

# **DEENDAYAL PORT AUTHORITY**



## **MECHANICAL ENGINEERING DEPARTMENT**

**Tender No. MS/WK/4063**

**TENDER FOR  
“ENGINEERING, PROCUREMENT AND CONSTRUCTION FOR  
PHASE-I DEVELOPMENT OF MECHANIZATION OF BULK  
CARGO HANDLING FACILITY AT BERTH NO.8 & 9 IN  
DEENDAYAL PORT, KANDLA”**

## **VOLUME-II**

**Employer’s Requirements, Scope of Work, Specifications & Drawings**

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**Sept.- 2023**

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# 1. PROJECT BACKGROUND AND SITE INFORMATION:

## 1.1. Introduction:

India is one of the largest consumers of coal in the world. In the financial year 2021-2022, total production of coal in India was 778.19 MMT<sup>1</sup> whereas in 2020-2021 the coal production touched 716.08 MMT registering a growth of 8.67%. Despite of having enough coal reserves, India has not been able to meet the demand from own production. The supply of coal of high quality in the country has been more limited. This gap in the demand and indigenous production is being bridged by import of coal from other countries.

In 2021-22, total import of coal was 208.93 MMT compared to 215.25 MMT in 2020-21, showcasing a decline of 2.94%.

Import of non-coking coal was 151.77 MMT in 2021-22 compared to 164.05 MT in 2020-21, majority of which are consumed by the power plants for electricity generation, cement plants, sponge iron plants and other small-scale industries etc.

The coking coal imports was 57.6 MMT in 2021-22 compared to 51.20 MMT in 2020-21 showcasing a growth of 12.50% which is being mainly consumed by the steel Industry.

DPA accounts for handling 20.10 MMT of coal in FY2021-22 including coal handling at Kandla berths and Tuna port (handled by Adani Kandla Bulk Terminal Pvt. Ltd.). The coal cargo traffic at berths of Kandla Port is 14.46 MMT in FY2021-22, whereas the coal cargo traffic at Tuna Port is 5.64 MMT in FY2021-22.

DPA is presently handling the bulk cargo using the conventional cargo handling methods on existing berths. The conventional cargo handling method includes unloading of cargo using existing Mobile Harbour Cranes (63t, 100t & 124t), then dump it on the wharf. The dumped bulk cargo at wharf is then loaded on to the trucks using payloader, which further moves the cargo to the stockyard and offload it at stockyard. Further, for the evacuation of the cargo to the end user, the payloaders at the stockyard loads the cargo on to the trucks and then the trucks get dispatched for delivering to the end user. The design handling capacity of 63t, 100t and 124t MHCs are 750 TPH, 1200 TPH & 1500 TPH respectively. As per the berthing policy of DPA (dated. 28.07.2022), the average daily berth output at existing coal handling berths is 20,000 TPD.

Deendayal port at Kandla is also willing to develop Mechanized Bulk Cargo handling facility at Kandla port for better handling of Bulk Cargo inside the port premises as:

- To enable efficient handling of vessels, leading to their faster turnaround time
- To enable faster turnaround time and higher productivity.
- To reduce multi handling of the cargo inside the port premises.

The proposed project is designed to increase cargo handling capacity of the port, which will reduce turn-around time of ships. The improved efficiency will benefit shipping companies as well as port users by reducing costs. Increased cargo-throughput will also increase Deendayal Port's income. Hence, considering the vast hinterland that is dependent on DPA for seaborne trade and currently prevailing traffic congestion at existing facilities of DPA, capacity additions are of utmost importance at DPA for serving the economy of the influence region and in turn, the economy of the whole country in the best possible manner.

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<sup>1</sup> CCO Data

DPA in the light of increasing future demand for Mechanized Bulk Cargo handling facilities, in order to attract good volume of bulk cargo at Kandla and maintain cleanliness at the port as well, which would be better for the port in long term, envisage and proposes to undertake the project. In order to cater to the future growth in Cargo traffic, the Authority has decided to undertake Phase-I Development of Mechanization of Bulk cargo Handling Facilities at Kandla on Berth no. 8 & 9.

