TENDER DOCUMENT

NIT No.: DLI/C&E/WI-665/297

FOR

Tender for ‘Design, Supply & Supervision of installation, testing and commissioning of ‘AIR COMPRESSORS, RECEIVERS AND COOLING TOWERS’ for the project of “Augmentation of Raw Material Handling facilities with new OHP Part-B (Package- 061) of Bhilai Steel Plant, (SAIL)”.

VOLUME – 2B

TECHNICAL SPECIFICATION

ENGINEERING PROJECTS (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)
Core-3, Scope Complex, 7, Institutional Area,
Lodhi Road, New Delhi-110003
TEL NO: 011-24361666  FAX NO: 011- 24363426
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GENERAL

The following Technical Specification shall be read in conjunction with General Technical Specification (GTS) of Bhilai Steel Plant, SAIL and General Specification. If there are any provisions in this Technical Specification, which are at variance with the provisions of General Technical Specification (GTS) of Bhilai Steel Plant, SAIL and General Specification, the provisions in this Technical Specification shall take precedence.

1.0 DOCUMENTS/ INFORMATION TO BE FURNISHED ALONGWITH OFFER.

(i) Clear Scope of supply.

(ii) Type and quantity of oil, lubricants & consumables for initial fill till successful commissioning of equipment.

(iii) List of Commissioning spares and start-up spares with unit rates.

(iv) List with unit rates of special tools and tackles, if any required.

(v) Price Schedule for supply work as per the format enclosed.

(vi) List of recommended spare parts for 3 years trouble free operation and maintenance alongwith unit rates as per the format enclosed in price schedule.

(vii) Technical Data sheets duly filled by the vendor (blank data sheets enclosed).

(viii) Weight of the equipment in Kgs.

(ix) Catalogues/ Leaflets and O&M Manuals.

(x) Reference list of your Customers for the similar supply of items.

(xi) Unpriced Copy
2.0 SCOPE OF SUPPLY

The scope of the work includes Design, Supply & Supervision of installation, testing and commissioning of ‘AIR COMPRESSORS, RECEIVERS AND COOLING TOWERS’ as per specifications and scope defined in tender documents complete with all accessories and drive, which are not mentioned specifically but are required for the efficient and trouble free operation of the equipment/system.

2.1 Following items are also included in bidder’s scope.

(i) Complete items as per the details given in the specifications.
(ii) Consumables like first fill of lubricating oils etc. for the initial operation of the equipment till handing over.
(iii) Commissioning spares and start-up spare parts.
(iv) Recommended spare parts for (3) three years trouble free operation and maintenance.
(v) Painting of complete equipment (including final painting before handing over to the Employer).
(vi) Supervision of Installation, testing & commissioning at site.
(vii) All drawings/documents along with operation and maintenance manuals as per requirement mentioned elsewhere in the tender document.
(viii) Getting approval of design/drawings and any other design calculation related to the equipment from BSP/MECON/EPI.
(ix) Carrying out any modifications/deletions/additions/alteration in design/drawings/documents as required by client & Client’s consultant and EPI for proper execution of works at site till completion and handing over of the project to the client.

2.2 Bidder to note the following:

1) BSP approved preferred make list shall be followed for Hydraulics & Pneumatics.
2) All HT and LT AC/DC motors, actuators, brakes etc. as per technological and process requirement.
3) Generally Squirrel Cage Induction Motor with DOL starter / Soft Starter will be provided. Use of Slip ring motor in general will be avoided. Suitable Rotor contactor panels and SS-grid Resistance Boxes will be provided for slip ring motors if inevitable.
4) Soft starter will be provided for LT motors of rating more than 75kW.
5) All LT motors for conveyors will be S6 duty and will have class F insulation with temperature rise limited to class B.
6) Equipment selection and dating will generally be based on ambient
temperature of +50 Deg.C. For specific areas and shops, the ambient
temperature conditions indicated above will be taken into consideration
and equipment suitably derated wherever necessary.

7) The equipment should be suitable for smooth, efficient and trouble free
service in the tropical humid climate prevailing at plant site and under the
ambient temperature conditions indicated above for the different shops
and areas. In hot areas of higher temperature conditions, the equipment
will be adequately protected against damage from radiant heat and hot
air.

8) Roller bearings will be provided at DE end for motor of rating 30KW and
above.

3.0 BRIEF SYSTEM DESCRIPTION

The turnkey package of this Contract Document comprises of the following sub-
systems:

1) **New Ore Handling Plant (OHP-II)** including receiving, unloading,
Stacking & Reclaiming and finally transporting of Raw Material required for
Blast Furnace #8, Sinter Plant-III.

2) New conveyor line for New Lime Dolomite plant RMP3 and for proposed
SMS-III.

3) **Modifications/ up-gradations of existing equipment, including:**
   - An additional series of conveyors from OHP I to JH-20 and JH-
     42(Exst’g) parallel to existing route.
   - Up gradation of capacity of existing shuttle conveyors J9BRSC1.

