean condition | | 0.15 mWC |
| | ∴ Percentage recovery of balls | | Min. 95 % recovery |
| | ∴ Life of sponge Rubber Balls | | Min. 4 weeks |
| 10.0 | The tube cleaning system shall be designed for following operation modes : | | |
| | a) Semi-Automatic start up initiated by push button. | | YES |
| | b) Semi-Automatic shutdown with ball collection effected by<br>i. Push button<br>ii. Ball monitoring | | YES |
| | c) Semi- Automatic backwashing of ball separator with ball collection effected by :<br>a. Push button<br>b. Diff. Pressure measuring system | | YES |
| | d) Semi-Automatic emergency backwashing of ball separator effected by diff. Pressure measuring system | | YES |
| | f) Provision for manual operation of complete tube cleaning system in case of control system failure. | | YES |
| | i) Whether the ball monitoring system is designed to perform the following functions : | | YES |

Ref. Doc

| | | | |
|---|---|---|---|
| | i. Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses when the number of balls falls below a set value<br>ii. Continuously measuring the size of the balls in circulation and initiating the shutdown of the tube cleaning system with alarm calling for replacement of balls when the no. of oversized balls falls below a set value | | |
| | j) Whether the electronic processor of the ball monitoring system is provided with the following:<br>i. Indicators for recirculating ball quantity<br>ii. Indicators for oversized ball quantity | | YES |
| 11.0 | Documents enclosed for bidder's reference | | |
| | Water Analysis | | Attached along with project information in section B. |
| | Turbo Blower Building equipment layout | | Enclosure-I |
| | P&ID of OLTCS | | Enclosure-II |
| | GA of surface condenser | | Enclosure-III |
| | Drive control philosophy | | Enclosure-IV |
| | Electrical load list format | | Enclosure-V |
| | LV motor specification | | Enclosure-VI |
| | Quality Plan | | Enclosure-VII |
| | Vendor List | | Enclosure-VIII |
| 12.0 | Mandatory spares | | For all the three skids |
| | Differential Pressure Transmitter | No. | 1 |
| | Differential Pressure Gauge | No. | 1 |
| | Pressure Gauge | No. | 1 |

**Annexure-E**

## CHECK LIST FOR OLTCS OFFER

**Note: Bidder to note that Check List shall be completely filled and the data required in-line with Check List shall be submitted along with their Offer to enable Purchaser to evaluate the offer submitted.**

| S.No. | Description | Enclosed [Yes/No] | Remarks/ Comments By Bidder |
|---|---|---|---|
| | **Bidder to confirm compliance with PEMC-05277** and its annexures without any deviations. | | |
| | Bidder has already raised pre-bid queries (if any) on Purchase specification for OLTCS. | | |
| | **Bidder to Confirm Compliance with** scope, terminal points and exclusions for Mechanical/Electrical/C&I Sub-Sections of Purchase Specification. | | |
| | Bidder shall design the OLTCS based on the design data furnished elsewhere in the specification. | | |
| | All the instrumentation indicated for OLTCS is included in bidder's scope of supply in-line with P&ID for OLTCS | | |
| | Bidder to ensure that the MoC of all equipment shall be in-line with purchase specification. | | |
| | Bidder Shall submit completely filled following Annexures enclosed with Technical Purchase Specification PY 51142,Rev00 along with their offer<br>**Annexure-I:** Key Information<br>**Annexure-II:** Guaranteed Datasheet<br>**Annexure-III:** List of Recommended Spare Parts<br>**Annexure-IV:** Special Tools and Tackles<br>**Annexure-V:** List of Deviations(Kindly submit the format with **NO Deviations**)<br>**Annexure-VI:** List of Commissioning spares<br>**Data Sheet - A** | | |
| | Bidder to note that all the consumables (oil/lubricants/Sponge Balls) required upto PG test shall be in Bidder's scope. | | |
| | Bidder to submit completely filled in Datasheet (enclosed in Doc. No. PY 51142) along with their offer. | | |
| | Electrical Load List format is enclosed with offer. | | |
| | Bidder shall furnish the list of Erection and commissioning spares along with their offer. | | |
| | Bidder shall quote one set of Special Tools and Tackles for OLTCS | | |
| | All the Cable Trays required for Power cum control cables are included in Bidder's Scope and the same shall be terminated at the ground level in-line with DETAILED TECHNICAL SPECIFICATION-ELECTRICAL of Job Specification, Doc. No. PEMC-05277 | | |
| | Bidder shall furnish Quality Plan to BHEL along with offer in their standard own format for general review by BHEL. | | |

**PRICE SCHEDULES**

| SL.NO | DESCRIPTION | QTY. | UNIT PRICE (Rs) | TOTAL PRICE(Rs) |
|---|---|---|---|---|
| **1** | **Supply of OLTCS skid as per BHEL specification PEMC-05277_Rev 00 and its enclosures** | 3 no. | | |
| **2** | **Erection supervision & Commissioning of OLTCS as per BHEL specification PEMC-05277 _Rev00 and its enclosures** | As per 2(a) & 2(b) | | |
| **2a** | **Per Diem rates per Service Engineer including Boarding, Lodging & Local Travel for the erection supervision and commissioning of all the three sets** | 15 days | | |
| **2b** | **Travel expenses from vendor works to project site and back for Service Engineer/Technician (this shall include charges if any for travel time) for the Scope of Service defined in Technical Specification (Doc. No. PEMC 0527) and all its annexure** | 2 | | |
| **3** | **Special Tools & Tackles** | 1 Set | | |
| **4** | **Mandatory Spares (Set includes all the items as per Data sheet A)** | 1 Set | | |
| **5** | **Optional Price** | | | |
| a | 2 years recommended spares along with their quantities and unit rate for normal trouble free operation of OLTCS based on bidders' experience.<br><br>[List for recommended spares to be furnished by bidder) | RO | | |
| **TOTAL PRICE (Rs)** | | | | |
| RO= Rate Only | NA= Not Applicable | | | |

**NOTES:-**

a) The above items shall be quoted as per tender specification **PEMC-05277_Rev00** & all its enclosures. Responsibility of ensuring correctness & completeness of scope of supply as per specification requirement solely lies with bidder.

b) Bidder to quote separately, in an identical format, 2 years operational spares with recommended quantity and unit rate. However ordering of the same shall be at the sole discretion of BHEL.

c) Bidder to fill up the above prices manually put his seal & signature and submits the same for price bid opening.

d) Evaluation of L1 vendor shall be based on sum of total price of Sl No.1, 2 , 3 & 4.

e) For the purpose of tender evaluation, a total of 15 man days to be covered in 2 visits have been considered. However, either or both of the number of man days or no of visits may change on either side based on the actual site requirement.

Ref. Doc

| RECORD OF REVISIONS | | | | | |
|---|---|---|---|---|---|
| **Rev. No.** | **Date** | **Revision Details** | **Prepared/ revised By** | **Reviewed By** | **Checked By** |
| 00 | 03.03.15 | First Issue | Ajit Singh | Pradeepa | AK Sinha |
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# STANDARD TECHNICAL PURCHASE SPECIFICATION

# FOR ON-LINE TUBE CLEANING SYSTEM (OLTCS)

## 01.00.00 GENERAL

01.01.00 This specification covers the design, performance and operational requirements, configuration and constructional features, manufacture, assembly, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting for delivery of condenser on-line Tube cleaning system (sponge rubber balls type) complete with all accessories as specified hereinafter and Supervision of Erection, commissioning of the OLTCS.

## 02.00.0 CODES AND STANDARDS

02.01.00 The design, materials, manufacture, inspection and testing of the condenser on line tube cleaning system complete with all accessories, shall comply with the requirements of the latest versions of the following appropriate and standards.

02.02.00 IS/BS/DIN/US Standards regarding pressure vessels, pumps, piping, flanges and others as necessary.

02.03.00 IS/BS/DIN/ASTM Standards for materials specification and testing procedures.

02.04.00 IS/BS/DIN/AWWA Standards for valves and their testing.

02.05.00 ASME PTC 12.2/HEI Standard for evaluation of the condenser performance.

02.06.00 In case of any conflict between the above codes/standards and this specification, the latter shall prevail and case of any further conflict in the matter, the interpretation of the specification by the purchaser shall be final and binding.

## 03.00.00 DESIGN AND CONSTRUCTION

### 03.01.00 General Requirements

03.01.01 Unless otherwise necessary, manufacturer's standard and proven models of the tube cleaning system shall be supplied.

03.0l.02 The tube cleaning system shall be capable of safe, continuous and trouble-free operation for removal of fouling and scaling materials from condenser tubes. Vibration, noise, mechanical stresses shall be kept within allowable

limits specified by relevant codes/standards. In design, due attention shall be given to ease of maintenance, repair and cleaning.

03.01.03 Suitable corrosion allowance shall be provided wherever necessary.

03.01.04 The tube cleaning system shall consist of ball separator at each condenser outlet, recirculating pump, ball collector, differential pressure measuring system for ball separator, ball monitoring system cleaning balls, piping, valves, distributors, injection nozzles, instrumentation, control panel, interconnecting cables and others as necessary.

**03.02.00 Performance Requirements**

The tube cleaning system with all accessories shall be designed and guaranteed to meet the following requirements.

03.02.01 The tube cleaning system shall perform satisfactorily under the flow and pressure drop conditions (in the condenser) specified in Data—sheet—A and shall be capable of removing the various forms of fouling and scaling from condenser tubes.

03.02.02 The ball separator at the condenser outlet, shall be designed such that the pressure drop across the ball separator under clean conditions shall not be more than that specified in Data sheet-A. The performance of the ball separator shall be continuous with minimum number of backwashing operations

03.02.03 The power consumption by ball recirculation pump during various operations shall be minimum possible.

03.02.04 The quantity of cleaning ball worn out and/or lost, shall be minimum possible.

**03.03.00 Operational Requirements**

The tube cleaning system and other accessories shall be designed for the following operation modes.

03.03.01 Complete automatic start-up of tube cleaning system initiated by pressing the push button (manual command).

03.03.02 Complete automatic shut-down of tube cleaning system with ball collection, effected by the following.

Push button (manual command).
Ball monitoring system (when the number of oversized) balls falls below a set-value.

03.03.03 Complete automatic backwashing of ball separator with ball collection, effected by the following.

- Differential pressure measuring system at a predetermined difference across the ball strainer/screen.
- Push button

03.03.04 Complete automatic emergency backwashing of ball separator with alarm indication, effected by differential pressure measuring system.

03.03.05 Complete automatic flushing of differential pressure measuring system when the tapering are blocked with debris.

03.03.06 Manual operation for start-up, Shut-down with ball collect, backwashing of ball separator, flushing of differential pressure measuring system, etc. in case of failure of control system.

**03.04.00 <u>Ball Separator</u>**

03.04.01 Ball separator body should be of rigid construction and shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the ball separating screen/strainer and shall have flanged inlet, outlet, ball extraction openings and pressure measuring tapings etc.

03.04.02 The ball separator shall be provided with manhole with bolted cover.

03.04.03 It is specified in Data Sheet-A, ball separator body shall be lined with suitable resilient material.

03.04.04 The ball separating screen/strainer shall be designed for the maximum differential pressure across the separator and shall be securely mounted in the body. Screen/strainer shaft shall be sized adequately considering the overloading of screen/strainer due to debris accumulation.

03.04.05 Suitable arrangement shall be made to prevent lodging of the debris at the entrance of ball extraction piping.

03.04 06 The ball separating strainers/screens shall have electric actuators for swiveling to allow for their backwashing. Also suitable hand wheels shall be provided to enable manual swiveling of strainers/ screens.

**03.05.00 Ball Recirculating Pump.**

03.05.01 The ball recirculating pump shall be horizontal centrifugal type. The casing shall be designed to withstand 1.5 times the shut-off pressure or twice the operating pressure, whichever is higher.

03.05.02 The impeller shall be non-clog type and shall be contoured suitably to avoid damage to the cleaning balls. The impeller shall be secured suitably to the shaft and shall be retained against circumferential movement by keys, pins or lock rings.

03.05.03 Replaceable type wearing rings shall be provided to prevent damage to the casing and impeller.

03.05.04 Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable codes/standards. Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes. Shaft sleeves shall be integral with water thrower plates at the end and the length must extend beyond the outer faces of gland packing so as to distinguish between shaft and the shaft sleeve and that past the seals/glands.

03.05.05 Bearings of adequate design shall be provided for taking the entire pump load arising from all probable condition of continuous operation through its range of operation. The bearings shall be designed on the basis of 20,000 working hours (minimum) for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Bearings shall be easily accessible without disturbing the pump assembly.

03.05.06 Stuffing box of suitable design to permit replacement of packing without removing any part other than the gland shall be provided. The stuffing boxes shall be sealed/cooled by the fluid being pumped.

03.05.07 Pumps shall be of self-lubricated, self-sealed and self-cooled type with oil replenishment once in three months. All pipework, flier etc., for sealing cooling and lubricating purpose shall be supplied and no external cooling/ lubricating/ sealing water will be supplied. Pump capacity shall take into account the cooling/ lubricating/ sealing water requirement.

03.05.08 All rotating components shall be statically and dynamically balanced.

03.05.09 The pump shall be designed such that pump impellers and other accessories of the pump are not damaged due to flow reversal.

03.05.10 The pump shall be capable of developing the required total head of rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the head vs. flow characteristic curve over a range of 40% of rated flow to 120-130% of rated flow.

03.05.11 The pump shall preferably be non-overloading type. The total head vs. capacity curve shall be continuously rising from the maximum flow point towards shut-off without any zone of instability

03.05.12 The pump shall run smoothly without undue noise and vibration. Peak to peak vibration limits and noise level shall be within the acceptable values of applicable codes/standards.

03.05.13 The pump and motor shafts shall be connected through a pin and rubber bush flexible type of couplings. Suitable coupling guards shall be provided for the couplings

03.05.14 The pump shall be capable of being started with discharge valve fully opened. Motor rating shall be adequate for this condition. The output KW rating of the pump drive motor shall not be less than the larger of the following.

Maximum power input to the pump over the entire range from maximum flow to shut-off condition. 125% of power input to the pump at duty point corresponding to 103% of the rated speed.

03.05.15 The pump and drive motor set shall be capable of continuously delivering the rated output for the voltage variation of ±10% and frequency variation of ±5% occurring separately or combined voltage and frequency variation of 10%

**03.06.00 Ball collector**

03.06.01 The body of the ball collector shall be designed to withstand 2.0 times the operating pressure, on 1.5 times the recirculating pump shut-off pressure whichever is higher The ball collector shall be designed and manufactured as per the application.

03.06.02 Ball collector shall be provided with an inspection window/ sight glass for visual inspection of the cleaning balls.

03.06.03 Ball collector shall be provided with suitable ports with covers for ball feeding and removal.

03.06.04 The ball collector shall be provided with vent and drain connections with isolating valves.

03.06.05 If specified in Data sheet-A, ball collector body shall be lined with suitable resilient material.

**03.07.00 Differential pressure Measuring System**

03.07.01 The ball separator shall be provided with a measuring system for differential pressure across the ball separating strainer/screen, to check debris accumulation and to initiate ball catching and backwashing operations. This shall consists of a differential pressure gauge for manual observation with adequate number of tapings with isolating valves.

O3.07.02 The contacts for differential pressure switch/ transmitter and for differential pressure gauge shall be independent so that in the event of failure of one, the other is available.

**03.08.00 Ball Monitoring system**

O3.08.01 Ball monitoring system shall be provided for continuous monitoring the quantity and size of the cleaning balls in circulation. The monitoring system shall perform the following function:

a) Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses, when the number of circulating balls falls below a set value.

03.08.02 The Monitoring system shall be of proven and reliable design and shall he complete with necessary transducers, amplifiers, transmission lines, power cables and electronic processor etc.

03.08.03 The electronic processor of the ball monitoring system shall be housed in the control panel and shall consist the following Indicators for:-
- required basic ball charge.
- recirculating ball quality.

**03.09.00 Cleaning Balls**

03.09.01 The sponge rubber cleaning balls shall be slightly oversized to the internal diameter of condenser tubes and should be able to remove all fouling and scaling deposits in the condenser tubes.

03.09.02 The specific gravity of the cleaning balls shall be such that good distribution of balls across the tube sheet and cleaning of all tubes are ensured.

03.09.03 The composition of the cleaning balls shall be based on natural rubber and shall be suitable for temperatures up to 65°C. Hardness of the cleaning balls shall be compatible to tube material and corrosion/fouling behavior. If cleaning balls consist of abrasive coated balls, the abrasive material shall also be compatible for use with the tube material.

03.09.04 Calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc., shall be furnished along with the bid.

**03.10.00 Piping, Valves, Distributors and Injection Nozzles**

03.10.01 Interconnecting piping, valves, injection nozzles and other fittings shall be designed to withstand 2 times the operating pressure or 1.5 times the pump shut-off pressure whichever is higher.

03.10.02 Inter-connecting piping shall be sized and routed optimally.

03.10.03 Necessary isolation valves, vent and drain valves for various equipment's shall be provided. Valves shall conform to appropriate standards. Valves provided in ball transport piping shall be ball type.

03.10.04 Adequate number of ball injection nozzles shall be provided for proper distribution of cleaning balls in condenser inlet. Ball injection nozzles shall be flanged type and shall have two sets of flanges, one for connecting to the ball transport pipe and other for connecting to the repairs or checking Distributors with sight glass shall be provided wherever ball transport piping branching out or joining together for proper guidance of cleaning balls.

**03.11.00 Actuators**

Tube Cleaning System shall be provided with actuators wherever necessary for various automatic operations. The actuators shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuators shall be provided with auxiliary hand wheel

for manual operation in the event of control system failure.

**03.12.00 Electric Motors**

The drive motors for recirculating pump shall conform to the requirements of the enclosed specification.

**03.13.00 Instrumentation and Control**

03.13.01 Complete instrumentation and control system for automatic operation of tube cleaning system, protection, interlocking, indication /annunciation of differential pressure and other malfunctions etc. shall be provided. This shall consist of ' adequate operational hardware, local control panel and interconnecting control and power cabling between the control panel and various equipments in the tube system.

03.13.02 Control panel shall house all necessary instruments, indicating/annunciation lamps, alarms, differential pressure indicators, timer, function selection switches, ball monitoring system processor, relays, protection and interlocking system, start/stop push button etc. shall be complete with internal wiring. The control panel shall meet the requirements of the enclosed specification.

03.13.03 Pressure gauges shall be provided at recirculating pump suction and discharge. All instrumentation shall be of reputed make and shall meet the requirements of the enclosed specifications.

**03.14.00 Other Accessories**

03.14.01 Counter flanges, flat faced slip on type, complete with gaskets, bolts and nuts etc. shall be supplied for ball separator inlet, outlet connections and all other terminal points. Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in Data Sheet-A.

03.14.02 Ball recirculating pump, ball collector with interconnecting piping and valves, shall be mounted on a frame. For fixing the frame, necessary foundation plates, bolts, nuts etc.-shall be provided.

03.14.03 Suitable lifting arrangements shall be provided for various equipment of the tube cleaning system, for handling during erection and maintenance.

**03.15.00 Material of Construction**

Materials of various equipment in the tube cleaning system shall be

corrosion resistant and consistent with the fluid handled. However, material specification for various components shall be equal to or superior to those specified in Data Sheet-A

## 04.00.00 PAINTING

04.01.00 The surface preparation of the various equipment/ components of the tube cleaning system shall be done as per the standard mentioned in Data Sheet-A and shall include the following.

Removal of oil, grease, dirt and swarf etc.
Removal of rust and scale etc.
Shot blasting.

04.02.00 All internal surfaces of the various equipment components of the tube cleaning system, which are subjected to immersion of water spray and which are not made of stainless steel or other corrosion resistant materials after surface preparation, shall be coated with four coats (minimum 500 microns thick) of epoxy paint of approved make and quality, over a coat of zinc chromite primer, unless otherwise specified in Data Sheet — A.

04.03.00 The external surfaces of the various equipment/ components of the tube cleaning system after surface preparation, shall be coated with two coats (minimum 250 microns thick) of synthetic enamel paint of approved make and quality, over two coats of red oxide primer, unless otherwise specified in Data Sheet-A.

## 05.00.00 SHOP INSPECTION AND TESTS

### 05.01.00 General

05.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved quality plan to ensure that the various equipment and other accessories of the tube cleaning system shall conform to the requirements of this specification and of the applicable codes/standards.

05.01.02 All materials used for manufacture/fabrication of the various equipment of the on line tube cleaning system shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacture shall arrange to carry out the necessary tests as per the approved quality plan and applicable codes at his cost for which samples shall be identified by BHEL's

representative.

05.01.03 All shop tests shall be conducted in the presence of BHEL/ Customer representative and test certificates/ reports for the same shall be furnished to BHEL for approval.

05.01.04 Qualification of welding procedures and welders shall he as per ASME B & PV code, Section-IX/ applicable codes.

**05.02.00 Ball Separator**

05.02.01 Chemical analysis, mechanical tests shall be carried out on materials used for body, strainer/ screen, strainer/ screen shaft and other parts as per the applicable material specification standards.

05.02.02 All butt welded joints shall be subjected to radiographic/ ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle/ penetrant testing to ensure freedom from defects.

05.02.03 Strainers/ screen shaft shall be subjected to ultrasonic test as per ASTM-A388 for subsurface defect with acceptance norm as per ASME B & PV code Section VIII Division 1.

**05.03.00 Ball Recirculating Pump**

05.03.01 Chemical analysis, mechanical tests shall be carried out on material used for casing, impeller, shaft sleeve, wear rings etc. as per the applicable material specification standards.

05.03.02 The casting used for pump casing and impeller shall be sound, clean and free from porosity, blow holes, hard sports, cold shuts, distortion and other harmful defects. All accessible surface of the impeller shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASTM B&PV code, section VIII Division 1. No welding or repairs shall be carried out without prior permission of BHEL.

05.03.03 Pump shaft and sleeve shall be subjected to ultrasonic test as per ASTM-E165 for surface defects.

05.03.04 Wear rings shall be subjected to penetrate test as per ASTM-E165.

05.03.05 Pump impeller and rotor assembly shall be statically and dynamically balanced as per ISO-1940.

**05.04.00 Ball Collector**

05.04.01 Chemical analysis, mechanical tests shall be carried out on material used for body and other accessories as per the applicable material specification standard.