The project is proposed to be executed through Engineering, Procurement, Construction, & Commissioning Contract basis. Specialized contractors shall be appointed for the components of the works. The facility shall be designed to handle bulk cargo through hopper & conveyor system and other relevant equipments on the facility.

The tender documents for this project has been prepared and issued for NIT on web portals like n-procure, CPP & DPA website. Their bids shall be evaluated for conformity to the employer's requirements and price competitiveness. The appointed contractors shall be monitored during execution for the successful completion of the project.

This call for the bid which is being addressed to potential Contractors for the design, engineering, supply, installation, testing and commissioning contract of "Engineering, Procurement and Construction for Phase-I Development of Mechanization of Bulk Cargo Handling Facility at Berth Nos. 8 & 9 In Deendayal Port, Kandla" on complete Lump Sum turnkey basis in accordance with the Contract provisions.

## **1.2. Site Location:**

Port of Kandla governed by the Deendayal Port Authority is located at the west coast of India, is one of the 12 major ports of India and the only Major Port in the state of Gujarat. It was declared as a Major Port on April 8, 1955.

Deendayal Port is a natural harbour situated in Kandla Creek and is 90 km from the mouth of Gulf of Kutch. Geographically, the port is spread in three locations viz., Kandla, Vadinar and Tuna Tekra.

The Major Port of Kandla is situated in the Gulf of Kutch on the West Coast of India, at latitude 23° 01' North longitude 70° 13' East. The Port serves a vast hinterland covering north and north-western parts of India.

## **1.3. Meteorology**

The climate at Kandla is governed by the monsoons. In the months June-September, the south-west monsoon occurs. The later period is often indicated as the post-monsoon period.

### **1.3.1. Winds**

Non cyclonic maximum winds (30-40 kmph) occur during May-August. Wind speeds are relatively less during North East Monsoon. However, wind speeds up to 180 KMPH have been observed during cyclonic storms.

### **1.3.2. Rainfall**

Rainfall at Kandla is low. Annual average rainfall is about 322 mm per annum with the total number of rainy days of 17 per year, about 90% of which is received during the south-west monsoon season, i.e., between June and September with a maximum of 153 mm in July. April and May are dry months with average rainfall below 0.6 mm per month.

### **1.3.3. Temperature**

The mean daily maximum temperature is 34°C and with 45°C the highest occurring in May. Mean daily minimum temperature is 20°C and with 12°C the lowest occurring in January.

#### **1.3.4. Visibility**

Throughout the year visibility is good as the region has zero fog days. However, during rains and squalls, the visibility deteriorates.

#### **1.3.5. Relative Humidity**

Relative humidity is generally high and rises to about 80% during the monsoons in the month of August.

#### **1.4. Road Connectivity**

Kandla Port is connected with National Highways NH 8A connecting Ahmedabad and Mundra/ Mandvi through Gandhidham. The four lane NH 8A extends right up to the port's main gate. The port is also connected through NH 141. The port also has fully developed road network, both in and around the Port area to facilitate faster movement of cargo. The road network within the port area is as below:

- Inside Cargo jetty area: 30km
- Outside Cargo Jetty area: 31 km

#### **1.5. Rail Connectivity**

Broad gauge (BG) tracks directly connect the Port at Kandla with the principal cities of Mumbai, Ahmadabad, Surat, Baroda, etc., and also Delhi, Punjab and Haryana through the route Ahmadabad – Ratlam – Kota – Mathura to Delhi. The second route is via Palanpur – Ajmer to Delhi. The nearest railway station is Gandhidham railway station is 15 km.

## **2. SCOPE OF WORK IN BRIEF AND DESIGN BASIS:**

The facilities are planned using the most modern port planning concepts so that the new facility will have the necessary operational capabilities and flexibility to attract maximum traffic, the deployment of larger vessels, the reduction or virtual elimination of demurrage payments and maximization of dispatch money earnings, etc.; all with minimal capital investment and operating costs.

The Port requires adequate equipment on the berth for handling the cargo at the berth. Since the majority of the world ships of this class do not have the handling equipment, onshore equipment is deployed for this purpose. This section however would deal with the basic layout of the facility taking into account the site-specific features.