3.1 New Ore Handling Plant (OHP-II)

The raw material to be handled by the proposed system is mainly, Iron Ore
Lump, Iron Ore Fines, Lime Stone (BF grade), Lime Stone (SMS grade),
Dolomite (BF grade), Dolomite (SMS grade), Quartzite, Manganese ore. These
raw materials are mainly required for Blast Furnace, Sinter Plant, Lime-
Dolomite Plant, SMS. All the raw materials will be received at the plant
boundary by rail. The type of Wagon will be BOXN, BOXNHA, BOY, BOBRN,
BOST, BOBS, BOXNEL, BOYL, BOXN HS etc which will transport the raw
materials depending upon the location of loading and type of raw materials.

(i) **Design Considerations**

The Ore Handling Plant (OHP-II) has been planned based on the following
assumption:

**A. Size of Raw Material**

1. Lump Iron Ore : -40 mm
2. Iron ore fines : - 8 mm
3. Lime Stone (BF/SP grade) : -60 mm
4. Dolomite (BF/SP grade) : -60 mm
5. Quartzite : -50 mm
6. Lime Stone (SMS grade) : -25 mm
7. Dolomite (SMS grade) : -25 mm
8. Pellets : -18 mm
9. Manganese Ore : -25 mm
10. Coke Breeze : -25 mm

B. No of Days of Working per year: 330 days

C. Maximum material carrying capacity of each wagon shall be as per IS: 10095-1982 reaffirmed 2001. Iron-ore-lump will be received in Track-Hopper & all other material in Wagon Tipplers. Two Track Hoppers have been considered for materials received in BOBS/ BOBRN wagons (mainly iron-ore), whereas wagon tippler with side arm charger has been considered for unloading the materials received in BOXN/BOST/ BOXNHA/BOY/BOBS, BOXNEL, BOYL wagons.

(I) UNLOADING, STORAGE, BLENDING AND RECLAIMING IN OHP-II

One number Wagon tippler WT no.B1 along with a Track Hopper TH-B1 with two parallel tracks on it have been envisaged for unloading Iron ore (lump and fines), Limestone & Dolomite (both BF grade and Sinter Plant grade), Mn-ore, Quartzite etc.

The Wagon Tippler shall be of Rota-side type capable of unloading BOXN and proposed BOXNHA ,BOXNHS, BOBS, BOY wagons as per IS:10095-1982, reaffirmed 2001. The rated unloading capacity shall be rated 20 Tips/hour. Adequate system of handling sticky rakes such as vibrator/air blaster shall be provided.

25t wagon axle load and 110t gross weight of wagons (BOX, BOXN, BOXN HA, BOXN HS, BOXN EL, BOYEL) to be considered for design of Wagon Tippler and track hopper. 2 nos. Weighbridges included in contractor's scope. The location of Weigh Bridge shall presently be considered at entry of pre hopper yard. However as the total railway track is being engineered by RITES, the location of Weigh Bridge may undergo change in detailed engineering stage. The drawings of wagon tippler/track hopper shall be subjected to approval by RITES/SECR/RDSO as applicable.

The placement of rakes shall be done by Side arm chargers capable of handling a full rake BOXN, BOXNHA, BOBS, BOY, BOXN EL, BOYEL wagons.

Two nos. of track hopper each of length 210 m excluding maintenance bay and holding capacity of 6000 t each considering material of bulk density of 1.6 t/ cu.m. shall be included in contractor's scope. The side angle of hopper with vertical shall be minimum 60 deg. Each hopper shall have four compartments. Track hopper envisaged to accommodate minimum 18 BOBS wagons. Contractor to maintain sufficient height of the track hopper superstructure to take care of OHE.

Total 4 nos. Electric hoist of 5 t capacity shall be provided for maintenance of Paddle Feeder at both ends of Track Hopper building. Two nos. double door pressurized cabin shall be provided for paddle feeder inside the track hopper.
tunnel. Anti-derailment device/ check rail shall be provided in the track hopper subject to approval of RITES. Supply / Laying of 60 kg/ m rail with continuous MS insert plate within track hopper building only are in scope of contractor.

In addition to the above, one dedicated compressor station at track hopper TH-B1 for unloading of BOBRN wagons is to be provided. Compressed air connection to BOBRN wagons to be provided at 15 mts interval. The details of requirement of compressed air, the pressure and type shall be obtained from RDSO. Other points as applicable for compressed air station shall be considered as per CS for compressed air facilities indicated elsewhere.

Provision of adequate illumination should be there on both pre & post tippler as well as on Merry Go Round circuit.

Two belt feeders below Wagon Tippler shall discharge the raw material on either of two conveyors i.e. Z1-C1 or Z1-C2 which, in turn will discharge the material at Jn House JH-Z1. From Jn House JH-Z1, conveyors Z3-C1 & Z3-C2 will carry the material and discharge at JH-Z3. There will be three incoming conveyors in Junction House JH-Z3. The tail end of two conveyors Z3-C1 & Z3-C2 will start from JH-Z1 and Belt conveyor Z3-C3 from JH-Z2. Junction house JH-Z2 shall be located in between the JH-Z1 & JH-Z3.