05.04.02 All but welded joints shall be subjected to radiographic/ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle/penetrant testing to ensure from defects.

**05.04.00 PIPING, VALVES, DISTRIBUTORS AND INJECTION NOZZLES**

05.05.01 Chemical analysis, mechanical test shall be carried out for material used for piping, fittings, valves, distributors and injection nozzles.

05.05.02 All welded joints of distributors & injection nozzles shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASTM-B&PV code, section VIII. Division-1.

05.05.03 Inspection and testing of valves including leakage test shall be carried out as per the requirements of applicable standards. Valve stem and ball shall be subjected to penetrant test as per ASTM-E165.

05.05.04 All material for various nozzles, stubs, gaskets, nuts, bolts etc.; shall be of tested quality and correlating test certificates for chemical and mechanical properties shall furnished.

**05.06.00 Rubber Lining**

Rubber lining if required in Data Sheet-A, shall be subjected to surface crack test, 100% spark and hardness tests and shall be checked for layer thickness, defects etc.

**05.07.00 Flange**

05.07.01 Chemical and mechanical test certificates shall be furnished for flange materials.

05.07.02 In case of fabricated flanges, all the welds shall be subjected to 100% radiography as per ASTM-B&PV code, section VIII. Division-1.

05.07.03 In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A388.

05.07.04 If the thickness of the plate used for flanges is 40 mm or more, the same shall be checked ultrasonically as per ASTM-A435 to demonstrate the absence of lamination and lack of fusion etc.

05.07.05 Flanges shall be checked for edge penetration, fit up and satisfactory working with matching parts.

**05.08.00 Dimensional Check**

Dimensional checks for various equipment/components of the tube cleaning system shall be carried out as per assembly drawing approved by BHEL Alignment and fit up of movable parts shall be checked.

**05.09.00 Hydraulic Checks**

Hydraulic test shall be conducted on various assemblies/ equipment/ components of the tube cleaning system at a pressure of 1.5 times the design pressure. The duration of the test shall be minimum 30 minutes.

**05.10.00 Leakage Test**

Leakage test shall be conducted at the design pressure on all assemblies of the tube cleaning system to demonstrate that the assemblies are leak tight and no water seepage shall take place at various nozzles and valve connections.

**05.11.00 Performance Test on Recirculating Pump**

Performance test on recirculating pump with drive motor shall be conducted as per HIS/BS-599/ASME PTC 8.0/TS5120. Performance curve i.e. discharge flow vs head, discharge flow vs power consumption and charge flow vs efficiency shall be plotted and acceptance norms shall be as per HIS/BS-599/ASME PTC 8.0. Vibration and noise shall be measured and acceptance norms shall be as per Hydraulic Institute (USA) standard. The procedure shall be mutually agreed before test.

**05.12.00 Functional Tests**

Various assemblies/ equipments/ components of the tube cleaning system shall be subjected to functional tests and the following shall be checked.

05.12.01 Smooth and free operation of all moving parts.
05.12.02 Interlock and sequential operation.

05.12.03 Satisfactory operation of ball monitoring system.

05.12.04 Satisfactory operation of actuators, torque switches, limit switches etc.

05.12.05 Satisfactory ball sorting i.e. separating the undersized ball and collecting them in separate chamber or ball collector.

## 06.00.00 TESTING AT SITE

After completion of installation at site, the tube cleaning system will be tested to check that the tube cleaning systems performance to meet the requirements of this specification. Rectification of all defects shall have to be done by the supplier at no extra costs to the owner/ purchaser. However, the owner/ purchaser reserves the right to reject the equipment/ parts not meeting the requirement if the deficiency still persists.

## 07.00.00 PERFORMANCE GUARANTEE

07.01.00 The tube cleaning system complete with all accessories shall be guaranteed to meet the performance requirement as given in Clause No. 03.02.00 and Data Sheet-A and also for trouble-free operation after commissioning.

07.02.00 The guaranteed performance figures shall be proved by supplier during performance testing. The performance testing of the complete tube cleaning system will be done at site after its installation at the following three stages.

a) After commissioning the turbine.
b) After six months the initial test.
c) After twelve months from the initial test.

The result from the initial test will be reviewed and the accepted results shall form the basis for subsequent tests after six months and twelve months from the initial test. If the result of these tests show the non-performance shall rectify or replace the equipments/ parts of the tube cleaning system to meet the guaranteed value, the supplier tube cleaning system as required to enable it to meet the guarantees.

07.03.00 Necessary performance evaluation/ calculation procedures and performance curve/ figures shall be furnished along with the bid.

07.04.00 If the guarantees specified are not achieved by the supplier, the owner/purchaser may, at his discretion, reject or accept the tube cleaning system after assessing the liquidated damages listed in Data sheet-A

against the supplier and such amounts shall be deducted from the contract price.

## 08.00.00 QUALITY ASSURANCE and QUALITY PLAN

08.01.00 The tube cleaning system and other accessories to be supplied, shall have assured quality and workmanship.

08.02.00 The bidder shall furnish his own quality plan based on materials, equipments of the tube cleaning system being offered for approval by BHEL.

## 09.00.00 NAME PLATE AND TAG NUMBERS

09.01.00 Ball separator, recirculating pump. Ball collector shall be provided with a permanently attached brass or stainless steel plate indicating the following details:

a) Design and maximum flow rates.
b) Design and test pressure.
c) Design temperature
d) Empty and operating weights.

09.02.00 Each valve in the tube clean system shall be provided with a name plate indicating the following:

a) Service
b) Design and test procedures
c) Maximum flow and flow direction
d) Size
e) Purchasers Tag Numbers

Tag number will be indicated on the drawing submitted for approval during contract stage.

09.03.00 Each motor shall be provided with a name plate indicating the following details:

a) Supply conditions.
b) KW Rating.
c) Make

## 10.00.00 DRAWINGS, DATA & INFORMATION TO BE SUBMITTED WITH THE BID

The bidder shall furnish the Following, drawings, data and information

along with the bid without which the offer will be deemed incomplete.

10.01.00 Data Sheets —B with all particulars/ data duly filled in (DATA SHEET—B).

10.02.00 General arrangement/ installation drawing of ball separator, ball recirculating unit, control panel each complete with all accessories, incorporating the principal dimensions and weights of equipment offered, size and location of various nozzle connections, supporting arrangement (wherever applicable)and scope of supply etc.

10.03.00 Cross-section/ detailed drawing of ball separator, recirculating pump, ball collector, differential pressure measuring system, ball monitoring system distributors, injection nozzles, actuators, motors, control panel etc.; indicating bill of quantities and materials of construction.

10.04.00 Flow and control logic diagrams for various operations of tube cleaning systems.

10.05.00 Performance evaluation/ circulation procedures and performance curves/figures.

10.06.00 Schedule of valves indicating type, rate, size, pressure and temperature ratings, materials etc.

10.07.00 Schedule of instruments indicating type, make, material of construction, range and accuracy etc.

10.08.00 Schedule of piping and fitting indicating size, materials, maximum working pressure and temperatures etc.

10.09.00 Control panel layout and list of instruments provided on control panel.

10.10.00 List of annunciations, protections and interlock provided.

10.11.00 Write—up on operation, control monitoring, interlock and protection of tube cleaning system.

10.12.00 Manufacturer's descriptive and illustrative literature of the equipments being offered.

10.13.00 A detailed experience list about the successful installations of similar equipments/components of the tube cleaning system for similar application.

10.14.00 A comprehensive write—up on the testing facilities, tests to be conducted for various equipments/components of the tube cleaning system, inspection method and QA system adopted by the manufacturer.

10.15.00 Quality plan for the tube cleaning system offered.

10.16.00 Calculations and basis for selection of cleaning balls, circulation quality, type, size, hardness, cleaning, frequency etc.

10.19.00 Ball recirculating pump performance characteristic curves.

10.20.00 Operation and Maintenance recommended spares / Mandatory Spares List.

NOTE: Apart from above, no other drawing/ document/ data sheet etc. shall be submitted along with the offer. If any drawing/ document etc. is submitted with the offer, same shall be considered as for 'Reference' purpose only and shall not be reviewed/ commented upon and any deviation, exclusion to scope, etc. taken in documents but not highlighted in the deviation schedule shall not be taken cognizance of.

## 11.00.00 PREPARATION FOR DELIVERY

### 11.01.00 PRESERVATION

Preservation shall be accomplished in accordance with acceptable commercial practices unless otherwise indicated on the purchase order or quotation request.

### 11.02.00 PACKING

Packing shall be accomplished in accordance with acceptable commercial practices unless otherwise indicated on the purchase order or quotation request.

The supplier shall make--shipment the minimum number of shipping containers consistent with the requirements of safe transit, available modes of transportation and routing. It shall be the supplier's responsibility to determine that packing as done is adequate to assure that all equipment shall arrive at destination in an undamaged condition and ready for the intended use.

When more than one shipping container is required, the supplier shall provide suitable container markings for recognition of parts of one unit as

per point list. Assembly instructions shall be included with each such shipment Sea-worthy packing shall be done for supplies from outside India and to, projects overseas.

**11.03.00 MARKING**

All shipping containers shall be identified with BHEL Purchase-Order Number, Drawing Number, Item & Part Number as per part-list-and the Supplier Packing list and shipping Numbers. Each Shipping, container, shall contain two packing lists, listing all of the particular container with one copy attached in a secure manner to the outside. Each part will be identified and keyed to packing list.

**11.04.00 SHIPMENT**

For specific shipping instructions, see Purchase Order. Approval to ship if applicable must be obtained from the applicable Purchasing. Unit. If shipment becomes short, the purchaser's approval of all shortage items must be obtained prior to shipment. At time of shipment, two copies of 'the packing list and shortage list, with promised shipping data if applicable, must be couriered to the Purchasing Unit as noted on the Purchase Order.

**VENDOR DOCUMENTATION**

Vendor shall confirm in their bid for compliance in all respect for the submission of documents as follows-

| Sl. No. | Document Name / Type | To Contain | Required With Offer | Required After P.O | |
|---|---|---|---|---|---|
| | | | Compliances from Vendor & No. of Sets Reqd. | No. of Sets Required – Engg. & Approval/Review Activities. | No. of Sets Required- For Site & Customer Submission |
| 1 | (a) Drgs, , Data Sheets , Catalogues. BOM etc.<br>(b) PIDs , SLDs, Block-Schematics etc. ( wherever applicable ) | Adequate Information & essential for proper Technical Evaluation of the Offers.<br>Other Information to be furnished as defined in the applicable Tech | 2<br>(Addl. Copies Required -wherever Offer Docs. are subject to Review by Customer. See Spec. Requirement) | – | – |

| Sl. No. | Document Name / Type | To Contain | Required With Offer | Required After P.O | |
|---|---|---|---|---|---|
| | | | Compliances from Vendor & No. of Sets Reqd. | No. of Sets Required – Engg. & Approval/Review Activities. | No. of Sets Required- For Site & Customer Submission |
| | | Specs. | | | |
| 3 | Deviations if any | To be clearly listed, furnishing reasons for non-compliance | 2 ( See also Sl-1 above ) | _ | _ |
| 4 | Master Document List (**MDL**)- | **a)** List of all Documents & Drgs., Spares Items etc. which are applicable for the Project. They shall be group wise enlisted in MDL Doc. | - | 3 | 16 |
| 8 | SPARES for Erection / Commissioning | **a**) Informative List required with Technical & Commercial bids.<br>**a.1**) To consider as Part of main scope of Supply.<br>**b**)Such Spares List is subject to Review during Detail Engg. | Vendor to Confirm Supply in their Offer. | 6 | 16 |
| 9 | "Operation and Maintenance Spares" / "Mandatory Spares" List | **a**)Recommended List by Vendor<br><br>**b**) List with Other Data – if Specified in Tech. Spec. | **1**) To Enclose with Offer.<br>**2**)To indicate price for the listed items in commercial offer & with extended validity | 6 | 16 |
| 10 | Vendor's "Bill of Material" Doc. | | - | **6** | 16 |
| 11 | Quality Assurance Plan (QAP ) & Factory Testing Procedure Documents | 1) Approval from BHEL required.<br><br>2) Submission along with the Engg. Docs. | **A**) Submission -if already standardized with BHEL / Draft proposal & it may be finalized after Review.<br>**B**) Submission compliance from Vendor required | 6 | 4 |
| 12 | FQAP (Field Quality Assurance Plan) & | 1) Approval from BHELsite required | same as for Sl-11 | 6 | 4 |

| Sl. No. | Document Name / Type | To Contain | Required With Offer | Required After P.O | |
|---|---|---|---|---|---|
| | | | Compliances from Vendor & No. of Sets Reqd. | No. of Sets Required – Engg. & Approval/Review Activities. | No. of Sets Required- For Site & Customer Submission |
| | Site Erection, Testing & Commissioning Procedure documents | 2) Submission along with the Engg. Docs. | above | | |
| 13 | Erection Documents & Drawings:- | 1) To contain final MDL, BOM, Handling & Storage Instructions Doc., Initial-Fill & Consumables Items list, Erection & Commissioning Spares List , Operation & Maintenance spares list / Mandatory Spares List etc.<br>2) Submission minimum 6 – weeks before eqpt. schedule dispatch.<br>3) The drgs. shall be kept in plastic pouches and neatly arranged, submitted in an aesthetic, appropriate & durable folder(s). Documents filed appropriately in Folder in – seriatim of MDL. | - | - | 16 |

| Sl. No. | Document Name / Type | To Contain | Required With Offer | Required After P.O | |
|---|---|---|---|---|---|
| | | | Compliances from Vendor & No. of Sets Reqd. | No. of Sets Required – Engg. & Approval/Review Activities. | No. of Sets Required- For Site & Customer Submission |
| 14 | O&M Manual Document Folder(s) | 1) Submission 1-month before schedule eqpt. dispatch ( Draft copy shall be submitted beforehand for review by BHEL )<br>2) The manual shall be submitted in an aesthetic, appropriate & durable folder(s). Each vol. shall be marked with its Vol. No.<br>3)**This Manual shall include primarily following information:**<br>-<br>**i)** Operational & safety instructions.<br>**ii)** Environmental Safety instructions & indicating compliances of the Regulations in-force.<br>**iii**) Guidelines incorporating requirements for Operation of the Equipment in Hazardous Environment- wherever applicable.<br>**iv)** Master document List (MDL) doc.<br>**v)** Bill of material (BOM) doc.<br>**vi)** Erection Instructions.<br>vii) Sub-vendor O&M Manuals | - | Adv. Copy ( 2 sets )- for review by BHEL | Final Copies –(16 sets) |

| Sl. No. | Document Name / Type | To Contain | Required With Offer | Required After P.O | |
|---|---|---|---|---|---|
| | | | Compliances from Vendor & No. of Sets Reqd. | No. of Sets Required – Engg. & Approval/Review Activities. | No. of Sets Required- For Site & Customer Submission |
| | | **vii**) Operational & all Systems / Items and sketches etc., led- (and applicable overhaul schedules<br><br>viii) Lubrication Schedule<br>**viii**) Initial-Fill Items List<br>**ix**) Approved QAP's Shop Tests & Calibration Reports.<br>**x**) Approved FQAP - along with related docs., with site testing & commissioning Protocols etc. | | | |
| 15 | "As –Built" Drawings & Documents | Submission within three weeks -after commissioning at site | - | - | 16 |
| 16 | Compact Disc (CD) | 1) MDL, All drawings, Documents, Data sheets – as Listed in Approved MDL Doc. , all applicable Catalogues (Scanned), BOM & all items covered in the O&M Manuals & the "As-built" Drgs.<br>2) To submit along with the submission of "As-built" drgs. & docs. | - | - | 3 |

# DATA SHEET- A

## Condenser "ON Line Tube Cleaning System".

| Sl.No | Description | Unit | Performance/ Data |
|---|---|---|---|
| 1 | **GENERAL** | | |
| 1.1 | NOs. of tube cleaning systems sets required for station | NOS. | |
| 1.2 | Liquid handled | | |
| 1.3 | Size of COLTCS | NB/Inches | |
| 2.0 | **DESIGN** | | |
| 2.1 | Operating pressure at Condenser inlet flange | Kg/cm2 | |
| 2.2 | Design Pressure for ball separator | Kg/cm2 | |
| 2.3 | Design Mechanical Temperature | Deg. C | |
| 2.4 | Condenser Details | | |
| | a) Type of condenser | | |
| | b) No. of Condenser sections | Nos. | |
| | c) No. of passes per condenser section (viz. condenser half) | Nos. | |
| | d) No. of tubes per condenser | | |
| | e) Tube Dia. OD x Thickness | | |
| | • Top two rows - | | |
| | • Remaining- | | |
| | f) Length of tubes between ends. | mm | |
| | g) Tube material | | |
| | h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser) | **MWC** | |
| 2.5 | CW flow rate through each ball separator | | |
| | - Normal | Cu.m/hr | |
| | - Maximum | Cu.m/hr | |
| 2.6 | Design differential pressure for ball separator strainer/screen | Kg/cm2(g) | |
| 2.7 | Pressure drop across ball separator i.e. between inlet & outlet flanges in clean condition at normal flow. | MWC | |
| 2.8 | Pressure drop across ball separator in chocked condition when strainer back washing starts | MWC | |

| | | | |
|---|---|---|---|
| 2.9 | No. of balls required for OLTCS per condenser section | Nos. | |
| 3.0 | **CONNECTING PIPE DETAILS** | | |
| 3.1 | **Condenser inlet pipe** | | |
| | a) Material | | |
| | b) OD X Thickness | mm | |
| 3.2 | Condenser outlet pipe | | |
| | a) Material | | |
| | b) OD X Thickness | mmXmm | |
| 4.0 | **MATERIALS OF CONSTRUCTION** | | |
| 4.1 | BALL SEPARATOR | | |
| | a) Body / housing | | |
| | b) Screen / Strainer | | |
| | c) Strainer shaft | | |
| | e) Internal Hardware including nuts, bolts , etc. | | |
| | f) Site Glass provision | | |
| 4.2 | BALL RECIRCULATING PUMP | | |
| | a) Casing | | |
| | b) Impeller | | |
| | c) Shaft | | |
| 4.3 | BALL COLLECTOR | | |
| | a) Body / housing | | |
| | b) Screen / Strainer | | |
| | c) Strainer/ shaft | | |
| | d) Site glass provision | | |
| 4.4 | Differential pressure measuring system | | |
| 4.5 | Injection nozzle | | |
| 4.6 | **Valves** | | |
| | **1)** Check Valves | | |
| | a) Body & Bonnet | | |
| | b) Seating surface & rings | | |
| | c) Disc for Check Valve | | |
| | d) Hinge Pin for Check Valve | | |
| | e) Backseat for check valve | | |

| | | | |
|---|---|---|---|
| | 2) BF Valves(65 NB & Above) | | |
| | Body & Disc | | |
| | Shaft | | |
| | Seal | | |
| | Sealing, Retaining segment & internals. | | |
| | Bearings | | |
| | Companion Flange | | |
| | 3) Ball Valves | | |
| | i) Body | | |
| | ii) Ball | | |
| | iii) Stem | | |
| 4.7 | Piping | | |
| | a) Up to 150 NB | | |
| | a) 200 NB & Above | | |
| 5.0 | COUNTER FLANGES for Ball Separator | | |
| | a) Flanges | | |
| | b) Fasteners | | |
| | c) Gaskets | | |
| 6.0 | OTHER COUNTER FLANGES | | |
| 6.1 | MATERIALS | | |
| | a) Flanges | | |
| | b) Fastners | | |
| | c) Gaskets | | |
| 7.0 | Material of Other components not specified above | | |
| 8.0 | PAINTING | | |
| 8.1 | INTERNAL SURFACE | | |
| | a) Surface preparation | | |
| | b) Primer | | |
| | c) Final paint | | |
| 8.2 | EXTERNAL SURFACE | | |
| | a) Surface preparation | | |
| | b) Primer | | |
| | c) Intermediate coat | | |
| | d) Final paint | | |
| 9.0 | Performance Guarantee & Bid Evaluation | | |

| | | | |
|---|---|---|---|
| 9.1 | Performance Parameters to be Guaranteed | | |
| | ∴ Pressure drop in ball separator in clean condition | | |
| | ∴ Percentage recovery of balls | | |
| | ∴ Life of sponge Rubber Balls | | |
| 10.0 | The tube cleaning system shall be designed for following operation modes : | | |
| | a) Semi-Automatic start up initiated by push button. | | |
| | b) Semi-Automatic shutdown with ball collection effected by<br>i. Push button<br>ii. Ball monitoring | | |
| | c) Semi- Automatic backwashing of ball separator with ball collection effected by :<br>a. Push button<br>b. Diff. Pressure measuring system | | |
| | d) Semi-Automatic emergency backwashing of ball separator effected by diff. Pressure measuring system | | |
| | f) Provision for manual operation of complete tube cleaning system in case of control system failure. | | |
| | i) Whether the ball monitoring system is designed to perform the following functions :<br>i. Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses when the number of balls falls below a set value<br>ii. Continuously measuring the size of the balls in circulation and initiating the shutdown of the tube cleaning system with alarm calling for replacement of balls when the no. of oversized balls falls below a set value | | |
| | j) Whether the electronic processor of the ball monitoring system is provided with the following:<br>i. Indicators for recirculating ball quantity<br>ii. Indicators for oversized ball quantity | | |

**ANNEXURE – I**

## KEY INFORMATION

1.00.00 Name of the Bidding Company :

2.00.00 Registered in (mention the name of the Country) :

3.00.00 Name, designation, telex & telephone number and postal address of responsible officer of Bidder to whom all reference shall be made for expeditious coordination. :

4.00.00 Name, designation, telex & telephone number and postal address of responsible officer of Indian Agent. :

5.00.00 Bidder's proposal number :

6.00.00 Bidder's proposal date :

7.00.00 Validity of offer, counted from the date of opening of bid :

8.00.00 Guaranteed completion period, counted from date of issuance of LOI/TOI :

9.00.00 Confirm that Scope of supply and services are exactly as per specification requirement. : Yes/No

10.00.00 Confirm that Guarantees are as per Annexure-II : Yes/No

11.00.00 Confirm Technical compliance with specification : Yes/No

12.00.00 Confirm that List of Recommended Spares has been furnished as per Annexure-III : Yes/No

13.00.00 Confirm that Special Tools & Tackles are as per Annexure-IV : Yes/No

14.00.0 Confirm that deviations ,if applicable, have been furnished as per Annexure-V : Yes/No

**Signature of Bidder's**
**Authorized representative .with date.....**

**ANNEXURE –II**

## GUARANTEED DATA

1.0.0 Pressure drop in ball separator in clean condition

2.0.0 Percentage recovery of balls

3.0.0 Life of sponge Rubber Balls

**Signature of Bidder's**
**Authorized representative .with date.....**

**Date.....**

**ANNEXURE – III**

## LIST OF RECOMMENDED SPARE PARTS

Bidder shall tabulate in the proforma below list of all spare parts as recommended by the respective manufacturer for regular, reliable operation. In case the Bidder has to add any other relevant information, the same shall be indicated herein. Continuation sheets of like size and format may be used as per Bidder's requirements.

| Sl. No | Description | Quantity | Unit Price | Total Price | Delivery Period | Remarks |
|---|---|---|---|---|---|---|

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**ANNEXURE –IV**

## SPECIAL TOOLS AND TACKLE

Bidder shall supply the following tools and tackles for operation, maintenance and replacement of equipment and component, supplied under the specification.

| Sl.No. | Description | Quantity | Model No./Type | Confirm Supply |
|---|---|---|---|---|
| **a** | | | | Yes/No |
| **b** | | | | Yes/No |
| **c** | | | | Yes/No |
| **d** | | | | Yes/No |

**ANNEXURE – V**

## DEVIATION FROM SPECIFICATION

If the proposal submitted has got any deviation from the technical stipulations in the bidding document, the Bidder shall tabulate below the full particulars of such deviations and shall sign below. Additional sheets may be enclosed, if necessary. Deviation is to be furnished with mention of specific clause numbers. Technical and commercial deviations to scope of supply and services, shall be indicated separately.

| Sl.No. | CLAUSE NO. | DESCRIPTION AS PER SPECIFICATION | DEVIATION BY BIDDER |
|---|---|---|---|
| | | | |

We confirm that all the deviations/exceptions to the Technical Specification PY51142, Job Specification and enclosures including reference documents attached are listed in this Annexure only. No other deviations or exceptions even if mentioned elsewhere shall be considered for any technical/ commercial evaluation or for ordering.