### **2.1. Technical Scope and Specification in General:**

#### **2.1.1. Introduction**

This indicative specification document covers design and engineering, manufacture, supply, handling at site, construction, erection, testing, commissioning and demonstration of performance guarantee of complete Bulk material handling. Complete system must be operated in smooth and trouble-free manner. This specification forms a part of the tender document and shall be read in conjunction with the same.

The scope covers all mechanical, civil, structural, electrical and fabricated equipment; interconnecting pipework and ducting; instrumentation and PLC / SCADA based controls; all utilities as required for completeness and successful operation of the system.

The tender shall be complete in all respect and any equipment or accessory not covered in the specification but deemed essential for proper design, operation and maintenance of the individual equipment and plant as a whole, shall be included in the offer.

The tenderer shall study the indicative specification and satisfy him-self thoroughly regarding the workability of the system and equipment, and shall take full responsibility for the guaranteed operation of the equipment/system as regards output, performance and smooth reliable working. The facility shall be designed to handle import of bulk cargo through hopper & conveyor system and other relevant equipments on the facility.

If the tenderer feels that any information and/or design data for the equipment described hereafter are in his opinion unsuitable or can be replaced, he shall indicate the same during Pre-bid meeting stage, on the basis of the design he considers suitable and capable of meeting the required operating and duty requirements in accordance with this specification.

The tenderer shall visit the site to make an assessment of the availability of infrastructure at site and for any other data/information deemed necessary for submission of offer.

All units mentioned in this specification are in metric system.

### **2.1.2. Standards**

The components of all equipment shall be designed, assembled and tested in accordance with the standards of the Standard Institution, Institution of Electrical Engineers and Manufacturer's Association of the country where they are manufactured. The equipment and component parts shall conform to the relevant standards published by the Bureau of Indian Standards Institution wherever available so that specific aspects under Indian conditions are taken care of. Where suitable Indian Standards are not available, other International Standards such as BS, ASTM, ANSI, ASME, AISI, and DIN may be adopted with prior approval of the EMPLOYER.

All items of equipment shall comply with the latest regulations and stipulations of Inspectorate of Factories, Controller of Explosives, DGMS and other applicable statutory bodies of Government of India and Gujarat including norms and regulations pertaining to pollution control. Where required by regulations, the successful tenderer shall have to obtain the necessary approval from the statutory authorities and other concerned agencies.

Charges for required statutory clearance from Inspectorate of Factories, Controller of Explosives, DGMS and other applicable statutory bodies of Government of India and Gujarat including norms and regulations pertaining to pollution control as per requirement, will be reimbursed to the contractor by DPAduring the contract period, on actual basis, on production of original receipts & documents of the authority. The same should be in the name of DPT.

The electrical equipment shall also conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein for installation and operation of electrical equipment and plant. All work shall conform to relevant design basis indicated in this document.

### **2.1.3. Other Requirements**

#### **2.1.3.1. Acceptability and interchangeability**

Standardization in design and construction of equipment and system intended for identical duties shall be preferred. All like parts of similar equipment are to be interchangeable.

It is recommended that all working parts, as far as possible are to be arranged for convenience of operation, inspection, lubrication and ease of replacement with minimum downtime.

#### **2.1.3.2. Quality and workmanship**

Workmanship and materials shall be of good commercial quality suitable for the purpose intended and in accordance with the highest standards and practices for equipment of the class covered by the specification. The equipment shall be shop assembled for checking accuracy of parts except where assembling is required to be done only at site.

#### **2.1.3.3. Painting**

All items of equipment and materials will be thoroughly cleaned and painted as per the separate painting specification given in this tender document and as per employer approved painting scheme.

#### **2.1.3.4. Name Plate**

Each equipment(s) shall be provided with a name plate installed at a convenient location indicating equipment number, capacity, other operating parameters etc.

#### 2.1.3.5. Equipment Numbering System

The tenderer shall indicate equipment/component numbers of all items being considered in the offer. Equipment numbering system will be finalized in consultation with the Employer.