The track hopper with four nos. paddle feeders of 1500 tph each, two on conveyors Z2-C1 and two on conv Z2-C2 has been envisaged. From Jn. House JH-Z2, either of three conveyors Z3-C1, Z3-C2 (coming from JH-Z1) & Z3-C3 (begin from JH-Z2) shall carry the material upto Jn house JH-Z3. Reversible shuttle conveyors Z2RSC1/2 at JH-Z2 will facilitate to discharge the material on either of any three conveyors. Therefore, JH-Z2 shall be designed suitably so as to receive material from any of the conveyors coming from Track Hoppers. Non sticky liners/ polymer liners are to be fixed in the track hoppers to improve flowability.

Suitable interchangeability shall be provided below Wagon Tipplers and Track Hoppers for the conveyors by providing Diverter gates.

In Jn House Z3, three nos. Reversible Shuttle conveyors no. Z3-RSC1,2&3 can feed any one of conveyor no. Z6C1, Z6C2 and Z6C3. Contractor to provide jumbo gallery suitable for three nos. mobile trippers up to JH-Z5 from JH Z4 over conveyors Z6C1, Z6C2 and Z6C3. Out of three trippers, two nos. (Over conv. Z6C2 and Z6C3) shall extend upto JH-Z6 and one no. shall have provision of extension up to junction house coming in future. Maintenance hoist of minimum 5t cap shall be provided for the trippers. Each of the three conveyors Z6C1, Z6C2 and Z6C3 shall be capable of feeding the stacking conv. Z4BC1 as well as itself in JH Z4 and stacking conv. Z5BC1 as well as itself in JH Z5. Each of the two conveyors Z6C2 and Z6C3 shall be capable of feeding the stacking conv. Z6BC1 as well as future conveyor in Junction House –JH-Z6.

The raw material can be either transported via. Jn House Z4, Z5 or Z6 to the respective stacking conveyors Z4B-C1, Z5B-C1 & Z6B-C1 for stockpiling or can be fed directly to the reclaiming conveyors Z7-C1/ Z7-C2 which means convey material directly from the WT/ Track Hopper to:

(a) To the Blast Furnace#8 Stock House
(b) To the Fuel & Flux crushing circuit of Sinter Plant-III.

Suitable interchangeability shall be provided at Junction house JH-Z4, 5 & 6 for the conveyors by providing 2-way chutes in mobile tripper. 5T Electric hoist
each shall be provided at JH-Z5 & JH-Z6. Whereas, JH-Z4 shall be designed only as a transfer point.

The Stacking conveyors Z4B-C1, Z5B-C1 & Z6B-C1 can form a stockpile 30m wide, 350m long and 10.5 m (maximum) high with the help of Twin boom stackers.

Suitable number of electrically operated Under-Slung Cranes, Hoists etc. shall be provided in all floors of Junction Houses and building for maintenance of equipment. Electro-Magnetic Separators, In-Line Magnetic Separators, Metal Detectors, Belt- Weigh-Scales, Air-Blasters/ Bin Vibrators shall be provided to make the system complete and the operation/ maintenance smooth.

(iii) STORAGE AND RECLAMATION OF ORE

From the Wagon Tipplers WT-B1 and the Track Hopper TH-B1, the raw material may sometimes be fed directly to the consuming plant in case of emergency. However, this shall not happen under normal circumstances, when the three Twin-boom stackers over conveyors Z4B-C1, Z5B-C1 & Z6B-C1 store the raw material in the designated place of the yard in bed nos. 1 to 6. Flexibility shall be in built in the Jn Houses Z4, Z5, & Z6 to ensure stacking is trouble free.

Bed blending system shall be possible with the stacker running to and fro on the length of the pile -or- on a length between two defined position in case more than one material is stored in a bed marked by travel limit switches, which through a relay sequencing circuit, with time control-reverses the traveling gear after the travel in each direction covering the desired length of the pile. After a layer of some pre -determined amount is deposited in one traveling direction of the stacker, probes fitted on the stacker boom gives it a “raise” signal as soon as a net height of material is formed. The next layer is then formed.

Iron ore may require stockpile formation as described above for blending and uniformity. However, the emphasis on blending shall be for iron ore fines which shall be blended while stacking.

Four nos Bucket-wheel reclaimers have been envisaged for bed no. 1 to 6.

All stacking line conveyors feeding and stackers etc. shall have a rated capacity of 1500 tph & a designed capacity of 1800 tph.

All reclaim line equipment shall have a rated capacity of 1500 tph and a designed capacity of 1800 tph in the ore handling area.

Reclamation takes place by the conveyors Z7-C3 (Bed no. 1), Z4A-C1 (Bed 2or 3), Z5A-C1 (Bed no.4 or 5) and Z6A-C1 (Bed no. 6) and the reclaimed material via Jn House Z4A, B, Z5A, B, Z6A and Z6B shall reach Jn House Z7. Two reclaim conveyors Z7-C1 and Z7-C2 between Z6A to Z7 will receive all the materials from yard for further transportation.