**Signature of Bidder's**
**Authorized representative .with date.....**
**Date .....**

**ANNEXURE – VI**

## LIST OF COMMISSIONING SPARE PARTS

Bidder shall tabulate, in the proforma below, list of all spare parts for commissioning. In case the Bidder has to add any other relevant information, the same shall be indicated herein. Continuation sheets of like size and format may be used as per Bidder's requirements.

| Sl. No | Description | Quantity | Unit Price | Total Price | Delivery Period | Remark |
|---|---|---|---|---|---|---|

# VARIANT TABLE - I

| Var. No | Item | OLTCS /cap. ($m^3$/hr.)/ Line size | Matl. Code | Ref. docs /drgs | Remarks |
|---|---|---|---|---|---|
| 01 | Online Tube Cleaning system (OLTCS) | 3125/ 750MM | PY9751142 16 | PY51142 PEMC-5277 | Project: NMDC-TB-5 |
| 02 | Supervision and E & C of OLTCS | --- | PY9851142 26 | PY51142 PEMC-5277 | Project: NMDC-TB-5 |
| | | | | | |
| | | | | | |
| | | | | | |

Ref. Doc

**RECORD OF REVISIONS**

| Rev. No. | Date | Revision Details | Revised By | Checked By | Approved By |
|---|---|---|---|---|---|
| 00 | 03.03.15 | First Issue with var 01 &02. | Ajit Singh | Pradeepa | AK Sinha |
| | | | | | |
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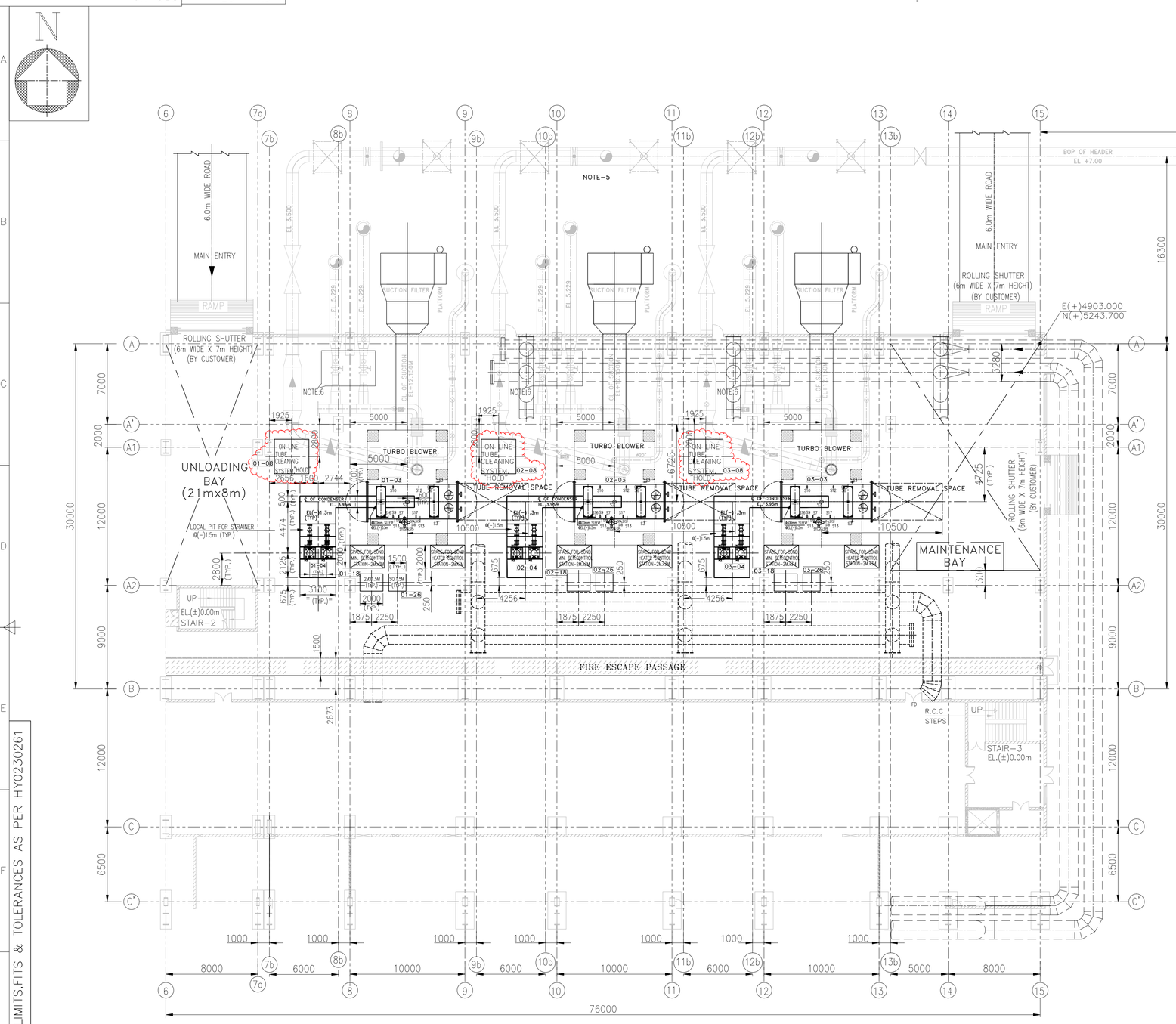
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

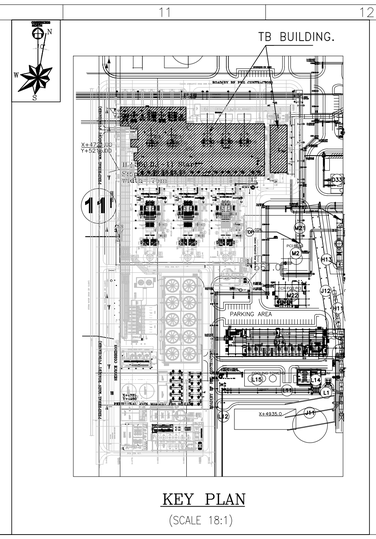
DRG. NO. 1-381-01-06119

SH. 01 OF 06

Enclosure-I




## GROUND FLOOR EL F.F.L (+)0.00M




KEY PLAN

(SCALE 18:1)

## REFERENCE DRAWINGS:

| | |
|---|---|
| 1.PBS BUILDING – EQUIPMENT LAYOUT: | NMDC/TL/010/01/50/BE/0202 PP100M2021 |
| 2. COLD BLAST DISCHARGE SUPPORT LAYOUT: | 0-336-00-37850 |
| 3. CABLE TRAY LAYOUT DRAWING: | 1-381-21-02843 |
| 4. MACHINERY ARRANGEMENT & FOUNDATION DRAWING: | HY-DG-0-336-00-37820 |
| 5. GA OF SURFACE CONDENSER: | HY-DG-1-36010-68401 |
| 6. GA OF STEAM JET AIR EJECTOR: | HY-DG-3-46101-04001 |
| 7. GA OF TWIN OIL COOLER: | HY-DG-3-16505-26201 |
| 7. GA OF GLAND STEAM CONDENSER: | HY-DG-2-56214-94101 |

## NOTES:

1. THE CABLE TRENCH/TRAY DETAILS SHALL BE AS PER CABLE TRAY LAYOUT DRAWING
2. TRENCH SHALL BE PROVIDED FOR CEP PUMPS & SUCTION PIPING
3. THE WALL OPENINGS & FLOOR OPENINGS SHALL BE AS PER "WALL & FLOOR OPENING DRAWING"
4. THE PLATE INSERT DETAILS SHALL BE AS PER "PLATE INSERT DETAILS DRAWING"
5. THE COLD BLAST AIR PIPING IS ONLY INDICATIVE,FOR NECESSARY DETAILS THE CORRESPONDING PIPING & SUPPORT LAYOUT SHALL BE REFERRED
6. THE TOP OF THE BLOW OFF VALVE ACTUATOR ELEVATION IS 7.5 METERS & INTERFERENCE WITH BEAMS AT THIS LOCATION SHALL BE AVOIDED AND TO BE TAKEN CARE DURING STRUCTURAL DESIGN BY CUSTOMER AND B.O.S OF BEAMS SHALL BE +8.00M
7. ALL EQUIPMENTS ARE PLACED CONSIDERING SAFETY AND MAINTENANCE ASPECTS
8. SUFFICIENT ACCESSIBILITY SPACE AROUND EQUIPMENT AND HEAD ROOM CLEARANCE IS PROVIDED
9. PLATFORM WITH LADDERS SHALL BE PROVIDED FOR ACCESSING VALVES,INSTRUMENT MOUNTING
10. FOR CEP TRENCH DETAILS REFER AUX. FOUNDATION DRG
11. ALL TRENCH DIMENSIONS ARE INSIDE DIMENSIONS

## LEGEND:

F.F.L – FINISHED FLOOR LEVEL – 0.00M CORRESPONDS TO R.L 561.7M ABOVE M.S.L
F.G.L – FINISHED GROUND LEVEL – (–)0.700M
H.P.P – HIGHEST PAVING POINT – (–)0.100M

## SCOPE OF SUPPLY:

BHEL | CUSTOMER

| Equip. No. | Tag No. | Description |
|---|---|---|
| 01-03 | 1-TBC-01 | CONDENSER FOR TB-1 |
| 02-03 | 2-TBC-01 | CONDENSER FOR TB-2 |
| 03-03 | 3-TBC-01 | CONDENSER FOR TB-3 |
| 01-04 | 1-TBP-01,02 | C.E.P FOR TB-1 |
| 02-04 | 2-TBP-01,02 | C.E.P FOR TB-2 |
| 03-04 | 3-TBP-01,02 | C.E.P FOR TB-3 |
| 01-08 | - | ONLINE TUBE CLEANING SYSTEM FOR TB-1 |
| 02-08 | - | ONLINE TUBE CLEANING SYSTEM FOR TB-2 |
| 03-08 | - | ONLINE TUBE CLEANING SYSTEM FOR TB-3 |
| 01-18 | - | OIL CENTRIFUGE FOR TB-1 |
| 02-18 | - | OIL CENTRIFUGE FOR TB-2 |
| 03-18 | - | OIL CENTRIFUGE FOR TB-3 |
| 01-26 | - | TRANSFER OIL PUMP FOR TB-1 |
| 02-26 | - | TRANSFER OIL PUMP FOR TB-2 |
| 03-26 | - | TRANSFER OIL PUMP FOR TB-3 |

| SUBMITTED FOR | APPROVAL | INFORMATION | REFERENCE | RECORD | CONSTRUCTION |
|---|---|---|---|---|---|

CUSTOMER: NMDC LIMITED

3.0 MPTY INTEGRATED STEEL PLANT
(NISP),NAGARNAR, CHHATTISGARH.
(PACKAGE DESCRIPTION)

CONSULTANT: मेकॉन लिमिटेड MECON LIMITED

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

| REV. | DATE | ALTERED | ZONE | REVISED AS PER CUSTOMER COMMENTS & GENERAL REVISION |
|---|---|---|---|---|
| 06 | 19.01.15 | K.D.K CHD/APPD G.S/V.V.S.S | | |
| 05 | 03.01.15 | G.K.C CHD/APPD G.S/V.V.S.S | | REVISED AS PER CUSTOMERCOMMENTS |
| 03 | 15.11.14 | G.K.C CHD/APPD G.S/V.V.S.S | | GENERAL REVISION UPDATED AS PER CUSTOMERCOMMENTS |
| 02 | 27.10.14 | K.D.K CHD/APPD G.K.C/V.V.S.S | | GENERAL REVISION UPDATED AS PER CUSTOMERCOMMENTS |
| 01 | 28.08.14 | G.K.C CHD/APPD G.S/V.V.S.S | | GENERAL REVISION UPDATED AS PER CUSTOMER COMMENTS |

| | |
|---|---|
| DESIGNED | K.D.K |
| DRAWN | K.D.K |
| CHECKED | G.K.C |
| APPROVED | SIGN.V.V.S.S.S |
| | DATE 11.08.14 |

TITLE OF DRAWING: TURBOBLOWER BUILDING EQPT. LAYOUT AT EL 0.00m

SCALE 1:200 | SHEET 01 OF 06 | REV 06

VENDOR'S DRAWING No 1-381-01-06119

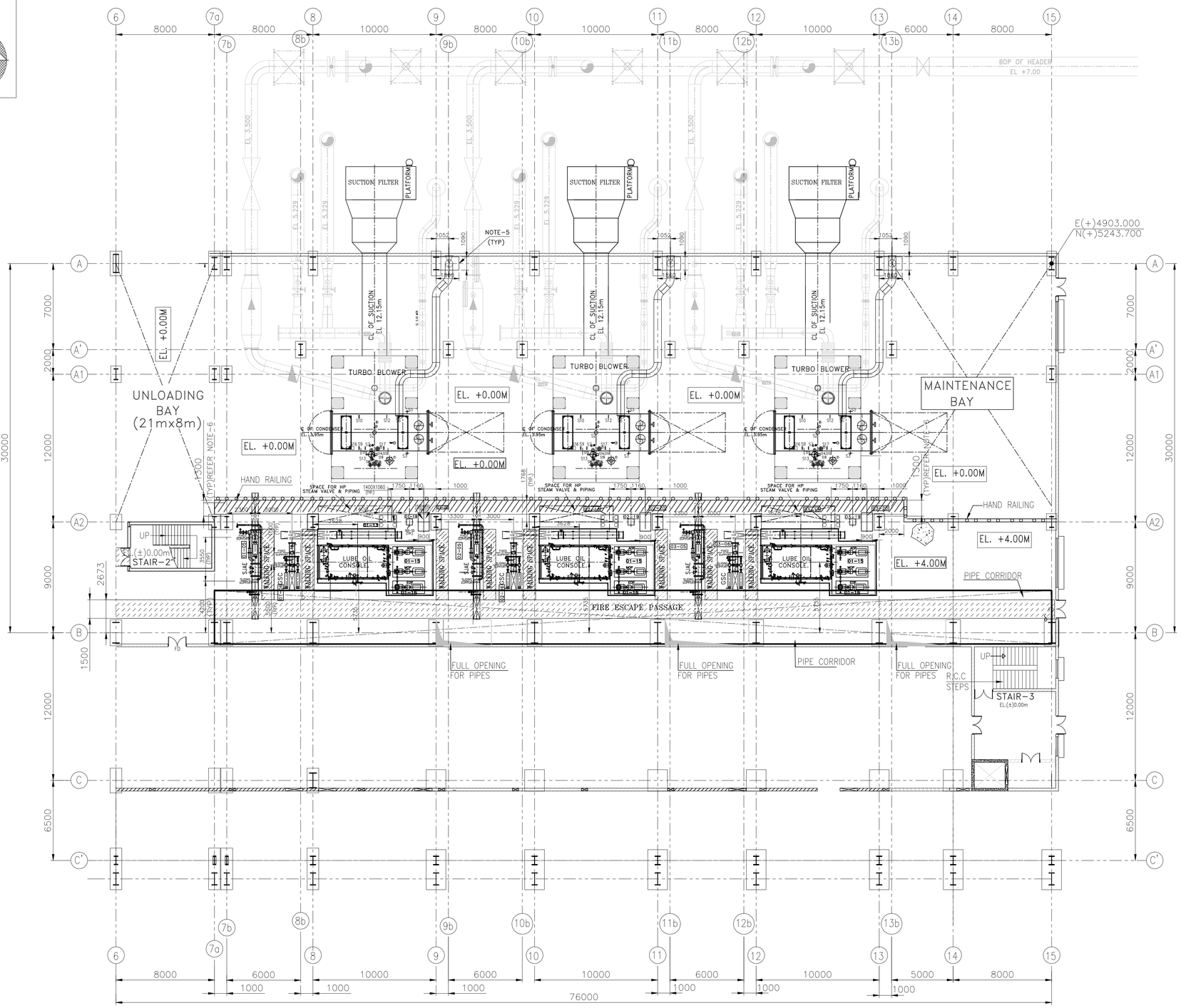
PROJECT DRAWING No NMDC/BHEL/010A/00/16/DE/1102

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-381-01-06119

SH. 02 OF 06




## MEZANINE FLOOR EL. +4.00M

## NOTES:

1. PIPES WILL BE ROUTED AT EL(+)8.00M NEARER TO COLUMNS GRID B-B LOADING AS INDICATED IN SHEET 5 OF 6
2. CROSS BEAMS AT INTERMEDIATE SPACING OF 2000MM SHALL BE PROVIDED BELOW MEZANINE FLOOR AT EL(+)4.00M
3. THE WALL OPENINGS & FLOOR OPENINGS SHALL BE AS PER "WALL & FLOOR OPENING DRAWING"
4. THE TENTATIVE CENTRE LINE ELEVATION OF PSV SUCTION IS +5.5M THE EXACT LOCATION SHALL BE PROVIDED AFTER RECEIVING THE VENDOR GA DRAWING
5. TB-BUILDING CIVIL DESIGN SHALL CONSIDER THE LOADS AS INDICATED IN SHEET 5 FOR 24" PSV. DESIGN AND SUPPLY OF PROPER SUPPORTING STRUCTURE,PLATFORM & HANDRAIL FOR 24" PSV IS NOT IN BHEL SCOPE OF SUPPLY AND SHALL BE INCLUDED IN THE SCOPE OF TURBO BLOWER BUILDING CIVIL DESIGN.
6. MINIMUM 1300MM CLEAR SPACE IS REQUIRED FROM COLUMN(A2-A2) EDGE FOR FOR PIPING AND VALVES. AS PER CUSTOMER'S REQUIREMENT OF MAINTENANCE AND ACCESSIBILITY,EXTRA SPACE CAN BE PROVIDED BY TB BUILDING CIVIL & FINAL DIMENSION SHALL BE INFORMED TO BHEL

| Equip. No. | Tag No. | Description |
|---|---|---|
| 01-05 | | Steam Jet Air Ejector Assembly for Turbo blower-1 |
| 02-05 | | Steam Jet Air Ejector Assembly for Turbo blower-2 |
| 03-05 | | Steam Jet Air Ejector Assembly for Turbo blower-3 |
| 01-06 | 1-TBGSC-01 | Gland steam condenser for Turbo blower-1 |
| 02-06 | 2-TBGSC-01 | Gland steam condenser for Turbo blower-2 |
| 03-06 | 3-TBGSC-01 | Gland steam condenser for Turbo blower-3 |
| 01-13 | - | Lube Oil Accumulators (S.S) for Turbo Blower -1 |
| 02-13 | - | Lube Oil Accumulators (S.S) for Turbo Blower -2 |
| 03-13 | - | Lube Oil Accumulators (S.S) for Turbo Blower -3 |
| 01-14 | - | Lube Oil Tank+Duplex Lube Oil Filter for Turbo Blower -1 |
| 02-14 | - | Lube Oil Tank+Duplex Lube Oil Filter for Turbo Blower -2 |
| 03-14 | - | Lube Oil Tank+Duplex Lube Oil Filter for Turbo Blower -3 |
| 01-15 | - | Main & Aux. Lube oil pump assembly for Turbo Blower -1 |
| 02-15 | - | Main & Aux. Lube oil pump assembly for Turbo Blower -2 |
| 03-15 | - | Main & Aux. Lube oil pump assembly for Turbo Blower -3 |
| 01-16 | - | Emergency Lube Oil Pump assembly for Turbo Blower -1 |
| 02-16 | - | Emergency Lube Oil Pump assembly for Turbo Blower -2 |
| 03-16 | - | Emergency Lube Oil Pump assembly for Turbo Blower -3 |
| 01-17 | - | Lube oil coolers for Turbo Blower -1 |
| 02-17 | - | Lube oil coolers for Turbo Blower -2 |
| 03-17 | - | Lube oil coolers for Turbo Blower -3 |
| 01-19 | - | Simplex Filter for Turbo Blower -1 |
| 02-19 | - | Simplex Filter for Turbo Blower -2 |
| 03-19 | - | Simplex Filter for Turbo Blower -3 |
| 01-20 | - | Jacking oil pump assembly for Turbo Blower-1 |
| 02-20 | - | Jacking oil pump assembly for Turbo Blower-2 |
| 03-20 | - | Jacking oil pump assembly for Turbo Blower-3 |

| REV. | DATE | ALTERED | REMARKS |
|---|---|---|---|
| 06 | 19.01.15 | CHD/APPD G.S/V.V.S.S | REVISED AS PER CUSTOMER COMMENTS & GENERAL REVISION |
| 05 | 03.01.15 | CHD/APPD G.S/V.V.S.S | REVISED AS PER CUSTOMER COMMENTS |
| 04 | 16.12.14 | CHD/APPD G.S/V.V.S.S | REVISED AS PER CUSTOMER COMMENTS |
| 03 | 15.11.14 | CHD/APPD G.S/V.V.S.S | GENERAL REVISION UPDATED AS PER CUSTOMER COMMENTS |
| 02 | 27.10.14 | CHD/APPDG.K.C/V.V.S.S | GENERAL REVISION UPDATED AS PER CUSTOMER COMMENTS |
| 01 | 28.08.14 | CHD/APPD G.S/V.V.S.S | GENERAL REVISION UPDATED AS PER CUSTOMER COMMENTS |

| | |
|---|---|
| DESIGNED | KDK |
| DRAWN | KDK |
| CHECKED | GKC |
| APPROVED | SIGN. VVSSS |
| | DATE 11.08.14 |

SUBMITTED FOR: APPROVAL ✓ | INFORMATION | REFERENCE | RECORD | CONSTRUCTION

CUSTOMER: NMDC LIMITED
3.0 MPTY INTEGRATED STEEL PLANT
(NISP),NAGARNAR, CHHATTISGARH.
(PACKAGE DESCRIPTION)