Reclamation from OHP takes place for the following circumstances:-

- Feeding of iron ore lump, dolomite, limestone, manganese, quartzite, pellet etc. to BF#8 stock house.
- Transporting Limestone/ Dolomite (SP grade) and iron-ore fines to fuel & flux crushing area for Sinter Plant-III.
Two streams of belt conveyors shall reclaim the material from new OHP-B yard to above places. Belt conveyor Z7-C1 & C2 shall carry the material and transport thru Z8-C1, C2, Z9-C1, C2, Z10-C1, C2 to Z11-C1 & C2 to Junction house JH-Z11. Junction House-Z11 can discharge the material either to existing conveyors R103/ R104 of Sinter Plant-III or proposed conveyor Z12-C1/ C2 of BF#8, with the help of reversible conveyors. To receive the material from Z11-C1 & C2, suitable modification in existing gallery of R103 & R104 is required. Also a junction house JH-Z11 with two reversible conveyors & tail end of belt conveyors Z12-C1 & C2 shall be erected above these conveyors. Further, conveyors Z12-C1 & C2 and then Z13-C1 & C2 shall move towards stock house of BF#8 and discharge at JH-Z15 onto reversible shuttle conveyors J15RSC1/2. The gallery from JH-Z14 to JH-Z15 shall have provision for installation of three identical conveyors i.e. Z15-C1, Z15-C2 and future conveyor Z15-C3. Suitable insert plate/ foundation bolts shall be provided for future conveyor Z15-C3. However, future conveyor Z15-C3 is not in scope of contractor.

Specification of future conveyor:
Length - ~ 35 m: Lift 0.0 m: Capacity 1200 tph: Belt width – 1400mm
Centre to centre distance from Z15C2 – 3010 mm

A junction house JH-Z14 shall be provided in between the junction houses JH-Z13 & JH-Z15. Two series of belt conveyors shall discharge the Sinter at the Junction House Z14 over belt conveyor Z15-C1 & C2. Junction House JH-Z14 and conveyors Z14-C1/C2 shall be in the scope of Employer i.e. BSP.

Suitable Junction houses with RCC floors, diverter gates & galleries shall be provided to transfer the material from one conveyor to another. The scope of contractor shall finish at JH-Z15 with complete drive and discharge (including reversible shuttle conveyor) facilities. The receiving belt conveyor below Z15-C1 & C2 shall be in the scope of Employer i.e. BSP. However, JH-Z15 shall have a provision (inserts/ foundation bolts) to erect outgoing conveyors to Stock House.

### 3.2 OTHER ADDITIONS/ MODIFICATIONS AND UPGRADE IN EXISTING OHP (REF. DRG. NO. MEC/S/9101/11/00/00/061.B01)

(i) **An Additional series of conveyor from OHP to J-20 and JH-42(Exst’g)**

further J17B-C1 shall discharge the material over J42-C2 in JH-17B. The capacity of the outgoing conveyors J20C3 and J17B-C1/J42C2 shall be 500tph and 1000tph respectively. Conveyor J20-C3 shall be provided with one no. belt weigh scale and have provision of discharging onto existing sinter carrying conveyor J27-C5 (Exst’g) in junction house JH-20 (Exst’g). Conveyor J42-C2 shall have provision of discharging onto existing conveyor J44-C5 in junction house J42 (Exst’g). Necessary modification/strengthening shall be carried out in junction house J42 to take care of additional loads by new conveyor. Suitable electrical interlock shall be provided between the conveyors J27-C5 & J20-C3 in junction house JH-20 to trip all the incoming conveyors in case feed rate exceeds capacity (500tph) of the corresponding downstream conveyor J27-C5. Similar interlock shall also be provided between J44-C5 & J44-C2 in junction house JH-42 to avoid any spillage/chute blockage.

These additional conveyors with gate will facilitate a new additional route for BF # 7.


(ii) **Up gradation of Reclaiming conveyors**

The capacity up-gradation and utilization of reclaim conveyors are of utmost importance to ensure smooth operation in the OHP.

The list of conveyors in the reclaiming circuit that shall be upgraded to 1500 tph are given in table 03.01.

<table>
<thead>
<tr>
<th>SL No</th>
<th>CONVEYOR NO</th>
<th>EXISTING</th>
<th>PROPOSED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BELT WIDTH mm</td>
<td>CAP</td>
</tr>
<tr>
<td>1</td>
<td>J9B-RSC1</td>
<td>1400</td>
<td>500 m³/hr</td>
</tr>
</tbody>
</table>

The capacity of all Belt conveyors shall be 1500tph for all raw materials viz. iron ore, limestone, dolomite with 1400mm belt width and belt speed shall be 2.0 m/s with a troughing angle of 35°. (Bulk density of raw material shall be considered as 2.2 t/m³ for power calculation/load data of structures and 1.6 t/m³ for volumetric capacity calculation of conveyor)

### 3.3 **NEW LIME DOLO PLANT (RMP III) AND SMS III CIRCUIT**

Existing conveyor R-101/R-102 shall be utilized to convey raw material required for Lime/Dolo Calcination plant RMP III and of SMS-III by tapping the conveyor from Jn house JH-N102 (With suitable modification in the Jn House) and taking a new route to the proposed Lime/Dolo calcination plant/SMSIII. Any civil work
related to installation of new conveyors in existing junction house JN#102 shall be contractor’s scope.

The SMS grade limestone, dolomite and iron ore in existing OHP-I shall be reclaimed via Jn House N101, N102. Existing Belt Conveyors R101/102 coming from OHP-I shall now mostly carry Lime stone and dolomite. In JH-N102, two existing reversible conveyor R103A & R104A are having a provision for taking material to Sinter plant III as well as proposed Lime Plant. A discharge chute below R103A & R104A to feed at the tail end of proposed belt conveyor L1C1 shall be provided at Junction house J-N102. Belt conveyor L1C1 shall discharge the material on L2C1 in junction house JH-L2. Conv L2C1 discharges onto conveyor L3C1 which discharges onto L4C1 in JH L3.Conv L3C1 in turn discharge material at Junction House JH-L4 to any of the two conveyors i.e. L5C1 & L7C1 with the help of diverter Gate.

Thereafter, conveyor L7C1 will carry the material and transfer onto conveyor L9C1. Conveyors L9C1 will carry the material up to Surge Bin building JHL9 through reversible shuttle conv. J9RSC1. Surge bin building JHL9 shall have 3 nos. bunkers of minimum geometric capacity 190 cub m each for storing iron ore lump/limestone/bauxite. Suitable rod gate and motorized rack and pinion gates shall be fitted at the bottom of bunkers. Three (3) nos. VVF controlled vibro feeders of 420 tph capacity each shall withdraw material from bunker and discharge it onto conveyor L10C1 which shall convey up to Junction house JH L10 for onward transportation to Surge Bin Building for SMS-III (Surge bins with Vibro-feeder as shown in flow diagram at JH-L9 are in contractor’s scope,) through SMS feeding conveyor. Conveyors L10C1 complete with discharge facilities and junction house JH L10 shall be in the scope of contractor and SMS feeding conveyor shall be in the scope of employer.

The other conveyor L5C1 shall receive material from conveyor L4C1 and discharge at JH-L5 on to conv. L6C1 which shall convey up to junction house JH-L6 and discharge onto lime plant feeding conveyor for onward transport to Lime & Dolomite calcination plant RMP III. Conveyors L6C1 complete with discharge facilities and junction house JH L6 shall be in the scope of contractor. However lime plant feeding conveyor shall be in the scope of employer i.e. BSP.

Calcined lime/dolomite is received from the day bins of lime/dolo product storage building of RMP III onto conveyor L8C1.Conv. L8C1 discharges onto conv. L9C2 in JH L8 which in turn discharges onto conveyor L10C1 in Surge Bin building JH L9. This finished product of RMP III is transported to the junction house JH L10 by conveyors L10C1 which shall also carry limestone, bauxite, iron ore received directly from OHP I yard to SMS III. The scope of contractor starts from tail end on conveyor L8C1 including skirt boards.

A fixed hopper of 8 cub m capacity on conveyor L10C1 near JH L9 with VVF controlled vibro feeder of 420 tph capacity shall also be used to transport coke fines as and when required in the storage bins of the bulk material charging system of SMS III. Any other material e.g limestone/ DRI can also be transported under emergency conditions through fixed hopper. Suitable ramp shall be provided to unload the material over hopper.
4.0 **Technical Specifications of Air Compressor, Receiver and Cooling Tower PACKAGE**

The scope of work of Air Compressors, Receivers and Cooling Towers package includes;

4.1.0 **Compressed Air Facility**

4.1.1 **Instruction to Contractor**

Dedusting system of RMH plant (Part-B) will require substantial quantity of compressed air. Also, compressed air will be required for track hopper poking. To meet these air requirements, **one common compressed air station** along with interconnecting inter-shop and in-shop piping facilities upto the individual consumers will be provided in the RMH area on turnkey basis. The compressed air station will be located suitably to ensure proper distribution of air to all the consumer points.

4.1.2 The Contractor will furnish all the drawings, documents, data like fault diagnosis, operation and maintenance manuals, general details and layout drawings, design calculations and equipment specification of plant and equipment, together with `as built' drawings for all mechanical, electrical, civil, structural and instrument & control.

4.1.3 **Meteorological data**

The following meteorological data will be taken into account for design of plant and equipment. Site conditions will be assumed to be as follows:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>:</th>
<th>50°C (Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity</td>
<td></td>
<td>5°C (Min)</td>
</tr>
<tr>
<td>Maximum</td>
<td>:</td>
<td>100%</td>
</tr>
<tr>
<td>Minimum</td>
<td>:</td>
<td>25%</td>
</tr>
<tr>
<td>Altitude above MSL</td>
<td>:</td>
<td>307m</td>
</tr>
</tbody>
</table>

4.1.4 **Selection Criteria**

a) Compressors will be designed at 50°C temperature and 60% RH, 35°C cooling water temp., 50 Hz frequency.

b) Performance guarantee tests will be demonstrated at 35°C temperature and 60% RH, 33°C cooling water temp., 50 Hz frequency.
c) Motor will be selected at 50°C temperature and 100% RH, 50 Hz frequency.

d) Design ambient temperature for Electrics will be considered as 50°C.

e) Compressors will safely run in the frequency range of 50 Hz +3% to -6%.

4.1.5 Delivery Schedule

Delivery schedule & commissioning schedule of compressors will be matched with the overall schedule of the package (061).