CONSULTANT: मेकॉन लिमिटेड MECON LIMITED

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

TITLE OF DRAWING: TURBOBLOWER BUILDING EQPT. LAYOUT AT EL +4.00M

SCALE 1:175 | SHEET 02 OF 06 | REV 06

VENDOR'S DRAWING No 1-381-01-06119

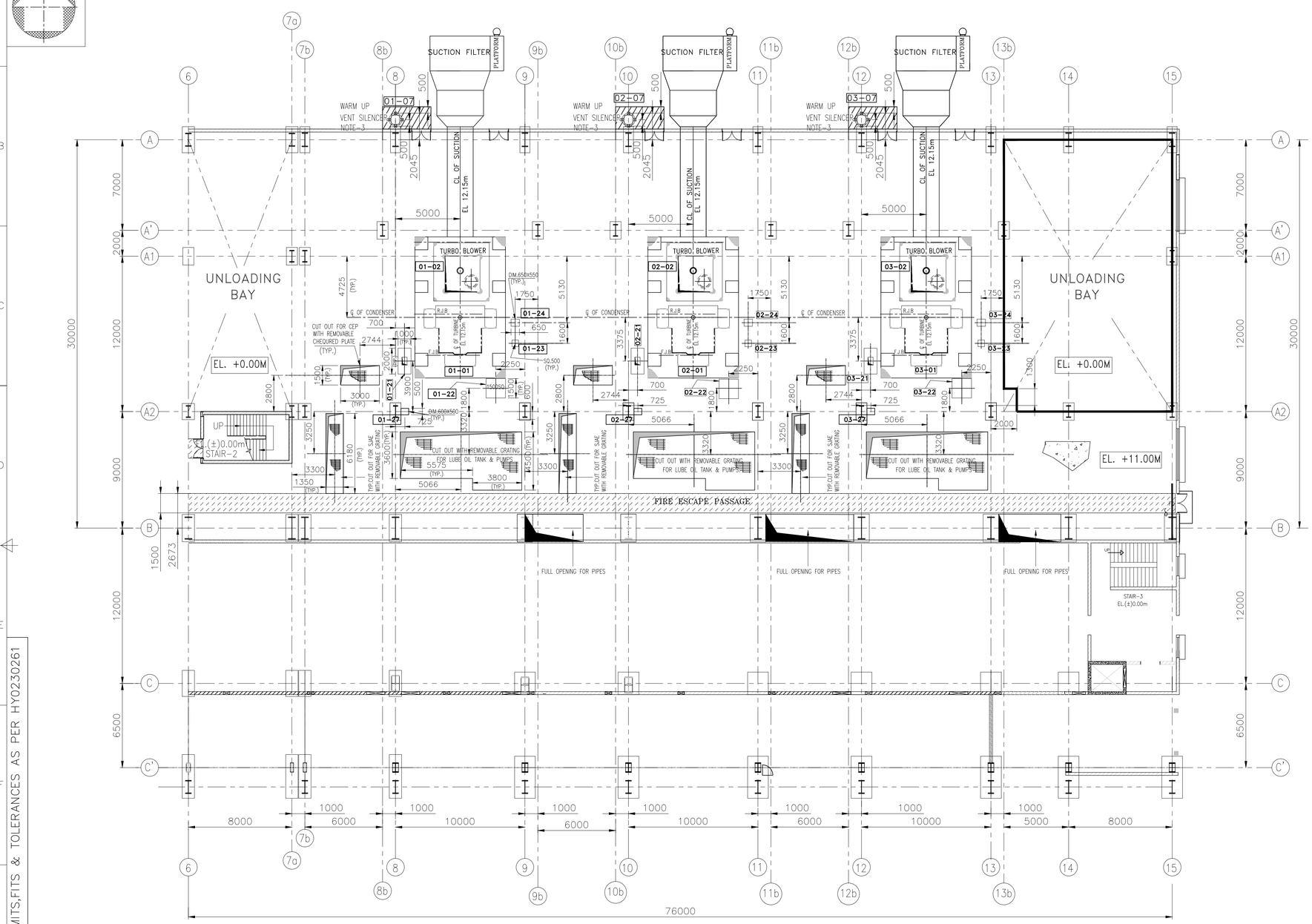
PROJECT DRAWING No NMDC/BHEL/010A/00/16/DE/1102

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-381-01-06119

SH. 03 OF 06




## OPERATING FLOOR EL. +11.00M

## NOTES:

1. CROSS BEAMS AT INTERMEDIATE SPACING OF MINIMUM 2000MM SHALL BE PROVIDED BELOW OPERATING FLOOR AT EL(+)11.00M
2. THE WALL OPENINGS & FLOOR OPENINGS SHALL BE AS PER "WALL & FLOOR OPENING DRAWING"
3. THE VENT SILENCER SHALL BE FIXED ON A CANTILEVER SUPPORT AT EL+11.00M WITH NECESSARY PLAT FORM AND HAND RAIL.
   TB-BUILDING CIVIL DESIGN SHALL CONSIDER THE LOADS AS INDICATED IN SHEET 5. DESIGN AND SUPPLY OF PROPER SUPPORTING STRUCTURE,PLATFORM & HANDRAIL FOR VENT SILENCER IS NOT IN BHEL SCOPE OF SUPPLY AND SHALL BE INCLUDED IN THE SCOPE OF TURBO BLOWER BUILDING CIVIL DESIGN.

| Equip. No. | Tag No. | Description |
|---|---|---|
| 01-01 | 1-TBT-01 | Steam Turbine-1 |
| 02-01 | 2-TBT-01 | Steam Turbine-2 |
| 03-01 | 3-TBT-01 | Steam Turbine-3 |
| 01-02 | 1-TBB-01 | Turbo Blower-1 |
| 02-02 | 2-TBB-01 | Turbo Blower-2 |
| 03-02 | 3-TBB-01 | Turbo Blower-3 |
| 01-21 | - | Local Gauge Board for Turbo Blower -1 |
| 02-21 | - | Local Gauge Board for Turbo Blower -2 |
| 03-21 | - | Local Gauge Board for Turbo Blower -3 |
| 01-22 | - | Governing Oil Console for Turbo Blower -1 |
| 02-22 | - | Governing Oil Console for Turbo Blower -2 |
| 03-22 | - | Governing Oil Console for Turbo Blower -3 |
| 01-23 | - | Governing Oil Accumulators (S.S) for Turbo Blower -1 |
| 02-23 | - | Governing Oil Accumulators (S.S) for Turbo Blower -2 |
| 03-23 | - | Governing Oil Accumulators (S.S) for Turbo Blower -3 |
| 01-24 | - | Oil Console for Barring with AC & DC motor for Turbo Blower -1 |
| 02-24 | - | Oil Console for Barring with AC & DC motor for Turbo Blower -2 |
| 03-24 | - | Oil Console for Barring with AC & DC motor for Turbo Blower -3 |
| 01-27 | - | Compressor process accumulator for Turbo Blower-1 |
| 02-27 | - | Compressor process accumulator for Turbo Blower-2 |
| 03-27 | - | Compressor process accumulator for Turbo Blower-3 |

| REV. | DATE | ALTERED | REV. | DATE | ALTERED | REV. | DATE | ALTERED | REV. | DATE | ALTERED | REV. | DATE | ALTERED | REV. | DATE | ALTERED | REV. | DATE | ALTERED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CHD/APPD | | | CHD/APPD | | | CHD/APPD | 06 | 19.01.15 | CHD/APPD G.S/V.V.S.S | 05 | 03.01.15 | CHD/APPD G.S/V.V.S.S | 04 | 16.12.14 | CHD/APPD G.S/V.V.S.S | 03 | 15.11.14 | CHD/APPD G.S/V.V.S.S |
| | | | ZONE | | | ZONE | | | ZONE | | REVISED AS PER CUSTOMER COMMENTS & GENERAL REVISION | ZONE | | REVISED AS PER CUSTOMER COMMENTS | ZONE | | REVISED AS PER CUSTOMER COMMENTS | ZONE | | GENERAL REVISION |

| REV. | DATE | ALTERED | REV. | DATE | ALTERED |
|---|---|---|---|---|---|
| 02 | 27.10.14 | CHD/APPDG.K.C/V.V.S.S | 01 | 28.08.14 | CHD/APPD G.S/V.V.S.S |
| ZONE | | GENERAL REVISION UPDATED AS PER CUSTOMERCOMMENTS | ZONE | | GENERAL REVISION UPDATED AS PER CUSTOMERCOMMENTS |

| | | | | | |
|---|---|---|---|---|---|
| SUBMITTED FOR | ✓ APPROVAL | INFORMATION | REFERENCE | RECORD | CONSTRUCTION |

CUSTOMER:

NMDC LIMITED
3.0 MPTY INTEGRATED STEEL PLANT
(NISP),NAGARNAR, CHHATTISGARH.
(PACKAGE DESCRIPTION)

CONSULTANT:

मेकॉन लिमिटेड
MECON LIMITED

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

| | |
|---|---|
| DESIGNED | KDK |
| DRAWN | KDK |
| CHECKED | GKC |
| APPROVED | SIGN. VVSSS |
| | DATE 11.08.14 |

TITLE OF DRAWING: TURBOBLOWER BUILDING EQPT. LAYOUT AT EL 11.0m.

SCALE 1:175 | SHEET 03 OF 06 | REV 06

VENDOR'S DRAWING No 1-381-01-06119

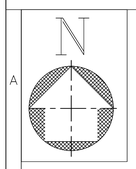
PROJECT DRAWING No NMDC/BHEL/010A/00/16/DE/1102

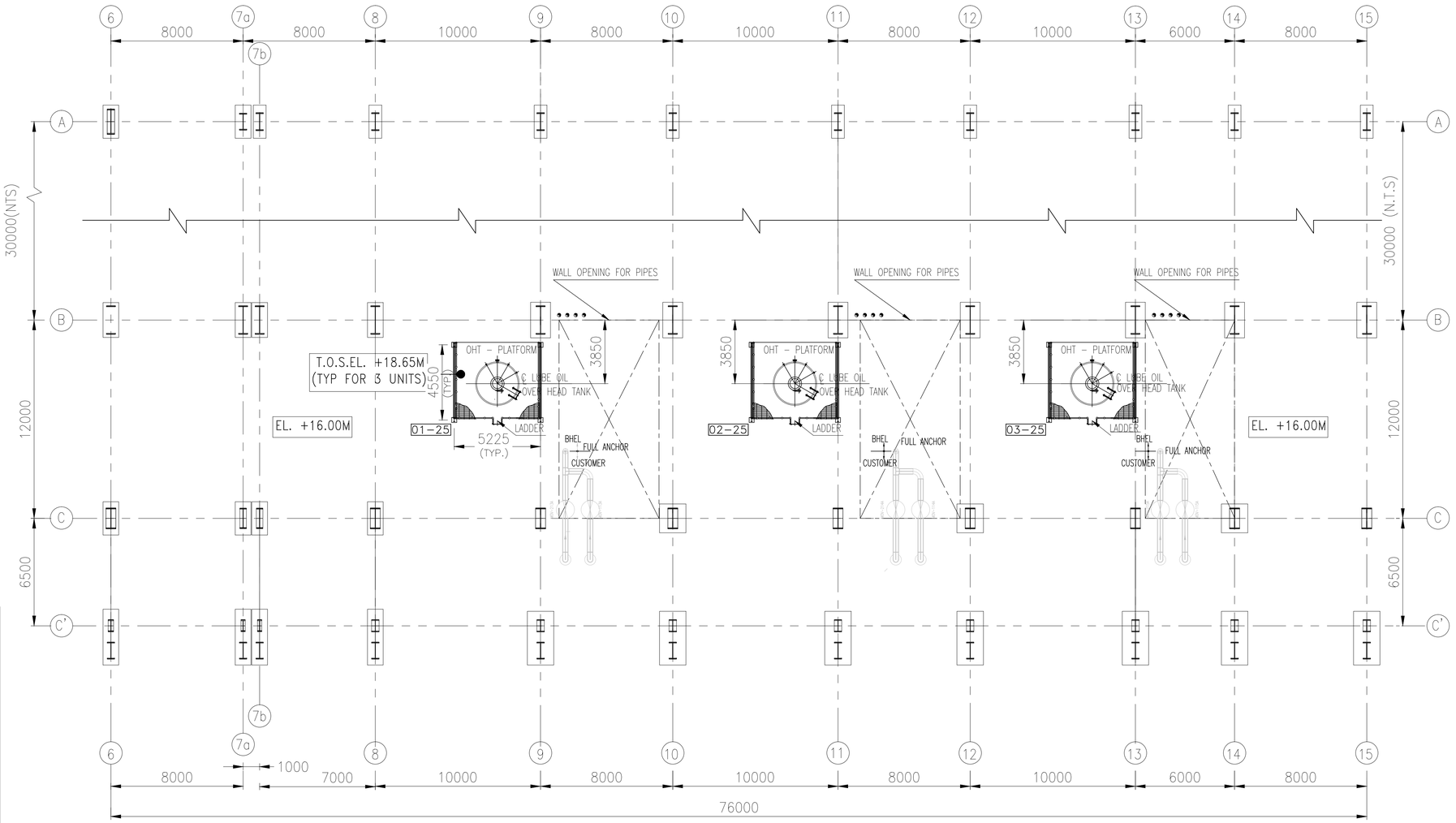
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-381-01-06119

SH. 04 OF 06




## FLOOR EL.(+)16.000M
## B-C BAY

## NOTES:

1. INTERMEDIATE SECONDARY BEAMS/PLATES/FOUNDATION SHALL BE PROVIDED BY CUSTOMER FOR FIXING OHT SUPPORT STRUCTURE,LADDER. ONLY SUPPORT STRUCTURE & PLATFORM FOR OHT IS IN BHEL SCOPE OF SUPPLY
2. DESIGN AND SUPPLY OF ANCHOR AT TERMINAL POINTS IS NOT IN BHEL SCOPE
3. THE PIPING SHOWN IS ONLY FOR REFERENCE.
   FOR DETAILS CORRESPONDING PIPING LAYOUT SHALL BE REFERRED



GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

| REV. | DATE | ALTERED | ZONE |
|---|---|---|---|
| | | CHD/APPD | |
| 06 | 19.01.15 | ALTERED G.K.C<br>CHD/APPD G.S/V.V.S.S | GENERAL REVISION |
| 05 | 03.01.15 | ALTERED G.K.C<br>CHD/APPD G.S/V.V.S.S | REVISED AS PER CUSTOMER COMMENTS |
| 04 | 16.12.14 | ALTERED G.K.C<br>CHD/APPD G.S/V.V.S.S | REVISED AS PER CUSTOMER COMMENTS |
| 03 | 15.11.14 | ALTERED G.K.C<br>CHD/APPD G.S/V.V.S.S | GENERAL REVISION |
| 02 | 27.10.14 | ALTERED K.D.K<br>CHD/APPD G.K.C/V.V.S.S | GENERAL REVISION<br>UPDATED AS PER CUSTOMERCOMMENTS |
| 01 | 28.08.14 | ALTERED G.K.C<br>CHD/APPD G.S/V.V.S.S | GENERAL REVISION<br>UPDATED AS PER CUSTOMERCOMMENTS |

| SUBMITTED FOR | APPROVAL | INFORMATION | REFERENCE | RECORD | CONSTRUCTION |
|---|---|---|---|---|---|

CUSTOMER:

NMDC LIMITED
3.0 MPTY INTEGRATED STEEL PLANT
(NISP),NAGARNAR, CHHATTISGARH.
(PACKAGE DESCRIPTION)

CONSULTANT:

मेकॉन लिमिटेड
MECON LIMITED

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

| | |
|---|---|
| DESIGNED | KDK |
| DRAWN | KDK |
| CHECKED | GKC |
| APPROVED | SIGN. VVSSS |
| | DATE 11.08.14 |

TITLE OF DRAWING: TURBOBLOWER BUILDING
EQPT. LAYOUT AT 16.0m.

SCALE 1:150 | SHEET 04 OF 06 | REV 06

VENDOR'S DRAWING No 1-381-01-06119

PROJECT DRAWING No NMDC/BHEL/010A/00/16/DE/1102

**LIST OF EQUIPMENT**

| S.No | Tag No | Description | Quantity | Weight(Kg) | | | Floor Elevation | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Empty | Operating | Flooded | | |
| 1 | 1-TBT-01<br>2-TBT-01<br>3-TBT-01 | Steam Turbine | 3 | | 58970 | 58970 | | Refer Machinery Arrangement and Foundation drawing for loads |
| 2 | 1-TBB-01<br>2-TBB-01<br>3-TBB-01 | Turbo Blower | 3 | | 53500 | 53500 | | Refer Machinery Arrangement and Foundation drawing for loads & note-8 |
| 3 | 1-TBC-01<br>2-TBC-01<br>3-TBC-01 | Condenser | 3 | 62000 | 86000 | 120000 | 0.00 | note-5 |
| 4 | 1-TBP-01,02<br>2-TBP-01,02<br>3-TBP-01,02 | Condensate Extraction Pump | 6 | * | * | * | Trench at ground floor | note-5 |
| 5 | | Steam Jet Air Ejector Assembly | 3 | 7100 | 8000 | 9000 | 4.00 | note-5 |
| 6 | 1-TBGSC-01<br>2-TBGSC-01<br>3-TBGSC-01 | Gland Steam Condenser | 3 | 1000 | 1200 | 1500 | 4.00 | note-5 |
| 7 | - | Warm up Vent Silencer-HP Steam | 3 | 3000 | 3000 | 3000 | 11.00 | Vent silencer to be fixed at El (+)11.00m |
| 8 | - | On line Tube Cleaning System | 3 | * | * | * | 0.00 | note-5 |
| 9 | 24" P.S.V | 24" Pressure safety valve | 3 | - | 4000 | - | 5.20 | The actual loads shall be provided after receiving the Vendor dwg of PSV |

**LIST OF EQUIPMENT BY T&C**

| S.No | Tag No | Description | Quantity | Weight(Kg) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Empty | Operating | Flooded | | |
| | | | | | | | | |
| 13 | - | Lube Oil Accumulators (S.S) | 3 | 975 | | 1275 | 4.00 | note-5 |
| 14 | - | Lube Oil Tank+Duplex Lube Oil Filter | 3 | 7500 | | 34500 | 4.00 | note-5 |
| 15 | - | Main & Aux. Lube oil pump assembly (Screw pump with AC Motor drives) | 3 | 3000 | | 3700 | 4.00 | note-5 |
| 16 | - | Emergency Lube Oil Pump assembly (Centrifugal Pump with DC Motor drive) | 3 | 950 | | 1050 | 4.00 | note-5 |
| 17 | - | Lube oil coolers | 3 | 6000 | | 7350 | 4.00 | note-5 |
| 18 | - | Oil Centrifuge | 3 | 1500 | | 2000 | 0.00 | note-5 |
| 19 | - | Simplex Filter | 3 | 160 | | 195 | 4.00 | note-5 |
| 20 | - | Jacking oil pump assembly (Gear Pumps with A.C+ D.C motor drives) | 3 | 500 | | 550 | 4.00 | note-5 |
| 21 | - | Local Gauge Board | 3 | 1000 | | 1000 | 11.00 | note-5 |
| 22 | - | Governing Oil Console | 3 | 700 | | 700 | 11.00 | note-5 |
| 23 | - | Governing Oil Accumulators (S.S) | 3 | 475 | | 600 | 11.00 | note-5 |
| 24 | - | Oil Console for Barring with AC & DC motor | 3 | 300 | | 350 | 11.00 | note-5 |
| 25 | - | Overhead Oil Tank | 3 | 2175 | | 10000 | 16.00 | note-5, Plat form at TOS EL.(+)18.65m. |
| 26 | - | Transfer oil pump | 3 | 100 | | 125 | 0.00 | |
| 27 | - | compressor process accumulator | 3 | 147 | | 200 | 11.00 | note-5 |