4.1.6 In general the guidelines laid down in the TS, GTS and SBD will be followed.

4.1.7 Scope of Work

The scope of the supply includes Design, Supply, Supervision, Packing, dispatch, transportation, delivery to site, installation, testing & commissioning completion of facilities, performance guarantee testing, and handing over to Bhilai Steel Plant, SAIL / EPI of AIR COMPRESSORS, RECEIVERS AND COOLING TOWERS as per specifications and scope defined in tender documents complete with all accessories and drive, which are not mentioned specifically but are required for the efficient and trouble free operation of the equipment/system.

The compressors will be housed inside a building (compressed air station). The Air receivers will be installed outside but adjacent to the building. The building and equipment foundations including grouting and chipping works, structural works, etc. are not covered under the scope of this specification. The compressed air station will comprise of the following main equipment:

A) AIR COMPRESSORS

i) Five (5) sets (3W + 1S + 1MS) each of 36 Nm3/min (@ 8 kgf/cm2(g) discharge pressure after cooler) oil free, water cooled rotary screw packaged type air compressors with electric motor and all its accessories & auxiliaries including the following:

a) Intercooler, after cooler, moisture separator with trap station,

b) Suction air filter cum silencer,

c) Lube oil system.

d) Cooling water system including duplex type filters in supply line.

e) Acoustic enclosure along with exhaust fan and necessary illumination.

Each Compressor will have dual type control system, which will permit operation of each compressor in either of the following way:

(a) Continuous Variable Load /unload regulation
(b) Automatic Start-Stop Regulation.

ii) A complete new and unused set of all special tools & tackles required for operation and maintenance.

iii) Contractor has furnished list of item wise spares for 2 years O&M along with unit rate. The item rates will be valid upto 12 months from last consignment at site.

iv) All anchor bolts & nuts, washers, foundation bolts, shear lugs, counter flanges for inlet and outlet of each compressor, receivers and connected piping & base frame for equipment. Miscellaneous materials and services, if not otherwise specifically mentioned will be included, but not limited to nuts, bolts, washers, gaskets, necessary connections for hook up with employer’s pipe network and equipment.

v) List of spare parts for 2 years operation & maintenance.

vi) Supply of first fill of lube oil & consumables and also for testing, commissioning and performance guarantee. Specification of all consumables will be indicated.

vii) Commissioning spares (All spares used until the plant is handed over to the employer).

**SPECIFICATIONS OF MOTOR SOFT STARTER**

To avoid impact on electrical system due to heavy motor starting current, a soft start system limiting motor current to 2 to 2.5 times shall be provided to ensure voltage drop at motor terminals limited to 15% with a provision of DOL starting. Contractor to submit the voltage drop calculation, considering adequate fault level at 6.6 kV board.

The soft start system shall be based on principle of flux compensated non-saturated magnetic amplifiers for control of motor starting current. Also, the starter should not introduce any harmonics into the system.

The flux compensated magnetic amplifiers shall work on principle of flux opposition and operate in the linear non saturable zone of magnetic circuit. The system will work on constant mode in the starting zone so as to result in smooth start.

The enclosure class shall be IP54.

The Sheet steel thickness shall be 1.6 mm.

The control circuit will utilize auxiliary contacts and timers for starting function.

Lamp indication shall be provided using LED type lamps.
Ammeter shall be provided on front door.

The cubicle will have cable entry and exit from bottom through gland plate.

Bypass device used shall be 6.6kV contactor.

**CONTROL & INSTRUMENTATION**

**General**

Electronic type instruments generally working on 4- 20 mA DC signal system will be used. The instrument panel will be suitably installed in the compressor room. All instrumentation items will be selected to function satisfactorily in shop floor environment.

**List of measurements & controls**

For each compressor, the list of measurements & controls will include, but not limited to, the following:

i) **Equipment/ local panel mounted measurements**

   i. Indication of differential pressure across suction air filter for each compressor.

   ii. Indication of pressure of compressed air after after-cooler and after compressor.

   iii. Indication of temperature of compressed air after after-cooler and air compressor.

   iv. Indication of pressure of compressed air in air receiver.

   v. Indication of pressure of lube oil before & after oil cooler.

   vi. Indication of temperature of lube oil before & after oil cooler.

   vii. Indication of differential pressure across lube oil filter.

   viii. Indication of temperature at the inlet & outlet of common header of compressor cooling water circuit.

   ix. Indication of pressure at the outlet of common header of compressor cooling water circuit.

   x. Indication of flow of compressed air.
ii) **Alarms and interlocks**

01 Following audiovisual alarms and interlocks will be provided for each compressor:

1) Differential pressure of air across suction air filter high - Alarm only.
2) Temperature of air after air compressor high - Alarm only.
3) Temperature of air after air compressor too high - Alarm and trip.
4) Pressure of air after after-cooler high - Alarm only.
5) Pressure of air after after-cooler too high - Alarm & trip.
6) Differential pressure across lube oil filter high - Alarm only.
7) Pressure of lube oil to compressor low - Alarm only.
8) Pressure of lube oil to compressor too low - Alarm & trip.
9) Temperature of lube oil to compressor high - Alarm only.
10) Cooling water supply pressure low - Alarm only.
11) Cooling water supply pressure too low - Alarm & trip.
12) Motor over load - Alarm & trip.
13) Manual tripping- Alarm only

**TESTING**

Unless otherwise stated, main equipment, valves and other ancillary units will be tested to various stipulations stated in Indian Standards of BIS or any other reputed international standard listed.

Recommended tests on Air Compressors are listed hereunder. Compressors may be tested using a suitable shop motor.

i) Volumetric and overall efficiency (type test)

ii) Capacity (Routine test)

iii) Specific power consumption from no load to full load (Routine test)

iv) Speed (Routine Test)

v) Testing of unloader (Routine test)

vi) Safety valve test (Routine test)

All other tests will be performed in accordance with IS: 5456.
STANDARDS AND CODES

The complete system as a whole and individual equipment will be in accordance with the Indian Standards, British Standards, DIN or American Standards like ASME, ANSI or any other internationally accepted codes.

GUARANTEE AND PENALTIES

The Contractor will guarantee individual as well as integrated performance of all the equipment supplied by them for the period as stipulated in the GCC prior to the date of issue of taking over certificate by the Employer. The final acceptance certificate will be issued by the Employer after successful commissioning of the Plant by the Contractor showing all the performance test at specified parameters.

The following parameters will be guaranteed at 35° C, 60% RH, 33° C cooling water temp., 50Hz frequency.

**Air Compressor:**

- * Rated Capacity at lowest frequency : 36 Nm³/ min (each)
- * Rated discharge pressure at the outlet of after cooler : 8 kgf/cm² (g)
- * Discharge temperature after after cooler at rated capacity and pressure : ≤39° C
- * Oil content in the air at the outlet of air compressor : Oil free
- * Specific Power consumption of the compressor at the rated condition mentioned above (kwh/Nm3) (at motor input) : 6.17
- * Noise Level : 80 dB(A)
- * Volumetric efficiency of each the compressor : 87.4 %
- * Inter cooler/ After cooler pressure drop : 0.2 kgf/cm² (max)
LIST OF PREFERRED MAKES

- **Compressor**
  M/s Atlas Copco, M/s ELGI, M/s Ingersoll Rand, M/s Kirloskar Pneumatics.

- **Electrics**
  1. **Motors**

  2. **Cables**
     Cables Corporation of India,
     Fort Gloster Industries Ltd.
     Industrial Cable (I) Ltd.
     Nicco Corporation Ltd.
     Universal Cables Ltd.
     Torrent Cables Ltd.

  3. **Control Stations Weather Proof**
     Baliga Lighting equipment Ltd., Bhartia Industries Ltd.
     Electrical Equipment Corporation, Ex-Protecta,
     Shrenik & Company.

  4. **Light fittings & Accessories**
     CGL, Philips, Bajaj.

  5. **Actuators - MOV**
     Auma India Ltd.,
     Flow tork Inc. USA,
     Continental Profiles Ltd.,
     Rotork Control Ltd.

- **Instrumentation**

  **TRANSMITTERS (PRESSURE, FLOW & LEVEL):**
  FUJI, YOKOGAWA BLUESTAR LTD., EMERSON, TATA HONEYWELL LTD, ABB.

  **BARGRAPH INDICATORS :**
  FUJI, YOKOGAWA BLUESTAR LTD., MASIBUS ELECTRONICS.
DIGITAL INDICATORS:
YOKOGAWA BLUESTAR LTD., MASIBUS ELECTRONICS, RANUTROL LTD.

MICROPROCESSOR BASED RECORDERS:
YOKOGAWA BLUESTAR LTD., LAXSONS ENGG. & ELECTRONICS PVT. LTD. (CHINO), FUJI, ABB.

PRESSURE/TEMPERATURE GAUGES:
A.N. INSTRUMENTS PVT. LTD., GENERAL INSTRUMENTS, MANOMETER (INDIA) LTD.

RTDs & THERMOCOUPLES:
GENERAL INSTRUMENTS, INDUSTRIAL INSTRUMENTATION, INSTRUMENTATION LTD, NAGMAN SENSORS, TOSHNIWAL BROTHERS.

TEMPERATURE TRANSMITTER:
YOKOGAWA BLUESTAR LTD, EMERSON, TATA HONEYWELL LTD, ABB.

DIGITAL SCANNER:
JYOTI, LECTROTEK, PROCON, MASIBUS.

PRESSURE SWITCH:
INDFOSS (INDIA) LTD., SWITZER INSTRUMENTATION PVT LTD.

FLOW TOTALISER:
YOKOGAWA BLUE STAR LTD., FUJI, SIEMENS.

LEVEL SWITCH / SENSORS:

LEVEL GAUGE:
J. N. MARSHALL & SONS, LEVCON INSTRUMENTS PVT. LTD., SIGMA.

SOLID STATE ALARM ANNUNCIATOR:
APPLIED ELECTRONICS LTD. (APLAB), PROCON INSTRUMENTATION PVT. LTD., PIRI SYSTEMS PVT LTD., IIC, MINILEC, MASIBUS.

POWER CABLES:
CABLE CORPORATION OF INDIA LTD., UNIVERSAL CABLES LTD., FORT GLOSTER INDUSTRIES LTD., ASIAN CABLES LTD, FINOLEX CABLES LTD., KEI.