**NOTES:**

1. The piping will be supported from both top and bottom sides of Floors at Elevation (+)4.0m &(+)11.0m
2. Piping Loads due to cold blast air Piping shall be considered as per Dwg no:0-336-00-37850
3. The piping load in vertical direction shall be considered as 2000 kg/Sq.m for each floor (+4.00m,+11.00m),at +8.00m and roof at elevation (+16.00m)
4. Piping loads otherthan (cold blast air piping) in horizontal direction(both Longitudinal and Transverse directions) at Elevations (+)4.0 m,(+)8.0 m,(+)11.0 m & (+)16.0 m shall be considered as 0.5 times Vertical load in each direction ie., (0.5 X Vertical Load)
   The Piping loads shall be considered between columns 7A to 14(Entire Length of Turbo Blower Building)
5. For weights,dimensions,foundation and fixing details to be considered for building & foundation design, corresponding equipment GA shall be referre
6. For s.no 9 24" PSV horizontal loads of 4000Kg to be considered in both Longitudinal and transverse directions
7. Horizontal loads (both Longitudinal and Transverse directions) for vent silencer fixing shall be considered as 2500kg each
8. Loads on operating floor EL + 11.000M due to inlet duct to Turbo blower: 2000 kg/sq.m load shall be considered between grid 8B & 9B, 10B & 11B, 12B & 13B on blower side

| REV. | DATE | ALTERED | CHD/APPD |
|---|---|---|---|
| 06 | 19.01.15 | ALTERED G.K.C | CHD/APPD G.S./V.V.S.S |
| 05 | 03.01.15 | ALTERED G.K.C | CHD/APPD G.S./V.V.S.S |
| 04 | 16.12.14 | ALTERED G.K.C | CHD/APPD G.S./V.V.S.S |
| 03 | 15.11.14 | ALTERED G.K.C | CHD/APPD G.S./V.V.S.S |
| 02 | 27.10.14 | ALTERED K.D.K | CHD/APPD G.K.C/V.V.S.S |
| 01 | 28.08.14 | ALTERED G.K.C | CHD/APPD G.S/V.V.S.S |

ZONE: UPDATED AS PER CUSTOMER COMMENTS & GENERAL REVISION | UPDATED AS PER CUSTOMER COMMENTS | UPDATED AS PER CUSTOMER COMMENTS | GENERAL REVISION UPDATED AS PER CUSTOMERCOMMENTS | GENERAL REVISION UPDATED AS PER CUSTOMERCOMMENTS | GENERAL REVISION UPDATED AS PER CUSTOMERCOMMENTS

| | | | | | | |
|---|---|---|---|---|---|---|
| SUBMITTED FOR | ✓ APPROVAL | INFORMATION | REFERENCE | RECORD | CONSTRUCTION | |

CUSTOMER: NMDC LIMITED
3.0 MPTY INTEGRATED STEEL PLANT
(NISP),NAGARNAR, CHHATTISGARH.
(PACKAGE DESCRIPTION)

CONSULTANT: मेकॉन लिमिटेड
MECON LIMITED

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

| | |
|---|---|
| DESIGNED | KDK |
| DRAWN | KDK |
| CHECKED | GKC |
| APPROVED | SIGN. VVSSS |
| | DATE 11.08.14 |

TITLE OF DRAWING: TURBOBLOWER BUILDING EQPT. LAYOUT

SCALE 1:200 | SHEET 05 OF 06 | REV 06

VENDOR'S DRAWING No 1-381-01-06119

PROJECT DRAWING No NMDC/BHEL/010A/00/16/DE/1102

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-381-01-06119

SH. 06 OF 90



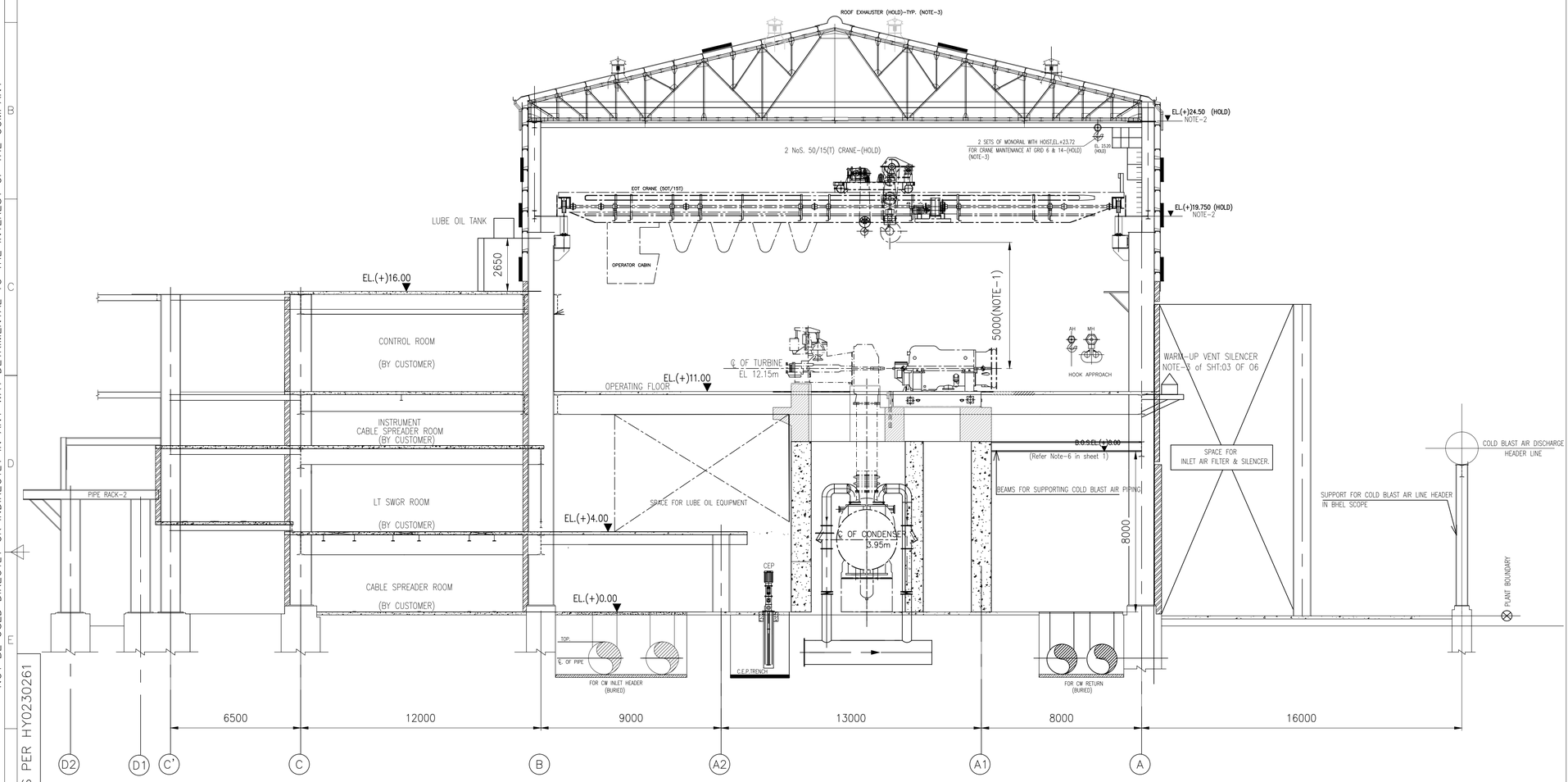
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO




ELEVATION VIEW

## NOTES:

1. CRANE HOOK HEIGHT HAS BEEN ARRIVED BASED ON TURBINE/BLOWER REQUIREMENT ONLY
2. THE ELEVATIONS SHALL BE DECIDED BY CUSTOMER AND INFORMED TO BHEL FOR CONCURRENCE
3. ROOF EXHAUSTERS,CRANE,MONORAILS,HOIST etc., ARE NOT IN BHEL SCOPE OF SUPPLY

| REV. | DATE | ALTERED | ZONE |
|---|---|---|---|
| | | CHD/APPD | |
| 06 | 19.01.15 | CHD/APPD G.S/V.V.S.S. | UPDATED AS PER CUSTOMER COMMENTS & GENERAL REVISION |
| 05 | 03.01.15 | CHD/APPD G.S/V.V.S.S. | UPDATED AS PER CUSTOMER COMMENTS |
| 04 | 16.12.14 | CHD/APPD G.S/V.V.S.S. | GENERAL REVISION |
| 03 | 15.11.14 | CHD/APPD G.S/V.V.S.S. | GENERAL REVISION |
| 02 | 27.10.14 | CHD/APPDG.K.C/V.V.S.S | GENERAL REVISION |
| 01 | 28.08.14 | CHD/APPD G.S/V.V.S.S | ADDED NEW SHEET |

| | | | | | |
|---|---|---|---|---|---|
| SUBMITTED FOR | ✓ APPROVAL | INFORMATION | REFERENCE | RECORD | CONSTRUCTION |

CUSTOMER:

NMDC LIMITED
3.0 MPTY INTEGRATED STEEL PLANT
(NISP),NAGARNAR, CHHATTISGARH.
(PACKAGE DESCRIPTION)

CONSULTANT:

मेकॉन लिमिटेड
MECON LIMITED

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

| | |
|---|---|
| DESIGNED | KDK |
| DRAWN | KDK |
| CHECKED | GKC |
| APPROVED | SIGN. VVSSS |
| | DATE 11.08.14 |

TITLE OF DRAWING: TURBOBLOWER BUILDING EQPT. LAYOUT

SCALE 1:125 | SHEET 06 OF 06 | REV 06

VENDOR'S DRAWING No 1-381-01-06119

PROJECT DRAWING No NMDC/BHEL/010A/00/16/DE/1102

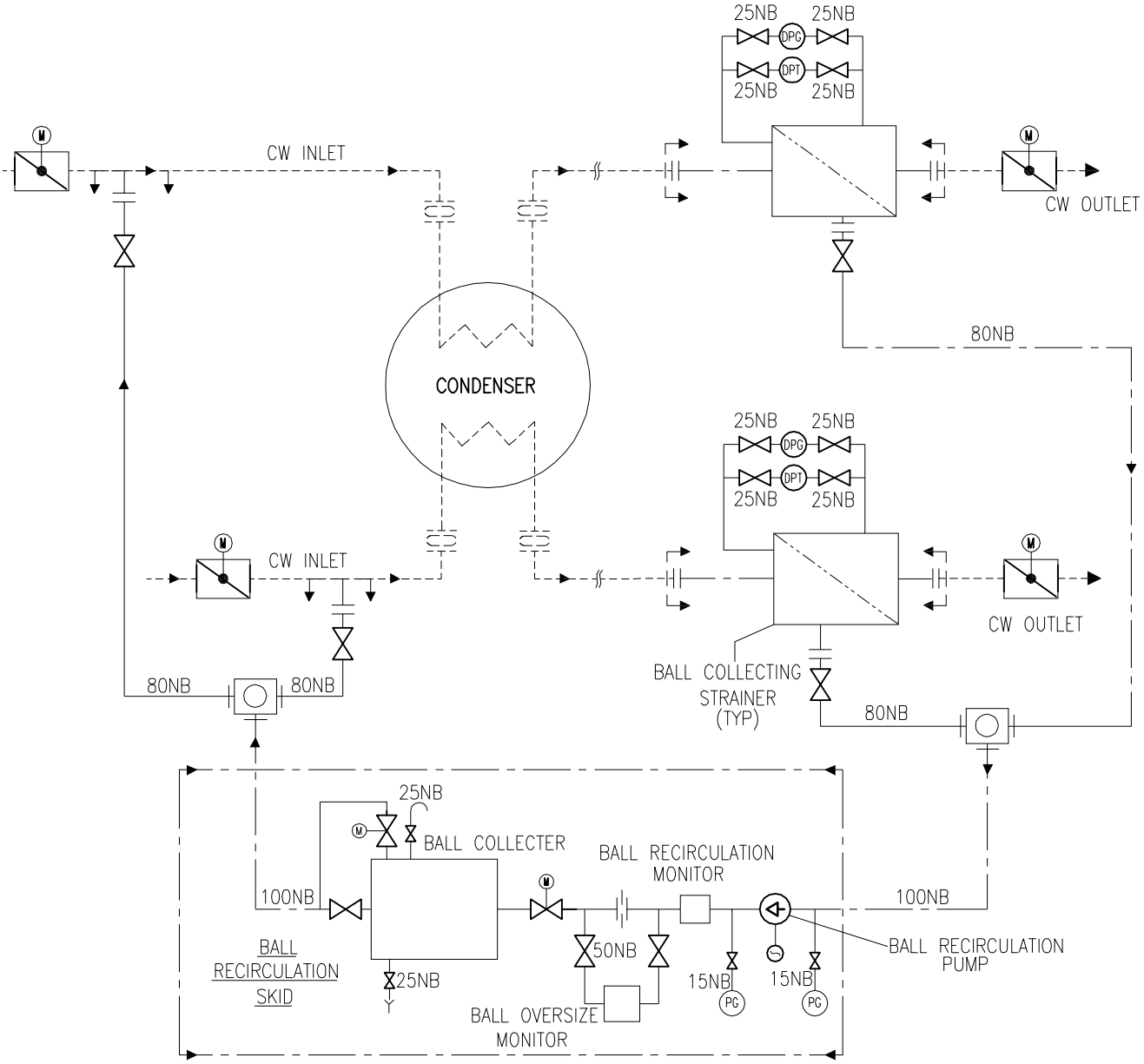
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN mm.

| REV. | DATE | ALTERED / CHECKED / APPROVED | REV. | DATE | ALTERED / CHECKED / APPROVED | REV. | DATE | ALTERED / CHECKED / APPROVED |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

FOR REFERENCE PURPOSE ONLY

Enclosure-II




NOTE:-

1. SCHEMATIC SHOWN IS TYPICAL FOR ONE CONDENSER, SHALL BE IDENTICAL FOR ALL THE CONDENSERS.
2. BY PASS LINE OF BALL COLLECTOR AND TYPE OF VALVE (MOTORISED /MANUAL) SHALL BE AS PER MANUFACTURERS PRACITCE
3. → BIDDERS SCOPE OF SUPPLY



COMPUTER NO.

REF. DRG. NO.

SIGN. & DATE

INVENTORY NO.

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

| | NAME | SIGN. | DATE | NO.OF VAR. |
|---|---|---|---|---|
| DRN. | XXXX | | | |
| CHD. | XXXX | | | |
| APPD. | XXXX | | | |

| DEPT. / CODE | UNTOL. DIMS. GR. ¢/M/f | | SCALE | WEIGHT (KG) | REF. TO ASSY. DRG. | ITEM NO. | NO.OF ITEMS |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

TITLE: PIPING & INSTRUMENTATION DIAGRAM FOR ON LINE TUBE CLEANING SYSTEM

CARD CODE

DRAWING NO. X-XXXXX-XXXXX

REV. XX

SHT. No

NO. OF SHT.

A4 SIZE

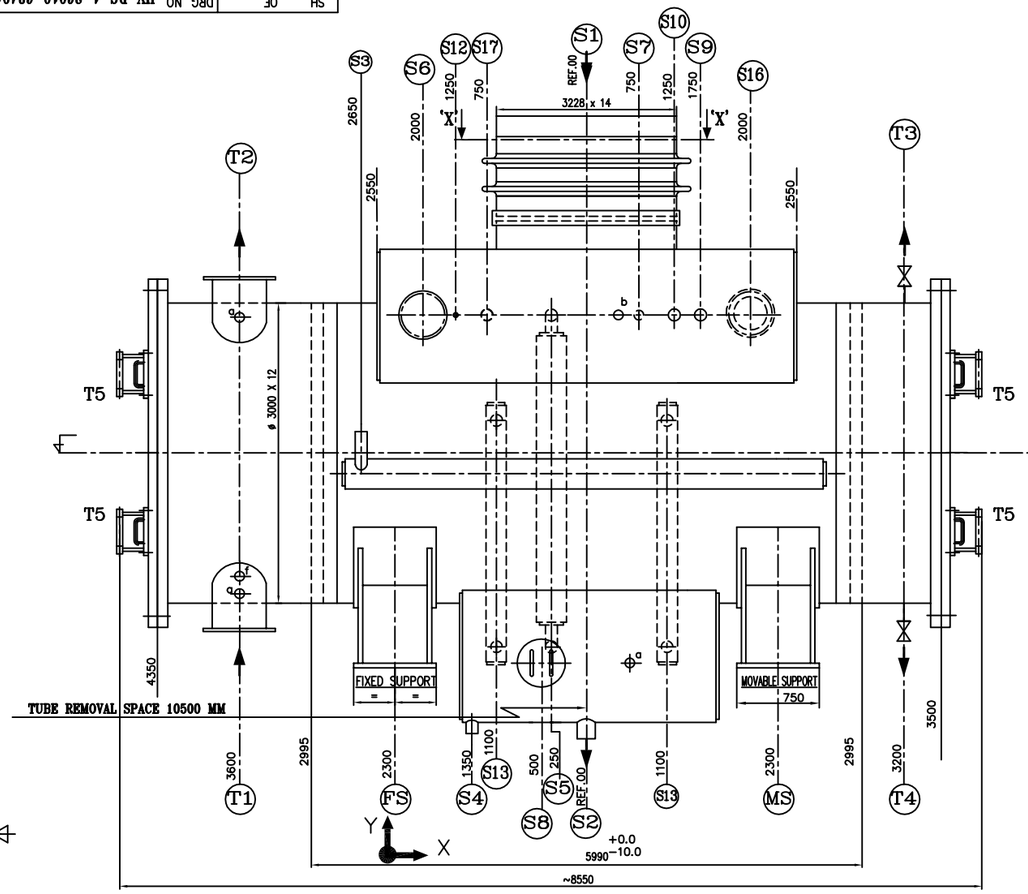
FIRST ANGLE PROJECTION

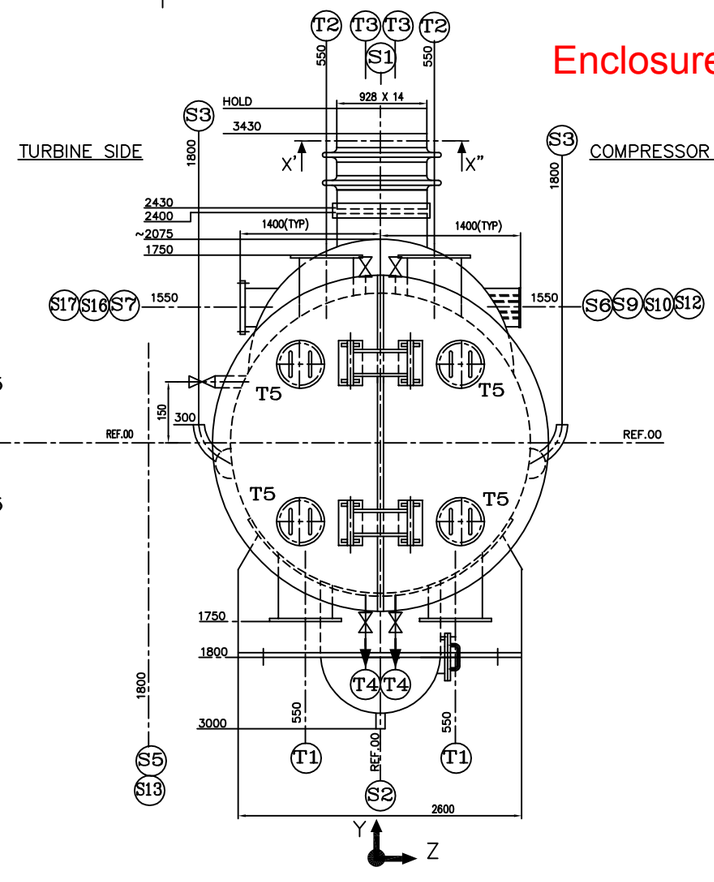
(ALL DIMENSIONS ARE IN mm)

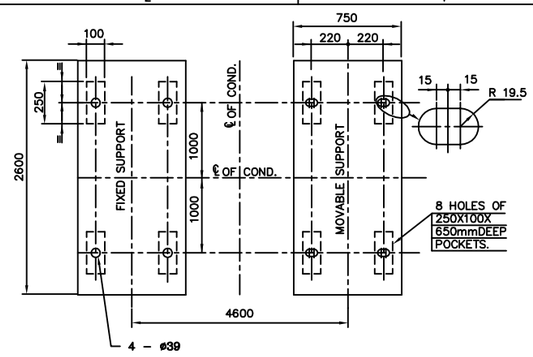
DRG. NO. HY-DG-1-36010-68401

SH OF

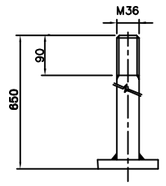
Enclosure-III



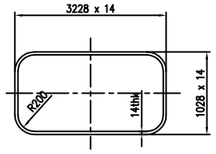




FOUNDATION DETAIL




FOUNDATION BOLT DETAIL



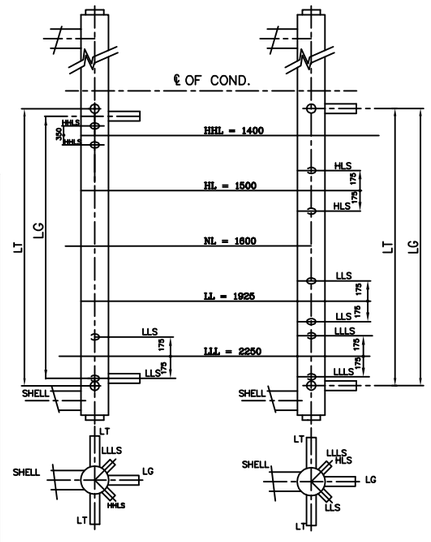

EXHAUST DETAIL (S1)
SECTION 'X X'

## MATERIALS

| | |
|---|---|
| TUBES – CONDENSING ZONE | SS: SA249TP304 |
| TUBES – AIR COOLING ZONE | SS: SA249TP304 |
| TUBE PLATE | SA 516 Gr.70 |
| SUPPORT PLATE | SA 516 Gr.70 |
| SHELL & OTHER PARTS | SA 516 Gr.70 |
| INTERNAL BOLTS & NUTS | SA 193 B7, SA194 2H |
| WATER BOX GASKETS | NAB |

## NOZZLE FORCES, MOMENTS AND THERMAL MOVENTS

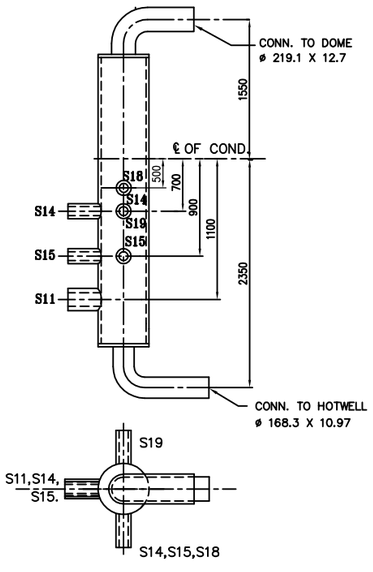
| NOZZLE REF | MOMENTS Kg-M | FORCES Kgs | THERMAL MOVEMENTS X mm | Y mm | Z mm |
|---|---|---|---|---|---|
| T1 | 6100 | 2300 | | | |
| T2 | 6100 | 2300 | | | |
| S2 | 2180 | 820 | | | |
| S3 | 900 | 350 | | | |
| S6 | 4880 | 1830 | | | |
| S7 | 490 | 190 | | | |
| S9 | 750 | 270 | | | |
| S10 | 750 | 270 | | | |
| | | | | | |




STAND PIPE–I




STAND PIPE–II




SURGE PIPE

## DESIGN DATA

| DESIGN CODE: H E I / B H E L | | | |
|---|---|---|---|
| DESCRIPTION | | SHELL SIDE | TUBE SIDE |
| TYPE | | | 2 PASS DIVIDED |
| DESIGN PRESSURE | Kg/sq.CM (g) | 1.1 & FULL VC. | 3.5 |
| DESIGN TEMPERATURE | °C | 100 | 65 |
| TEST PRESSURE | Kg/sq.CM (g) | HY.FILL | 4.55 |
| TEST TEMPERATURE | °C | AMBIENT | AMBIENT |
| CONDENSER PRESSURE | Kg/sq.CM (abs) | 0.12/0.143 | |
| STEAM QUANTITY (MIN.) | t/hr. | 87.12 | |
| STEAM QUANTITY (MAXIMUM) | t/hr. | 109.1 | |
| COOLING WATER INLET TEMP. | °c | 35 | |
| COOLING WATER QUANTITY | cu.M/hr. | 6250 | |
| ** TOTAL SURFACE AREA | sq.M | 2170 | |
| TUBE SIZE (OD X THICK) | | ø 22 x 22 BWG | |
| NO. OF TUBES | | 5320 | |
| PRESSURE DROP ON C.W. SIDE | M.W.C. | 6 | |
| HOTWELL CAPACITY (NL TO LLL) | MINUTES | 2 MINUTES | |
| EMPTY WIEGHT | | 62,000 Kgs. | |
| WORKING WIEGHT | | 86,000 Kgs. | |
| FLOODED WIEGHT | | 120,000 Kgs. | |
| INSPECTION | | BHEL | |
| CLEANLINESS FACTOR ON WATER SIDE | | 0.85 | |

** The Surface Area includes 15% Plugin margin

## LIST OF INSTRUMENTS CONNECTIONS

| REF. | DESCRIPTION | SIZE | QTY | LOCATION |
|---|---|---|---|---|
| a | TEMPERATURE GAUGE | M 33X2 | 7 | HOTWELL, STEAM INLET, C.W.INLET & OUTLET. |
| b | COMPOUND PRESSURE GAUGE | 1/2"(SW)VALVE | 5 | ON SHELL |
| c | LEVEL GAUGE L = 1200 | 1"ANSI300 RF | 4 | ON STAND PIPE |
| d | LEVEL SWITCH CONNECTION | 1" SW. | 10 | ON STAND PIPE |
| e | LEVEL CONTROLLER/TRANSMETER CONN. | 2"ANSI 150 RF | 8 | ON STAND PIPE |
| f | WATER EXPANSION RELIEF VALVE | 3/4" / 1" S.W | 2 | ON C.W. INLET |

## LIST OF NOZZLES

| REF | DESCRIPTION | SIZE | QTY | REMARKS |
|---|---|---|---|---|
| TUBE SIDE NOZZLES | | | | |
| T1 | COOLING WATER INLET | 30" ANSI 150 SORF | 2 | FLANGED |
| T2 | COOLING WATER OUTLET | 30" ANSI 150 SORF | 2 | FLANGED |
| T3 | WATER BOX VENT | ø60.3 X 5.54 | 2 | S.W. |
| T4 | WATER BOX DRAIN | ø60.3 X 5.54 | 4 | S.W. |
| T5 | WATER BOX INSPECTION HOLE | 18" ANSI 150 SORF | 6 | FLANGED |
| SHELL SIDE NOZZLES | | | | |
| S1 | EXHAUST STEAM INLET | AS PER SEC.X–X | 1 | FLANGED |
| S2 | CONDENSATE OUTLET | ø273.05X12.7 | 1 | B.W. |
| S3 | AIR SUCTION | ø114.3X6.02 | 2 | B.W. |
| S4 | HOT WELL DRAIN | ø60.3 X 5.54 | 1 | B.W. |
| S5 | EXPANSION SURGE. | ø508 X 12.7 | 1 | – |
| S6 | ATMOSPHERIC RELIEF VALVE | 24" ANSI 150 SORF | 1 | FLANGED |
| S7 | GLAND STEAM LEAKAGE CONN. | ø60.3 X 5.54 | 1 | B.W. |
| S8 | HOTWELL INSPECTION HOLE | 18"ANSI 150 SORF | 1 | FLANGED |
| S9 | CONDENSATE RECIRCULATION | ø88.9 X 5.49 | 1 | B.W. |
| S10 | CONN. FOR MAKE UP WATER. | ø88.9 X 5.49 | 1 | B.W. |
| S11 | DRAIN FROM STEAM INLET (PIPING TO TURBINE) | ø168.3 X 7.11 | 1 | B.W. * |
| S12 | CONDENSATE PUMP DEAERATION | ø33.4X4.55 | 1 | B.W. |
| S13 | STAND PIPE | ø114.3 X 6.02 | 2 | -- |
| S14 | INTER CONDENSER DRAINS. | ø60.3 X 5.54 | 2 | B.W. * |
| S15 | AFTER CONDENSER DRAINS. | ø60.3 X 5.54 | 2 | B.W. * |
| S16 | DOME INSPECTION HOLE | 18"ANSI 150 SORF | 1 | FLANGED |
| S17 | VACUUM BREAKER CONNECTION | ø88.9 X 5.49 | 1 | B.W |
| S18 | G S C DRAINS | ø60.3 X 5.54 | 1 | B.W. * |
| S19 | SJAE AIR HEADER DRAIN | ø33.4X4.55 | 1 | B.W. * |

## NOTES:–

1. COUNTER FLANGES, FASTNERS FOUNDATION BOLTS AND PACKINGS ARE UNDER B.H.E.L SCOPE OF SUPPLY.
2. TUBES ARE PROVIDED WITH SELF DRAINING ARRANGEMENT.
3. * CONNS. MOUNTED ON EXPANSION SURGE PIPE–S5.
4. HOTWELL, CONNECTING PIECE, S.S.EXPANSION BELLOW,TUBES, STAND PIPES & SURGEPIPE WILL BE SUPPLIED LOOSE TO SITE, FOR ERECTION AND ASSLY. BY ERECTION AGENCY
5. PAINTING: –

   THE SURFACE TO BE SAND BLASTED CLEANED & DEGREASED BEFORE PAINTING.

   a). STEAM SPACE: 2 COATS OF STEAM WASHABLE PAINT
   b). EXTERNAL SURFACES: 2 COATS OF ZINC PHOSPHATE PRIMER
   c). WATER SPACE: 2 COATS OF COAL TAR EPOXY.

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO



| REV. | DATE | ALTERED | CHECKED | APPD |
|---|---|---|---|---|
| ZONE | | | | |

SUBMITTED FOR: APPROVAL | INFORMATION | REFERENCE | RECORD | CONSTRUCTION

CLIENT: NMDC LIMITED
3.0 MTPY INTEGRATED STEEL PLANT
(NISP), NAGARNAR, CHHATTISGARH
TURBO BLOWER STATION (PACKAGE NO. 010A)

CONSULTANT: मेकॉन लिमिटेड
MECON LIMITED

CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

| | NAME | SIGN. | DATE | NO.OF VAR. |
|---|---|---|---|---|
| DRN. | SUDHAKAR | SUDHAKAR | 14.10.14 | N.A |
| CHD. | LKM | LKM | 14.10.14 | |
| APPD. | M.VENKAT | | 14.10.14 | |

DEPT. HEE | CODE 405 | GRADE OF TOL.DIM. C/M/F | SCALE NA | WEIGHT (KG) NA | REF. TO ASSY DRG. NA | ITEM NO. N.A | NO.OF ITEMS N.A

TITLE: G A OF SURFACE CONDENSER

CARD CODE

DRAWING NO. HY-DG-1-36010-68401 | REV. 00

SHEET No. 1 | NO OF SHEETS 1

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DWG. NO. 4-381-21-03556

SHT. 01 OF 11

Enclosure-IV

# DRIVE CONTROL PHILOSOPHY



COMPUTER FILE NAME IE057-LOGICS-R01.DWG

REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO

| SUBMITTED FOR: | APPROVAL | INFORMATION ✓ | REFERENCE | RECORD | CONSTRUCTION |
|---|---|---|---|---|---|

CLIENT

NMDC LIMITED
3.0 MTPY INTEGRATED STEEL PLANT
(NISP), NAGARNAR, CHHATTISGARH
TURBO BLOWER STATION (PACKAGE NO. 010A)

CONSULTANT

मेकॉन लिमिटेड
MECON LIMITED

CONTRACTOR

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

| | | |
|---|---|---|
| DESIGNED | ROBINS | DRIVE CONTROL PHILOSOPHY |
| DRAWN | ROBINS | |
| CHECKED | KAMAL | |
| APPROVED | SEKHAR | SCALE N.A. SHEET 1 OF 11 REV. 02 |
| | DATE:25.09.14 | VENDOR'S DRAWING NO. 4-381-21-03556 |
| | | PROJECT Drg. No.- NMDC/BHEL/010A/00/27/DE/1601 |

| REV. | DATE | ALTERED | ZONE |
|---|---|---|---|
| | | CHD/APPD | |

| REV. | DATE | ALTERED | ZONE |
|---|---|---|---|
| 02 | 20.12.14 | ROBINS<br>CHD/APPD KAMAL | REVISED IN LINE WITH OTHER UNIT FEEDBACK |

| REV. | DATE | ALTERED | ZONE |
|---|---|---|---|
| 01 | 6.11.14 | ROBINS<br>CHD/APPD KAMAL | REVISED IN LINE WITH MOM DATED 6.11.2014 |

**CONTROL PHILOSOPHY**

The control philosophy for different type of drives such as Bi-directional, unidirectional, Solenoid operated are detailed below:

## 1.0 Bi-directional drives (inching or otherwise)(Non- Intelligent Modules)

a) All bi-directional drives shall be operable from Remote i.e. from Control Room. Local control stations (LCS) shall be provided for all bi-directional drives, LCS shall have Open, Close, Emergency Stop push buttons. Interposing relay in DCS.

b) Remote manual operation of all drives shall be done from Operator station. Suitable provision shall be made for Bidirectional drives requiring remote sequential / automatic operation.

c) Remote control commands i.e. OPEN, CLOSE and STOP (separate and independent), generated from LCS shall be issued to MCC. The open & close commands shall be reset from Limit switch (LS) feedback. The LS feedback is taken from actuator to MCC. The LS feedback is taken to DCS through MCC with multiplication relay in MCC (latching in MCC). Remote selection feedback shall be envisaged from MCC to DCS.

d) Open and Close push button from LCS shall be wired to MCC.
( Open – 'NO' contact; Close – 'NO' Contact).

e) Emergency stop of the drive has been envisaged from LCS. Emergency stop push button shall be mushroom head type and shall be push to stop and turn to release type. The Emergency stop pushbutton ('NC' contact) shall be hard-wired directly to MCC.

f) Load break switch (LBS) shall be provided near all valve actuators for power isolation. Open power contact of LBS shall be wired to MCC.

g) Necessary electrical protections shall be realized at MCC, whereas process interlocks and protections shall be realized in DCS.

h) Following signal exchange shall take place between MCC & DCS.

- Valve open, close & Motor stop command from DCS.
- "MCC Disturbance" (Thermal overload /local/ MCC not in service/ switch fuse off ).
- Remote selection from MCC to DCS (DI)
- RUN/ON feedback

I) Following signal exchange shall take place from valve actuator to DCS.
- Valve status feed back by means of end position limit switch contact (open & close).
- Torque switch contacts (open & close).
- Valve position feed back (4-20 mA) for inching duty drives.

J) Following signal exchange shall take place from valve actuator to MCC.
- Valve status feed back by means of end position limit switch contact (open & close).
- Torque switch contacts (open & close).

K) Following signal exchange shall take place from Local control station to MCC. These provisional shall be part of actuator. No separate LCS is applicable.
- Open push button.
- Close push button.
- Emergency stop push button.
- L/R selection switch

L) Following signal exchange shall take place from Local control station to DCS.
- Emergency stop push button feedback.

## 2.0 Unidirectional LT Drives(Intelligent Modules)

a) Unidirectional LT drives shall be operable from Remote i.e. from CONTROL ROOM. Local control stations (LCS) shall be provided for all LT drives, LCS shall have Start and Emergency Stop push buttons.

b) Remote operation of all drives shall be done from Operator station. Suitable provision shall be made for those unidirectional drives requiring remote sequential / automatic operation. Remote selection

feedback) (DI) shall be envisaged from IMCC to DCS. L/R switch in LCS

c) Remote control commands i.e. start and stop (separate and independent), shall be generated from DCS and shall be issued to IMCC through interposing relays located in DCS. Latching command shall be done in IMCC.

d) Start push button from LCS shall be wired to IMCC. (Start-'NO'). L/R switch hard wired to IMCC.

e) Emergency stop of the drive has been envisaged from LCS. Emergency stop push button shall be mushroom head type and shall be push to stop and turn to release type. The Emergency stop pushbutton ('NC' contact) shall be hard-wired directly to IMCC.

f) Necessary electrical protections for the drive shall be realized at IMCC, whereas process interlocks and protections are realized in DCS.

g) Following signal exchange shall take place between IMCC & DCS:
- Drive start command & stop command.
- "IMCC Disturbance" (Thermal overload/ local/ IMCC not in service/ switch fuse off ).
- Remote selection feedback from IMCC to DCS (DI).
- RUN/ON feedback
- Tripped feedback

h) Following signal exchange shall take place between IMCC & DCS for both soft & hardwire:
- Remote selection feedback from IMCC to DCS (DI).
- RUN/ON feedback
- Tripped feedback
- Current feedback(Motor rating above 45 KW)

i) Suitable current transformer & transducer shall be provided in IMCC wherever drive rating is above 45 KW. Remote monitoring shall be in DCS.

j) Following signal exchange shall take place from Local control station to IMCC.

- Start push button.
- Emergency stop push button.(Emergency stop PB disable after commissioning)
- Ammeter (only for motor > 45 KW)
- L/R Switch

k) Following signal exchange shall take place from Local control station to DCS.

- Emergency stop push button feedback.

**3.0 Solenoid Operated Drives**

a) Solenoid operated drives shall be operated from remote from CONTROL ROOM. Local operation of these drives is not envisaged.

b) Remote manual operation of all drives shall be done from Operator station. Suitable provision shall be made for Drives requiring remote sequential / automatic operation.

c) Remote control commands i.e. Energize / De- energise shall be generated from DCS and shall be issued to the solenoid through interposing relays located in DCS for the 24V DC operated solenoid drives. Powering of solenoid shall be from DCS

d) Necessary process interlocks shall be realized in DCS.

e) The following signal exchange shall take place between solenoid operated drive and DCS for solenoids operating on 24V DC.

- Valve open command and close command from DCS through interposing relay mounted in DCS.
- Status feedback from the drive by means of limit switches.

**4.0 D.C. DRIVES/ MOTORS**

a) D.C. drives shall be operated from Remote i.e. from CONTROL ROOM.

b) Remote manual operation of all drives shall be done from operator station. Suitable provision shall be made for unidirectional drives requiring remote sequential / automatic operation.

c) Remote momentary control commands i.e. start and stop (separate and independent) shall be generated from DCS and shall be issued to DCSC through interposing relays located in DCS.

d) Necessary electrical protection for drive shall be realized at DCSC, whereas process interlocks and protections are realized in DCS.

e) Following signal exchange shall take place between DCSC and DCS: -
   a. Drive start command & stop commands
   b. Drive status feed backs (ON/OFF), under voltage feed back & over load feed back .
   c. Motor current
   d. DC power fail (optional)

f) Suitable DC shunt & transducer shall be provided in DCSC for remote monitoring of motor current in DCS.

g) Following signal exchange shall take place from Local control station to DCSC.
   - Start push button.
   - Emergency stop push button.

## 5.0 ANALOG DRIVES

a) A drive control function residing in DPUs is used to position the pneumatically operated control valves. Interlock and protection Open/Close Commands, originating from field or generated internally in Control Logics , are interfaced with the drive control function residing in processors.

b) Control Valve actuator design shall take care of fail safe condition i.e. bringing valve to full open/full close or stay put mode, on signal failure.

c) Auto/Manual operator control and display for various control loops shall be provided through Operator station, using Analog Displays.

d) Analog Displays have following functionality:
   - Auto/Manual selection with control device “Raise/Lower Buttons”
   - Set point indication with “Raise/Lower Buttons”
   - Indication for deviation between set point and measured value
   - Measured value indication.
   - Final control element portion indicators.

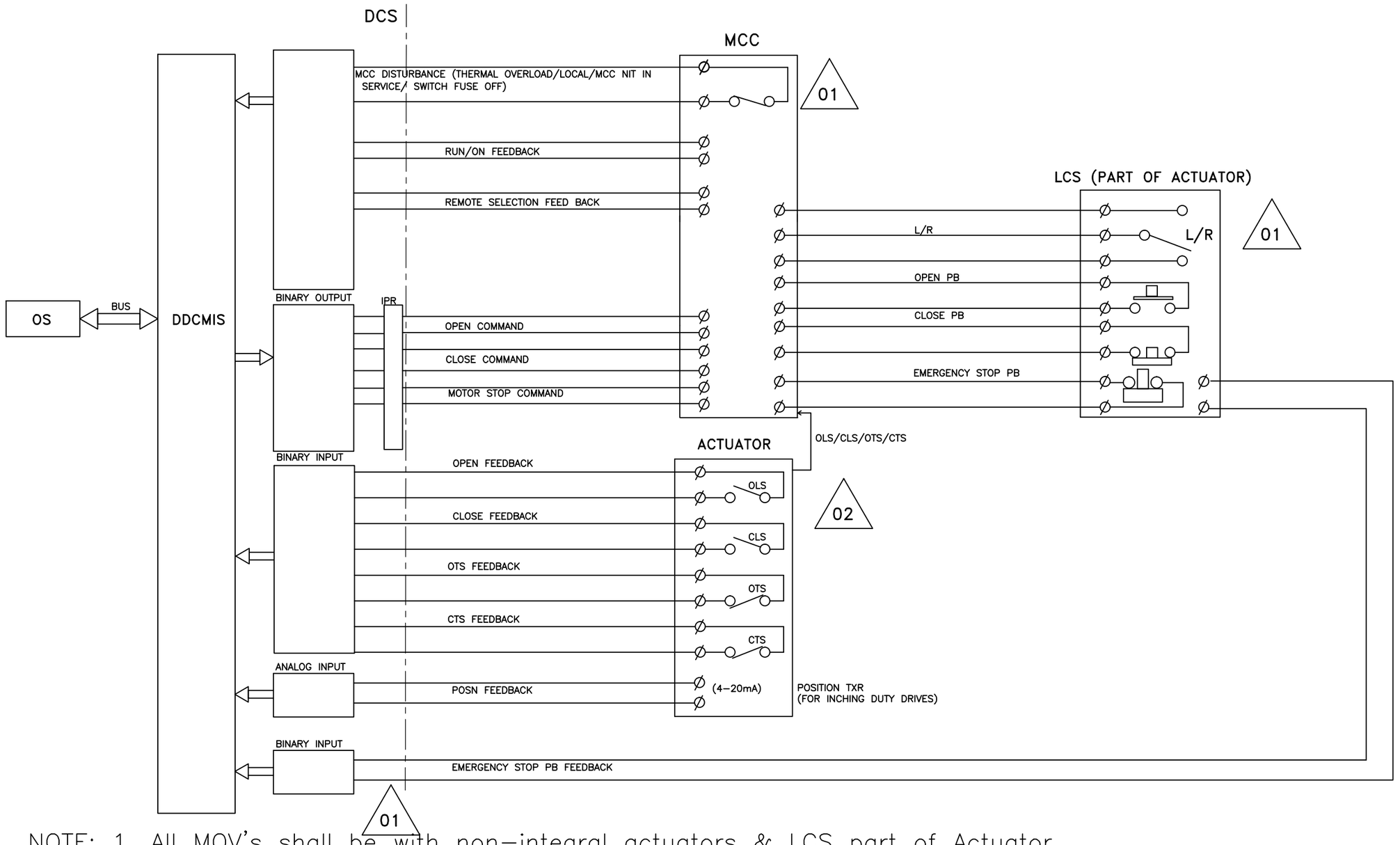
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 4-381-21-03556

SHT. 6 OF 11

# DCS INTERFACE FOR BIDIRECTIONAL DRIVE




NOTE: 1. All MOV's shall be with non-integral actuators & LCS part of Actuator.

| | | | |
|---|---|---|---|
| | TITLE: DRIVE CONTROL PHILOSOPHY | CARD CODE | DRAWING NO. 4-381-21-03556 REV. 02 |
| | | | SHEET NO. 7 NO OF SHEETS 11 |