INSTRUMENTATION SCREENED CABLES:
CABLE CORPORATION OF INDIA LTD., FINOLEX CABLES LTD., TOSHNIWAL CABLES, DELTON CABLES, KEI, ASIAN CABLES, UNIVERSAL CABLES.

COMPENSATING CABLES:
TOSHNIWAL CABLES, GENERAL INSTRUMENTS, UDAY RAJ, KEI.
B) AIR RECEIVERS

3 no. of Air Receivers of 8 m³ water holding capacity at 8 kgf/cm²(g) operating pressure, complete with all fittings such as safety valves, drain connection with auto condensate trap and bypass valve, vent connections and all inlet and outlet connections with companion flanges, supporting arrangement, access platforms, instruments etc. The material of construction will be as per IS – 2002 – Gr. – 2A . The air receiver will be designed, manufactured and tested according to IS – 7938, 1976 (RA 1991).

C) COOLING TOWER

Quantity: Three (3) sets (2W+1S) each of 60 cum/hr.
Type: Induced draft counter flow
Casing/ Basin: FRP
Frame Work: MS hot dip galvanized
Fills: PVC
Nozzles: Brass
Bolts, nuts, miscellaneous hardware: MS electro galvanized
Fan hub & blades: Cast Aluminium
Fan type: Axial flow, direct drive
Fan speed: 720 rpm
Degree of protection of motor: IP 55 (temperature rise limited to class
Ladder: Galvanised steel ladder with safety cage & hand railing up to
the top of tower. Inclined to 30° to the vertical
Eliminators: No. of deflector to be arranged to reduce drift loss < 0.2%
of water circulation.
Cooling Tower Accessories:
(i) Level switch at cooling tower basin (to be interlocked with pump)
(ii) Make up connection with float valve (float made of copper) &
    back up ball valve
(iii) Quick fill connection with ball valve
(iv) Overflow connection
(v) Drain connection with ball valve
(vi) GI wire mesh 18 gauge strainer
(vii) Equalizing line of cooling towers with isolation valves
DATA SHEETS
5.0 TECHNICAL DATA SHEET (To be filled by the vendor)

A. AIR COMPRESSORS

01. Manufacturer's Name & address :

Model No. :

Type :

No. provided :

Rated capacity Nm³/min :

Rated discharge pressure kgf/cm²g :

kW input at motor terminal :

Motor rating :

Air temp. at delivery after after-cooler at rated capacity and pressure, deg.C. :

Screw Speed, rpm
  1st stage (male & female) :
  2nd stage (male & female) :

Oil content in the air at outlet of air compressor, ppm. :

Noise level at source when the Compressor running at rated capacity, dB (A). :

Cooling water requirement :

Pressure drop across compressor :

Temp. rise :
### 02. Inter cooler & after cooler

<table>
<thead>
<tr>
<th></th>
<th>Inter cooler</th>
<th>Aftercooler</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. per compressor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design standard/code</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. working pressure, kgf/cm²</td>
<td>:</td>
<td></td>
</tr>
<tr>
<td>i) Water side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) Air side</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tube material, size and thickness</td>
<td>:</td>
<td></td>
</tr>
<tr>
<td>Shell material and thickness, mm</td>
<td>:</td>
<td></td>
</tr>
<tr>
<td>Moisture content in air after aftercooler, ppm</td>
<td>:</td>
<td></td>
</tr>
<tr>
<td>Space required for pulling out tube assembly of intercooler &amp; aftercooler</td>
<td>:</td>
<td></td>
</tr>
</tbody>
</table>

### 03. Moisture separator

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Make</td>
<td></td>
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<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td></td>
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<tr>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>Design standard/code for pressure vessel</td>
<td>:</td>
</tr>
<tr>
<td>Shell material and thickness</td>
<td>:</td>
</tr>
<tr>
<td>Design pressure,kgf/cm² (g)</td>
<td>:</td>
</tr>
<tr>
<td>Moisture content after separator</td>
<td>:</td>
</tr>
</tbody>
</table>
B. **Motor**

Type : 
Make : 
Rated kW at 50 deg.C : 
Rated kW at 40 deg.C : 
Rated voltage & system condition : 
Frame size : 
Class of insulation : 
Rated speed & direction of rotation : 
Starting system : 

C. **AIR RECEIVER**

Number : 
Design Standard/ Code : 
Capacity : 
Overall dimensions : 
Wall plate thickness : 
Plate material : 
Design Pressure : 
Working Pressure :
D. COOLING TOWER FOR COMPRESSOR COOLING

Make & Model : 
Type : 
Quantity : 
Overall size of cooling tower : 
Capacity of cooling in TR. : 
Water flow m3/h : 
Air flow : 
Design water inlet temperature, outlet temperature : 
Material of construction and its thickness : 
Speed in rpm : 
Drive details : 
Shaft Power consumption : 
Wheel diameter : 
Efficiency : 
Size of fan : 
Static & Dynamic weight of fan & motor assembly : 
Bare weight and operating weight of cooling tower : 
Noise level at 1m distance in dB(A) : 
Fixing details : 
Vibration level : 
Water spray nozzle type : 