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 4-381-21-03556

SHT. 7 OF 11

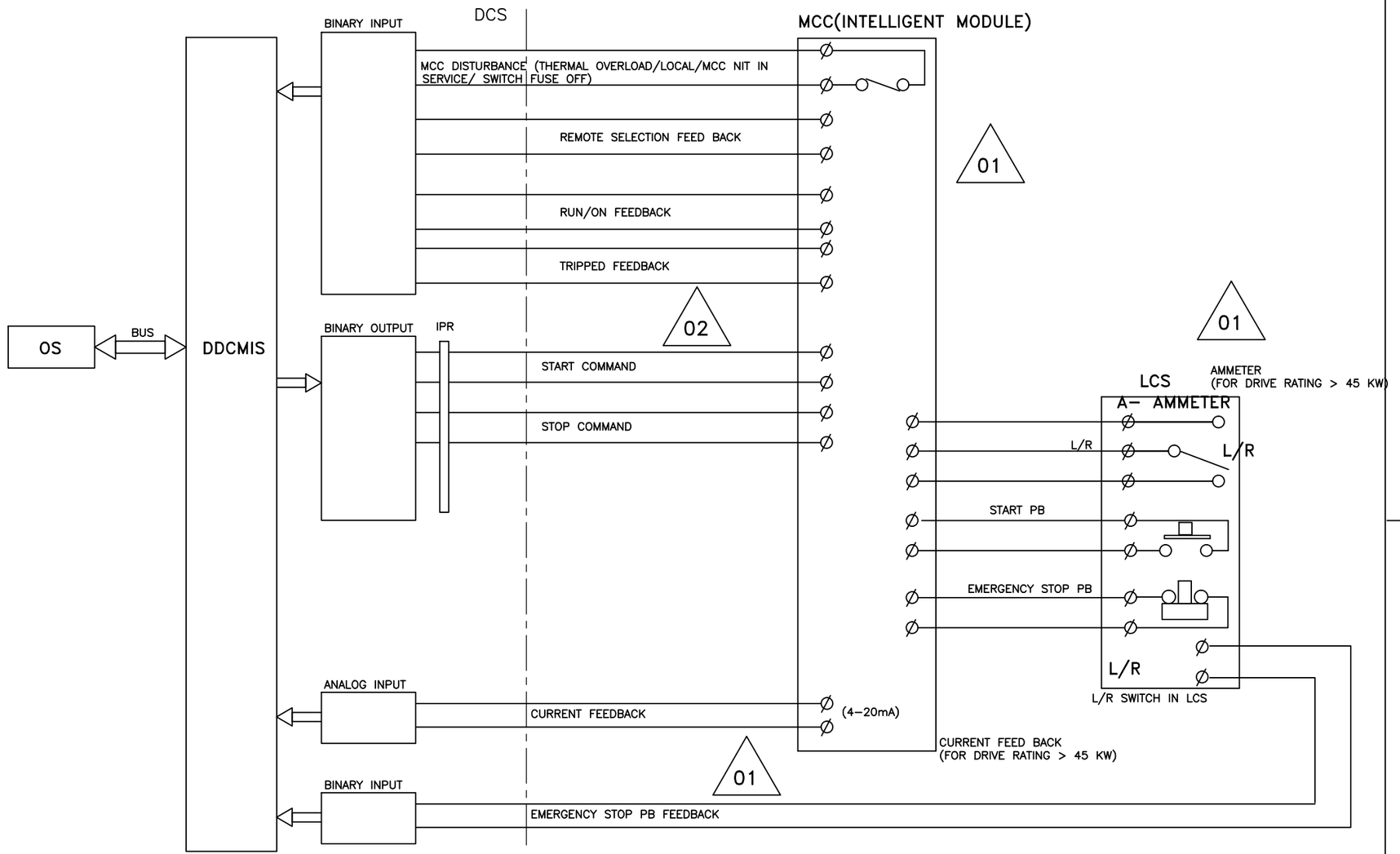


REF. DRG. NO. IE057-LOGICS-R01.DWG

SIGN. AND DATE

INVENTORY NO

## DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE




NOTE:

1. All LT drives shall be with MCC intelligent Module TYPE.
2. Following signal shall be both soft & hardwire: a)Remote selection feedback. b)RUN/ON feedback. c)Tripped feedback d) Current feedback.

02

| | | | |
|---|---|---|---|
| | TITLE: DRIVE CONTROL PHILOSOPHY | CARD CODE | DRAWING NO. 4-381-21-03556 REV. 02 |
| | | | SHEET NO. 8 NO OF SHEETS 11 |

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

SHT. 8 OF 11

DRG. NO. 4-381-21-03556

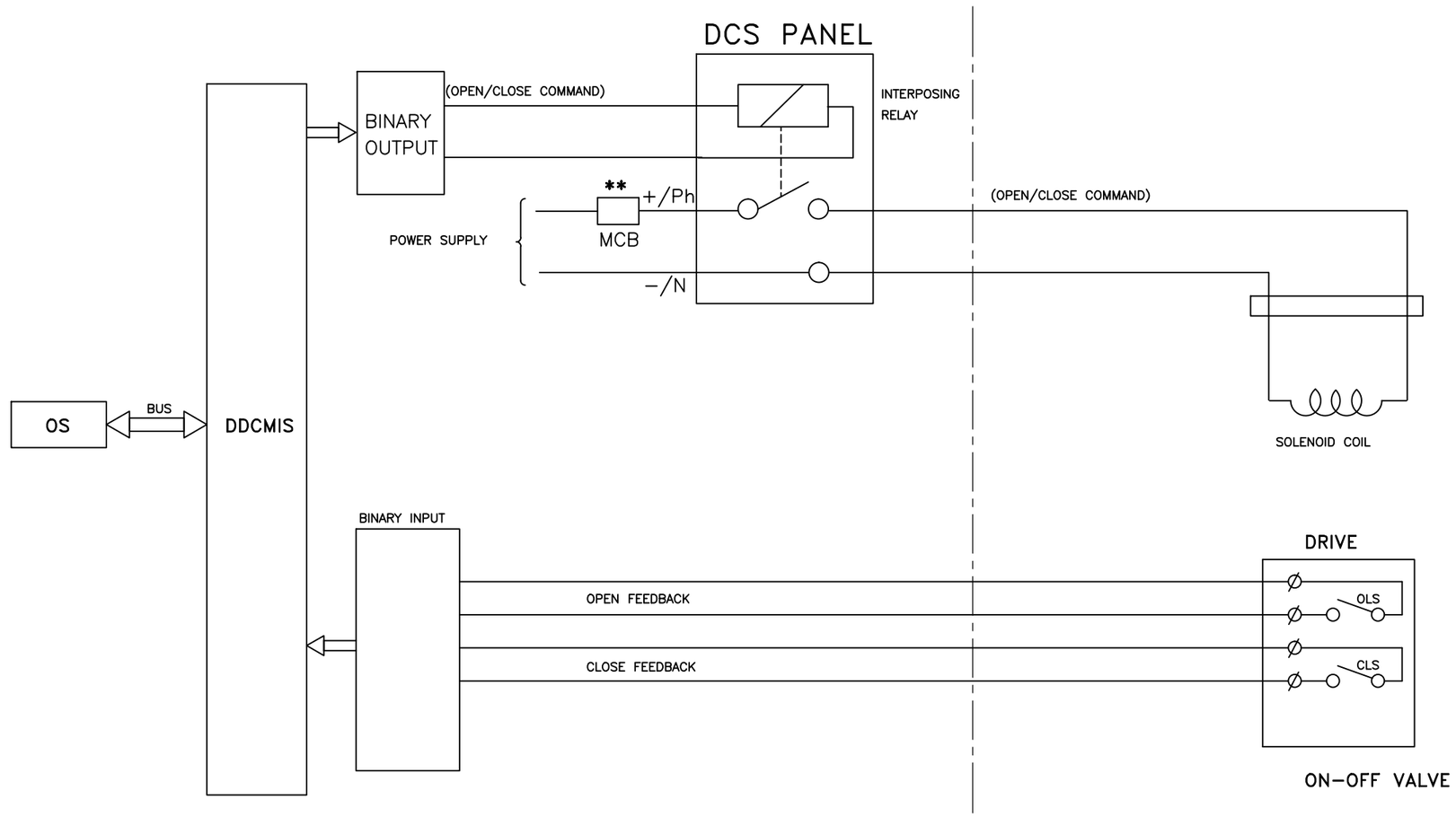


REF. DRG. NO. IE057-LOGICS-R01.DWG

SIGN. AND DATE

INVENTORY NO

## DCS INTERFACE FOR 24 VDC SOLENOID DRIVE(ON-OFF APPLICATION)




NOTE:

1. Normal Energised/De-energisation of solenoid shall be selected based on failsafe condition/operations.
2. **-MCB SHALL BE PROVIDED FOR EACH SOLENOID.

| TITLE | CARD CODE | DRAWING NO. | REV. |
|---|---|---|---|
| DRIVE CONTROL PHILOSOPHY | | 4-381-21-03556 | 02 |
| | | SHEET NO. 9 / NO OF SHEETS 11 | |

FIRST ANGLE PROJECTION | (ALL DIMENSIONS ARE IN mm)

DRG. NO. 4-381-21-03556 | SHT. 9 OF 11

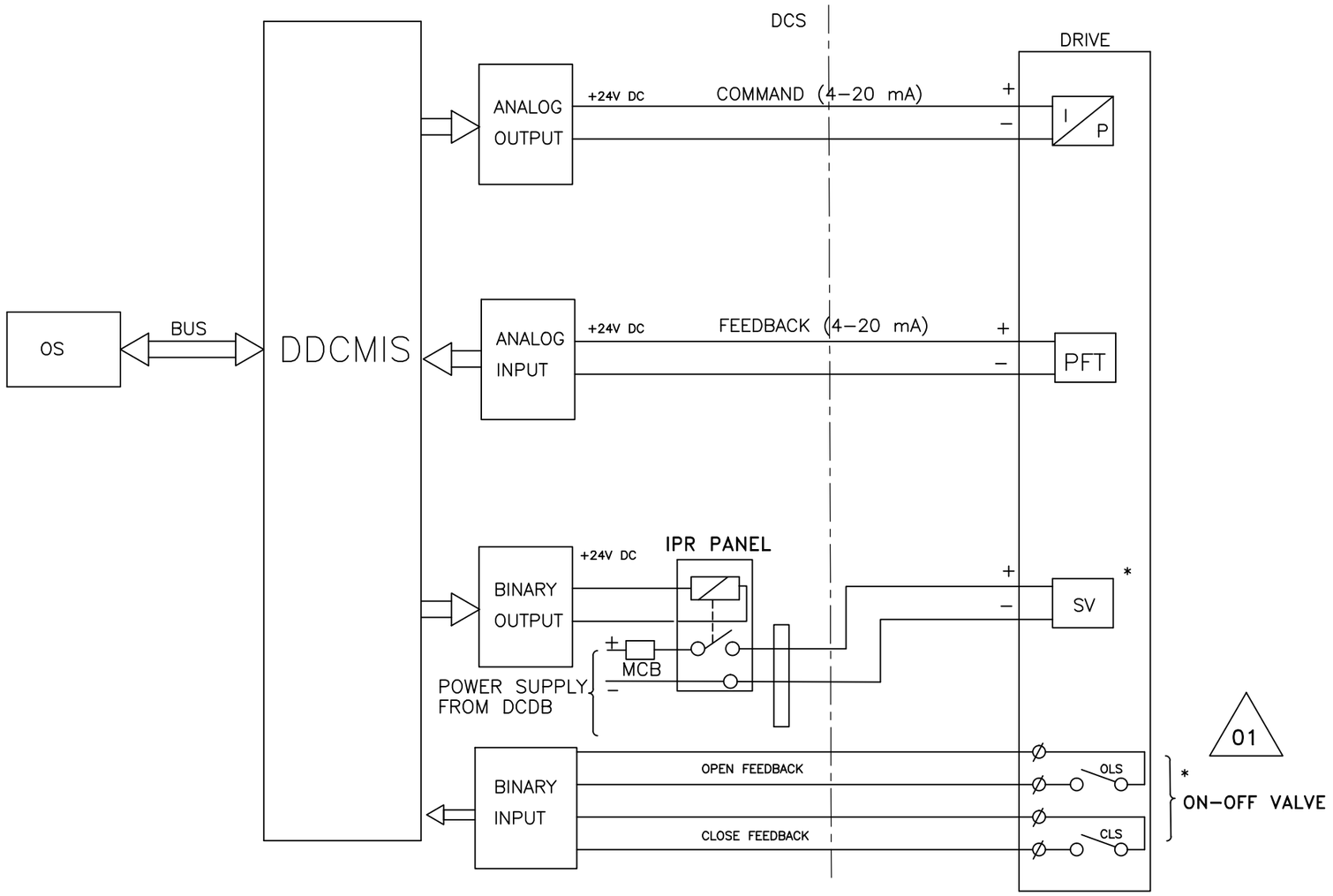


REF. DRG. NO. E057-LOGICS-R01.DWG

SIGN. AND DATE

INVENTORY NO

## DCS INTERFACE FOR ANALOG DRIVE(CONTROL AND ON-OFF APPLICATION)




NOTE:

1. * APPLICABLE FOR FAILSAFE ACTION ON INTERLOCK CONDITIONS FOR CONTROL VALVE.

| TITLE | CARD CODE | DRAWING NO. | REV. |
|---|---|---|---|
| DRIVE CONTROL PHILOSOPHY | | 4-381-21-03556 | 02 |
| | | SHEET NO. 10 / NO OF SHEETS 11 | |

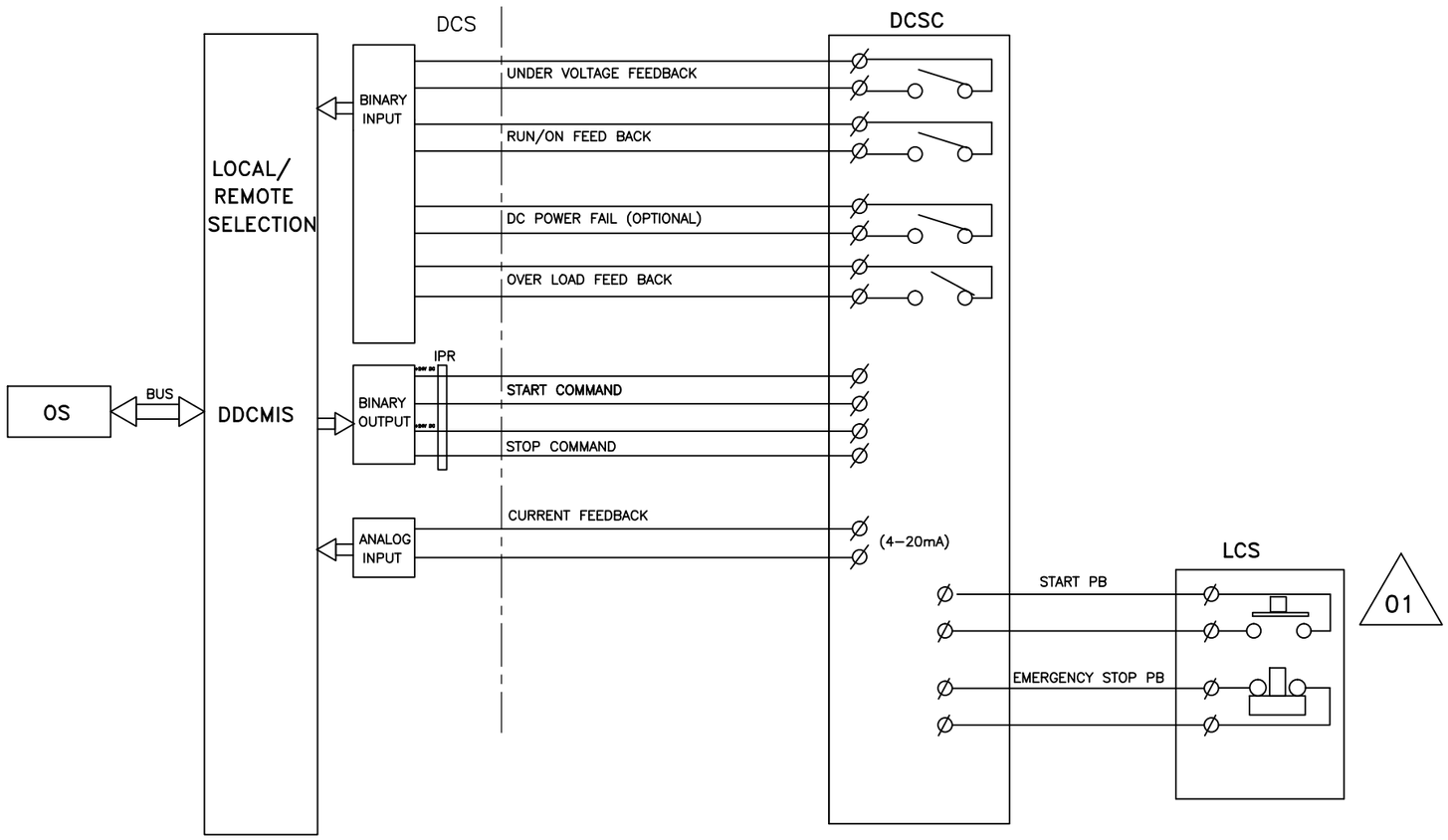
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

SHT. 10 OF 11

DRG. NO. 4-381-21-03556

# DCS INTERFACE FOR DC DRIVE






INVENTORY NO | SIGN. AND DATE | REF. DRG. NO. IE057-LOGICS-R01.DWG | IT MUST NOT BE USED

| TITLE | CARD CODE | DRAWING NO. | REV. |
|---|---|---|---|
| DRIVE CONTROL PHILOSOPHY | | 4-381-21-03556 | 02 |
| | | SHEET NO. 11 / NO OF SHEETS 11 | |

# ELECTRICAL LOAD LIST FOR BOP MECHANICAL EQUIPMENTS / SYSTEMS / PACKAGES

**A) -------**

| Sl. No. | Description of Load | Equipment Tag No. | Type of load (Motor / Non motor) | Rating (kW) | Volt-age (V) | Type of Enclosure | | | Duty | | Direction | | | No of Units | | Rated BKW | Emergency Power required for GT Start-up | Emergency Load (Required during Black-Out) | Required for Emergency Shutdown | Status of Load | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | WP | e | EX | C | I | U | BI | | W | S | | | | | | |
| | | | | | | | | | | | | IN | NI | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | |

WP : WEATHER PROOF
e : INCREASED SAFETY
EX : EXPLOSION PROOF
C : CONTINUOUS
I : INTERMITTENT
U : UNIDIRECTIONAL
BI : BIDIRECTIONAL
IN : INCHING
NI : NONINCHING
W : WORKING
S : STANDBY

| Computer File: | PROJECT : | | Prepared By | Checked By | Approved By | Sheet no. | Rev. No. | Document No. |
|---|---|---|---|---|---|---|---|---|
| PEMC-XXXX(Consolidated Electrical Load List for TENDAHO).XLS | 2X 40 MW Tendaho, Phase-2 | Name | | | | | | |
| **PE&SD System Engineering Group** **Hyderabad** | **Electrical Load List** | Sign. | | | | No. of sheets | Date | |
| | | Date | | | | | | |

| | TITLE : GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS | SPECIFICATION NO. PE-SS-999-506-E101 |
|---|---|---|
| BHEL | | VOLUME NO. : II-B |
| | | SECTION : D |
| | | REV NO. : 00 DATE : 29/08/2005 |
| | | SHEET : 1 OF 4 |

## 1.0 INTENT OF SPECIFIATION

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

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

## 2.0 CODES AND STANDARDS

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

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

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

## 3.0 DESIGN REQUIREMENTS

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

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

### 3.3 Starting Requirements

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

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

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

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) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

## 5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

## 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
*(To be given for motor above 55 kW unless otherwise specified in Data Sheet).*

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

| | TITLE | SPECIFICATION NO. |
|---|---|---|
| BHEL | MOTOR | VOLUME II B |
| | | SECTION D |
| | DATA SHEET - C | REV NO. 00 DATE 29/08/2005 |
| | | SHEET 1 OF 2 |

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

| NAME OF VENDOR | | | | REV. | |
|---|---|---|---|---|---|
| | | | SEAL | | |
| NAME | SIGNATURE | DATE | | | |

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

Enclosure-VII

Package - COTCS

## MODEL QUALITY PLAN FOR BALL SEPERATOR

| Sl.No. | Component/ Operation | Charastricts Checked | Class | Type of Check | Quantum of Check | Referen ce Docum ents | Acceptance Norms | Format of Record | Agency D M C N | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Ball separator** | | | | | | | | | |
| 1.1a | Raw Material- Housing shell, Screen Rib | Chemical & Mechanical Properties | Major | Chemical & Physial check | Sample Heat | Apprvd drg/Data sheet/ specn. | Apprvd drg./Data sheet/ specn. | Inspection Reort | X P V V | Mateerial T.C. requireds |
| 1.1b | Nozzle flange, Main flange, Screen shaft | do Sub surface defects | Major Major | DO NDT | DO 100% | Appvd drg/Data sheet/ specn. | Appvd. drg./Data Sheet/ Specn. | Inspection Report NDT Report | X P V V | Material T.C. required |
| | | | | | | ASME SA 435 | | | | |
| 1.1b | Nozzle pipes | Chem. & Mech. Properties | Major | Chem. & Physical | Sample Heat | Apprvd drg/Data sheet/ Specn. | Apprvd drg./Data Sheet/ Specn. | Matl. TC | X P V V | Material TC required |
| 1.1c | Ball Extraction Nozzle Pipes | Lekage Tightness | Major | Hydro Test | 100% | DO | DO | DV | X P V V | Material T.C. required |
| 1.2. | In process- welding procedure qualification and welder perforamcne qualifcation | Weld Soundness | Criti- cal. | Pysical & R.T. | 100% | EN-287-1 | EN-287-1 | EN-287-1 | X P V V | Qualified welder,s appvd procedure to be used for welding |
| 1.2.2 | Final tests (comple- ted equipments) after assembly | a)Dimn. Orienta- tion workman- ship & finish | Major | Visual measure | 100% | G.A. drg. | G.A. drg | I.R | X P V V | |
| | | b)Leak tightness assembly | Criti- cal | At design pressure for 1/2 HR | 100% | GA drg | No Leakage | I.R. | X P W W | |
| | | c)Dry function test | Criti- cal | Opera- tional test for (a) smooth 7 free operation of all moveable parts (b) Interlocks and sequenctial operation © Satisfacory operation of ball monitoring system (d) Satisdactory operation of cactuator torque switches, limit switches etc. | 100% | Appvd. GA/drg/ Specn. | | I.R. | X P W W | |

| MODEL QUALITY PLAN FOR BALL VESSEL | | | | | | | | Package - COTCS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Ball vessel | Ball seperator | | | | | | | | | | |
| 2.1 | Raw material- | Chemical & | Major | Chem & | 1 Sample | Apprvd. Drg./ | Apprvd. Drg./ | Material | X | P | V | V |
| | Housing shell | Mechanical | | Physical | Cast/Heat | data sheet | data sheet | T.C. | | | | |
| | Nozzle flange and | Properties | | | Batch | | | | | | | |
| | dish end | | | | | | | | | | | |
| 2.2. | Weld Quality | | | | | | | | | | | |
| | Pressure parts | | | | | | | | | | | |
| | Completed butt | sub surface | critical | RT | 10% of total | ASME SecVIII | ASME Sec VIII | RT Report | X | P | V | V |
| | weld | defects | | | butt weld | Div.1 | Div. 1 | | | | | |
| | | | | | | Appendix-4/ | Appendix-4/ | | | | | |
| | | | | | | UW 52 | UW 52 | | | | | |
| 2.3 | Fabricated shell | Dimn. & | Major | Measure | 100% | Apprvd drg. | Apprvd. Drg. | I.R. | X | P | V | V |
| | | Orientation | | | | | | | | | | |
| | | workmanship | | | | | | | | | | |
| | | required | | | | | | | | | | |
| | | Hydro Test | Critical | Leakage test | 100% | Apprvd drg. | Apprvd. Drg. | I.R | X | P | V | V |

**Package - COTCS**

**MODEL QUALITY PLAN FOR INTER CONNECTING PIPES INCLUDING V PIPES AND INJECTION NOZZLE**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.0.0 | Raw Material | Check & | Major | Chem. & | 1 Sample | Appvd.drg. | Appvd. Drg. | T.C | X | P | V | V | |
| a | Nozzle pipes for | Mechanical | | physical | Heat/Batch | data sheet | data sheet | | | | | | |
| | V-Piece, Pipes | Properties | | check | | | | | | | | | |
| | | Leak tightness | | Hydro check | 100% | Apprvd. Drg. | Apprvd. Drg. | T.C. | X | P | V | V | |
| | Nozzle pipes | (Fab. Pipes) | | | | data sheet | data sheet | | | | | | |
| | | | | | | | | | | | | | |
| 3.1.1 | In process | Refer cl no.1-2 | | | | | | | | | | | |
| | | of Q.P. for Ball | | | | | | | | | | | |
| | | seperator | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 3.1.2 | Complete pipe work | Refer cl.no. 2-3 | | | | | | | | | | | |
| | | for Q.P. Ball | | | | | | | | | | | |
| | | Vessel | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

## MODEL QYALITY PLAN FOR RECIRCULATING PUMP FOR COTCS,DF AND SCS

| S.No. | Component/Operation | Characterstics /Checked | Class | Type of Check | Quantum of check | Reference Documents | Acceptance Norms | Format of Record | Agency | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | D | M | C | N | |
| 1 | Raw material, casing | Chemical & | Major | | For each | Approved | Approved | T.C | X | P | V | V | |
| | impeller, wearing rings | Mechanical | | | item | drg./data | .drg./data | | | | | | |
| | sleeve gland, shaft | properties | | | 1 sample | sheet | sheet | | | | | | |
| | | | | | Heat Batch | | | | | | | | |
| | | | | | | | | | | | | | |
| 2 | Final inspection on | Performace | Crtical | Performance | 100% | Approved | Approved | Inspection | X | P | V | V | |
| | assembled pump | Test | | check | | drg./data | drg./data sheet | Report | | | | | |
| | | Q VS Head | | | | sheet | | | | | | | |
| | | VS Efficency | | | | | | | | | | | |
| | | VS Power | | | | | | | | | | | |
| | | Consumption | | | | | | | | | | | |
| | | Vibration noise | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | Visual dimn. | Major | Visual | 100% | | | | | | | | |
| | | Workmanship | | | | | | | | | | | |

## IS/ASTM EQUIVALENT STANDARD IN DIN/EN FOR VARIOUS MATERIALS INDICATED IN THIS SPECIFICATION

| SL NO | IS NO | ASTM NO | DIN | EN 10025(93)-S275 | 10025(93)- S275 | BS |
|---|---|---|---|---|---|---|
| 1 | 2062Fe 410WA | | | | | |
| | | | | EN10025(93 | 10025(93)- S275JO | |
| 2 | 2062Fe410WB | | | | | |
| | | | | EN10025(93 | 10025(93)S275J2G3 | |
| 3 | 2062Fe410WC | | | | | |
| | | | | EN10025(93 | 10025(9)S275J2G4 | |
| | | | | EN-10088/2( | En-10088/2(95) | |
| 4 | | SS316L | | | 14307 | 1449/2(83)316S11 |
| | | | | EN-10088/2 | En-10088/2(95) | |
| | | | | | | 1449/2(83)316S13 |
| 5 | | SS316 | | | | 1449/2(83)316S31/S33 |
| 6 | | SS-SA249TP304 | | | | BS1503-304S31 |
| 7 | | SS-213GR TP304 | DIN14301 (X5CrNi18107) | | | 1449-304S31 |
| 8 | | SS-317 | DIN1449 (XCrNiMo1713) | | | BS1449/2(83) 317S16 1554(90)-317S17-2901-317S96 |
| 9 | 318GR-2 | | | | | |
| 10 | | 193 | DIN6915 | | | |
| 11 | 210 | | DIN1691 | | | |

REMARKS--- WELDER QUALIFICATION AS PER EN 287-1.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QUALITY PLAN | CUSTOMER : | | PROJECT TITLE | | | SPECIFICATION : NUMBER : | | | | | |
| | | BIDDER/ VENDOR : | | QUALITY PLAN NUMBER PED-506-00-Q-006/0 | | | SPECIFICATION TITLE | | | | | |
| | SHEET 1 OF 2 | SYSTEM | | ITEM AC ELECT. MOTORS BELOW 75KW (LV) | | | SECTION | | | VOLUME III | | |
| SL. NO. | COMPONENT/OPERATION | CHARACTERISTICS CHECK | CAT. | TYPE/ METHOD OF CHECK | EXTENT OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORM | FORMAT OF RECORD | AGENCY P | AGENCY W | AGENCY V | REMARKS |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | 11 |
| 1.0 | PAINTING | 1.SHADE | MA | VISUAL | SAMPLE | MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD | BHEL SPEC. SAME AS COL.7 | LOG BOOK | 3 | - | - | |
| 2.0 | ASSEMBLY | 1.WORKMANSHIP | MA | VISUAL | 100% | MANUF'S SPEC | MANUF'S SPEC | -DO- | 3 | - | - | |
| | | 2.DIMENSIONS | MA | -DO- | -DO- | MFG. DRG./ MFG. SPEC. | MFG. DRG./ MFG. SPEC. | -DO- | 3 | - | - | |
| | | 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE | MA | VISUAL | 100% | MFG.SPEC./ RELEVANT IS | MFG.SPEC. RELEVANT IS | -DO- | 3 | - | - | |
| 3.0 | TESTS | 1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. | MA | -DO- | 100% | IS-325/ BHEL SPEC./ DATA SHEET | SAME AS COL.7 | TEST REPORT | 3 | 2,1 | 2,1 | NOTE -1 |
| | | 2.OVERALL DIMENSIONS & ORIENTATION | MA | MEASUREMENT & VISUAL | 100% | APPROVED DRG/DATA SHEET | APPROVED DRG/DATA SHEET & RELEVANT IS | INSPN. REPORT | 2 | 1 | - | |
| BHEL | | | PARTICULARS | | BIDDER/VENDOR | | | | | | | |
| | | | NAME | | | | | | | | | |
| | | | SIGNATURE | | | | | | | | | |
| | | | DATE | | | | | | BIDDER'S/VENDORS COMPANY SEAL | | | |

| | QUALITY PLAN | CUSTOMER : | PROJECT TITLE | SPECIFICATION . NUMBER . |
|---|---|---|---|---|
| | | BIDDER/ VENDOR : | QUALITY PLAN NUMBER PED-506-00-Q-006/0 | SPECIFICATION : TITLE : |
| | SHEET 2 OF 2 | SYSTEM | ITEM AC ELECT. MOTORS BELOW 75KW (LV) | SECTION VOLUME III |

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

NOTES:

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

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

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

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

| Sl. No. | Item Description | | Manufacturers |
|---|---|---|---|
| | filters | | (I) Pvt. Ltd., Superflo |
| 16 | Rubber Dismantling Joints | : | BDX, CORI Engineers, D.Wren, |
| 17 | Diesel Engine | : | Cummins/Ashok Layland /Ruston/ Kirloskar |
| 18 | Softening & DM Plant | : | Resin India / Thermax / Thermax Cullinyan / VA Tech / Ion Exchange / GEA Energy Systems |
| 19 | R O Plants | : | VA Tech, GEA Energy Systems, Ion Exchange, Hindustan Dorr Oliver , Permionics |
| 20 | Effluent Treatment Plant | : | VA Tech, GEA Energy Systems, Triveni, Eimco-KCP. Hindustan Dorr Oliver, Aireff Detox, Ion Exchange |
| | Thickener | | VA Tech, GEA Energy Systems, Triveni, Eimco-KCP. Hindustan Dorr Oliver, Aireff Detox, Ion Exchange |
| | Raw Water treatment | | VA Tech, GEA Energy Systems, Triveni, Hindustan Dorr Oliver, Aireff Detox, Ion Exchange |
| 21 | Drinking water Treatment Plant | : | VA Tech, GEA Energy Systems, Ion Exchange, BANCO, Thermax, Triveni, Aireff Detox, Ion Exchange |
| 22 | Electro chlorinator | | HES Water , CHLOROCONTROL, PENWALT, MILTON ROY, Ion Exchange |
| 23 | Basalt Liners | : | DEMECH, Vidyut Green Bank, Enviro Abrasian, Garden Reach Ship Builders & Engg. |
| 24 | Oil Skimmer | : | JVM Engg (Oil Skimmer Inc). |
| 25 | Plate Heat Exchangers | : | Alfa Laval, GEA Ecoflex, Tranter |
| 26 | Surge Tanks | : | Anup Engg., Zenith Erectors, Haldia., Perfect Engg., Sakthi Hitech |
| 27 | C.I. Valves (gate, globe, NRV) | : | Kirloskar Brothers, Steam & Mining, IVPL Nasik, BDK, Fouress, Hawa Engineers, Ahmedabad. |
| 28 | CS Valves (gate, NRV) | : | Audco, Fouress, BHEL, KSB, Steam & Mining, BDK, Kirloskar, Virgo |
| 29 | Plug Valves | : | Audco- L&T, Vass Ind., Xomox, Virgo, BDK, Steam & Mining. |
| 30 | Ball Valves | : | Audco, KSB, AL Saunders, Xomox, Virgo, |

| Sl. No. | Item Description | | Manufacturers |
|---|---|---|---|
| | | | BDK, Virgo, Akay Industries, |
| 31 | GM Valves | : | Leader, Steam & Mining, NECO, Upadhyay Valves, Bombay Metals & Alloys, Kalpana Valves |
| 32 | Butterfly Valves (Manually & electrically operated) | : | L&T, Fouress, Kirloskar Brothers, IVPL Nasik, VIRGO, AL Saunders, Steam & Mining, Keystone, BDK, XOMOX, Jash |
| 33 | Diaphragm Valves | : | AL Saunders, Fluid System, BDK , Steam & Mining. |
| 34 | Float Valve | : | Leader, IVPL Nasik, IM Engineers, Steam & Mining. |
| 35 | Control Valve | : | BHEL, L&T, Fouress, IL, MIL Controls, NECO Scharbet, Darling |
| 36 | Solenoid Valve | : | Rotex, Sicmag, Scharder, NECO INDFOS, Eastern Pneumatic, Bluestar, AVCON, ASCO. |
| 37 | Air Release Valve | : | IVPL, IM Engineers, Steam & Mining, Schroder Duncum, Fluid Line Valves. |
| 38 | Pressure Reducing Valve | : | JNM, Fouress, Bestobell, IL, Mazda, Nirmal Ind., Forbes Marshal |
| 39 | Strainer/Filter | : | Otokiln, Superflo, Triveni Plenty, Filter Mfg. Ind., Purolator, Filteration Engineers |
| 40 | Electric Actuators | : | Beacon Rotork, Auma, Marsh Engineers, Keystone, Limitorque, Antrieb, IL, Palghat |
| 41 | Rotory Pneumatic Actuators | : | AL Saunders, Xomox, EL-O-Matic, Virgo, L&T, Flocon, Precision Processing Equipt. Co. |
| 42 | Hoses | : | Aeroflox/Markwel/Senior Flexonics, Inalsa, Teksons |
| 43 | Pipes a) MS/GI MS ERW Black | : | SAIL/TATA/Jindal/Zenith/Man/ SAW /Surindra/ Bansal Skipper /Utkarsh/Bhushan/Ajantha Pipes/Venketesh Udyog |
| | b) DI | : | Electro Steel Casting, Jindal Saw, Tata-Kubota |
| 44 | RCC Pipes & Fittings | : | SUR Industrial Pipes, Hind Ceramics, Indian Hume Pipes, Daya Cuncrching. |
| 45 | HDPE Pipes & Fittings | : | EMCO, KWH Heliplastic , Astral Polyolefins, Oriplast |
| 46 | PVC Pipes & Fittings | : | Oriplast, Finolex, Bharat Pipe & Fittings, Supreme Industries. |

| | | |
|---|---|---|
| Electrical | : | AUMA India, Beacon Rotork Controls, Limitorque |
| Pneumatic | : | Marsh Engg., Keystone, IL, Massoneilan, EL-O-MATIC, Virgo, AL Saunder, L&T, Flocan |

**02.05 Pipes & Pipe Fittings**

| Item Description | | Manufacturers |
|---|---|---|
| MS ERW BLACK Pipes upto DN 150 | : | Good luck steel, Advance Steel, Surya roshni Ltd, Shyam engineering, P.K. Tubes, NEZONE, P.S. Steel, Venktesh udyog. |
| MS PIPES OF SIZE FROM DN 200 TO DN 1400 (ERW/SW/SAW) | : | SAIL, BHEL, TISCO, Jindal, Zenith, Saw Pipes, Welspun, Man Industries, Maharastra Seamless, Indian Seamless, BST, Advance Steel, Indus Tubes, Mukat, Lloyds, Surya roshni Ltd., Ratnamani, Shyam, P. K. tubes, Venktesh udyog. |
| SS Pipes / fittings | : | Heavy Metal Tubes, Nobel Tubes, Rajendra Mech. Ind., Sterling Supply Agency, Vitrag, Poonam Enterprises, N.L.Hazra, M.S.Fittings, Jindal Saw ltd., Ratnamani Metals, Reliable steel |
| Seamless MS/CS Pipes | : | Amardeep Steel, Choksy Tubes, MJ Patel, Nagardas Kanji, Poonam Enterprises, Sandulk Asia, MEC Tubes, Nagardas & Kusai, Noble Tubes, Allied Steel, Kamlesh Tube, Menilal & Bro, Uday Tubes, Maharastra Seamless (P) Ltd, Imperial Steel, Soor Neogi Koumar, Jindal, Ratnamani, P.k. Tubes, Reliable steel. |
| MS/CS Pipe Fittings | : | EBY Ind., High-Tech, Hydro technic, Hydro-Air Engg., Project Toolings, Shivananda, M.J.Patel, Nagardas & Kusai, MEC Tubes, Nobles Tubes, Amardeep Steel, Allied Steel, Kamlesh Tube, Menilal & Bros, Poonam Enterprises, N.L.Hazra, M.S.Fittings, Sunrise, Prodorite, Tube product incorporate, Gujrat Infra pipes, Modern store, Anil metal, Flash forge, Saradmoni, Sanghvi, Madras Steel, Upadhya valves, Parmar, Strategic Engineering, Sawan, Engineering service enterprise, K.L. parui, Godavari, P.K. tubes, Ferro tubes, Anant extrusion, R.D forge, Venktesh Udyog, Hari udyog. |

## 10. FLUID SYSTEMS & PIPING ENGG (LUBRICATION & HYDRAULICS)

| SL. NO. | ITEM | MAKE | REMARKS |
|---|---|---|---|
| **1.** | **Hydraulics** | | |
| a. | Medium Pressure / High Pressure Hydraulic System | Rexroth / Parker / Eaton | |
| b. | Piston / Vane Pumps & Hydraulic Motors | Rexroth / Parker / Eaton | |
| c. | Gear Pump (Low Pressure) | Del Pd Pumps (ROTODEL) / IMO / Tushaco / Rexroth / Parker | |
| d. | Screw Pump (Low Pressure) | Imo / Alweiler / Nortek / Tushaco | |
| e. | Hydraulics Proportional Valve | Rexroth / Parker / Eaton | |
| f. | Hydraulic Servo Valve | Rexroth / MOOG | |
| g. | Accumulator with Safety Shut-Off Block | Fawcett Christie / Hydac / Parker | |
| h. | Accumulator Charging Kit | Fawcett Christie / Hydac / Parker | |
| i. | Pressure Filter | Hydac (Germany) / Pall / Internormen / Parker | |
| j. | Return Filter | Hydac (Germany) / Pall / Internormen / Parker | |
| k. | Heat Exchanger | Alfa Laval / Indswep / Tranter | |
| l. | Level Indicator | Levcon / Buhler / Techtrol / Wika / Dr. Tiefenbach / Rexroth / Parker | |
| m. | Level Switch | Shridhan / Stauff / Dr. Tiefenbach / Buhler / Techtrol | |
| n. | Pressure Gauge & Temperature Gauge | Wika / Forbes Marshall / Stauff / Hydac | |
| o. | Pressure Switch | Rexroth / Hydac / Parker / Danfoss | |
| p. | Air Breathers | Stauff / Parker / Hydac | |
| q. | Contamination Analysis Kit | Pall / Parker (UCC) | |
| r. | Centrifuge | Alfalaval / Westfalia | |
| t. | Vacuum Dehydrator | Pall / Parker / Nortek | |
| u. | Electrostatic Liquid Cleaner | Ferrocare | |
| v. | Mobile Motorised Pump – Motor – Filter unit for oil filling | Pall / Eaton / Parker / Hydac / Stauff | |
| w. | Nitrogen Booster Station | Hydac / Parker | |
| x. | HP Nitrogen Compressor | J.A. Beckar Shone | |
| **2.** | **Oil lubrication System** | | |
| a. | Oil lubrication System | Lincoln Helios / Shaan Lube / Bijur Delimon | |
| b. | Electrical Heater | Escorts / Alco / Nortek | |
| c. | Basket Filter | Pall / Boll & Kirch | |
| d. | Heat Exchanger | Alfa Laval / Indswep / Tranter | |
| e. | Control Valve | Forbes Marshall (Arca) / Samsung / Fisher | |
| f. | Expansion Joint | Esbi / Stanflex / Elaflex | |
| g. | Air Breathers | Stauff / Parker / Hydac | |

| SL. NO. | ITEM | MAKE | REMARKS |
|---|---|---|---|
| h. | Level Indicator | Levcon / Buhler / Techtrol / Wika / Dr. Tiefenbach | |
| i. | Level Switch | Shridhan / Stauff / Dr. Tiefenbach / Buhler / Techtrol | |
| k. | Level Indicator Cum Switch | Stauff / Wika / Dr. Tiefenbach / Buhler | |
| l. | Pressure Gauge & Temperature Gauge | Wika / Forbes Marshall / Stauff | |
| m. | Pressure Switch Thermostat | Rexroth / Hydac / Parker / Danfoss Switzer / Hydac / Stauff / Danfoss | |
| n. | Differential Pressure Gauge / Switch | Wika / Switzer / Hydac / Danfoss / ABB / Endress Hauser | |
| o. | Pressure Transmitter | Fisher / Forbes Marshall / Endress Hauser / Emerson | |
| p. | Temperature Transmitter | Fisher / Forbes Marshall / Endress Hauser / Emerson | |
| q. | Flow Switch | Forbes Marshall / Endress Hauser / Kobold | |
| r. | Pressure Reducing Valve | Fisher / Forbes Marshall / Samsung | |
| s. | Water Sensor (On tank) | ASI Casitrol / Nortek / Parker | |
| t. | Centrifuge | Alfalaval / Westfalia | |
| u. | Vacuum Dehydrator | Pall / Parker / Nortek | |
| v. | Mobile Motorised pump – Motor – Filter unit for oil filling | Pall / Hydac / Eaton / Parker / Rexroth | |
| w. | Flow Meter cum Totalizer | Rockwin / Forbes Marshall | |
| x. | Water in Oil Detector (Drip leg) | Parker / ASI Casitrol | |
| **3.** | **Air-Oil System (Complete Unit)** | Rebs / Nortek | |
| **4.** | **Grease Lubrication System (Complete Unit)** | Lincoln Helios / Bijur Delimon / Nortek | |
| **5.** | **Descaling System** | | |
| a. | Centrifugal Pump for Descaling System | KSB / Halberg | |
| b. | Piston Pump for Descaling System | Uraca / Wepuko | |
| c. | Air / Gas Safety Relief Valve | L&T / Fainger / Mankenberg | |
| d. | Spray Valve For Descaling System | Hauhinco / Hunt / Elwood / OH DE High Pressure Technologies | |
| e. | Accumulator for Descaling system | WSR (Germany) / BHPV / ISGEC | |
| f. | HP Compressor | Imgersoll Rand / J.A. Beckar Shone | |
| g. | Auto Back Wash Filter | Boll & Kirch / Hydac | |
| h. | Spray Nozzles | Lechler / Spraying System | |
| **6.** | **Air Controls (All Components)** | Ross / SMC / Parker / Festo / Rexroth | |

| SL. NO. | ITEM | MAKE | REMARKS |
|---|---|---|---|
| **7.** | **Water Pipework** | | |
| a. | Centrifugal Pump (12 bar & | KSB / Grundfos / Kirloskar / Voltas | |