#### 2.1.3.6. Safety

All design must comply with latest national/ international standards/practices pertaining to safety, health and environment. All equipment shall be complete with approved safety devices wherever a potential hazard to plant and personnel exists. Safe access for personnel in the plant shall be provided. These items shall include not only those usually furnished with the machinery but also cover guards, cross-overs, stairways, ladders, platforms, handrails etc. which are necessary for safe operation of the plant. Proper fire protection and firefighting arrangement wherever necessary shall be provided. Special care shall be taken to protect enclosed electrical equipment from entry of rats, lizards and other creeping reptiles which may cause electrical short circuit inside live equipment.

#### 2.1.3.7. Language of drawings and documents

All correspondence, data drawings, documents etc. shall be in English language and all technical data shall be in metric system.

#### 2.1.3.8. Pollution control

The required pollution control measures for the plant to be provided by the tenderer shall be elaborated in the offer.

#### 2.1.3.9. Design Life

The design life of material handling structural system is 30 years. The system shall be design for 24 hours per day and 365 days per year. The conveying system offered shall be designed and constructed for continuous duty at rated capacities and under climatic and ambient conditions.

### 2.1.4. Power & Water Supply

Incoming power shall be arranged by vendor for proposed new Substation of Berth-8 & 9 from existing nearby power source substation. Vendor shall lay two (2) circuits of HT Power cable from existing 11 KV feeders placed at the nearest power source including LT/Control/Communication cable as per detail design and engineering. Vendor shall use existing cable trench and crossing after cleaning where ever available and new trench and crossing shall be constructed as required. Vendor shall consider cleaning of existing trench and crossing, construction, modification, repair of existing cable trench and crossing for laying of new cables and final length of the route shall be derived after detail route survey and engineering by successful bidder in consultation with Employer. It is recommended the vendor to visit the site and provide best optimized layout option with combination of underground and overhead installation for cable routing from existing switch yard to new sub-station of Berth-8&9.

Distribution of power 11 kV, 690 V, 415V & 230V for Material handling system, general power distribution & lighting.

Vendor shall responsible for installing necessary HT/ LT feeder / panels, required modification / overhauling etc. at source substation Switch Yard to accommodate requirement of power supply for new Substation of Berth-8 & 9. Vendor shall submit the scheme for required changes in existing system for approval to Employer along with the schedule of shutdown required in existing system.

Water line shall be extended from the Existing main water pipeline for fire water / DSS water/ Potable water tank, if available. Dust suppression system shall be provided at all transfer towers/loading point. However additional pumps and pipe required shall be laid by vendor.

### 2.1.5. General Scope of Work

The equipment selection and design has been planned keeping in view the maximum utilization of the indigenously available components and materials required, thereby restricting the dependence of spare parts or maintenance service from outside India to the minimum.

For instance, even if the equipment is procured from abroad, it would be kept in view while making the basic design and specifications:

- Generally, all consumables are available in India,
- Servicing of all components could be easily carried out from India,
- Design and entire supply will conform to the local regulatory authorities' requirements, such as electricity authorities, dock safety, etc.

Most of the equipment used in this facility can be manufactured in India.

All design will conform to the relevant Indian Standards and Codes of Practice. In case any information is not available in the Indian Codes, equivalent codes issued elsewhere will be suitably adopted subject to approval.

Equipment shall be designed with careful consideration of the accessibility of all drives and other machinery for inspection and maintenance.

Machine components such as motors, reducers, bearings, etc., shall be standardized. All equipment shall be suitable for heavy duty and continuous operation.

Provision of space for future requirement shall be kept wherever applicable.

#### 2.1.5.1. Design and engineering

- a) Engineering services including (but not limited to) design and engineering of plant and equipment, technological structures and non-standard equipment, piling, if required, and civil work, excavation for foundation, building structures, electrics, instrumentation, automation, utility services, cranes and hoists, illumination, water system and power system for the entire system. Drawings and documents shall be submitted for Employer's review/approval include layout, GA, assembly, P&I diagrams, SLDs, block diagrams, flow diagrams, control philosophy, functional description, test certificates, engineering and installation drawings etc. Drawings shall be submitted in PDF and AutoCAD format.
- b) The contractor has to appoint a Technical Consultant at his own cost to prepare & review the detailed design and drawings and for their internal quality check & assurance for the work with approval of Engineer-In-Charge. Contractor has to appoint their consultant for his internal works and materials for confirming their internal quality policy. The appointed consultant of the contractor shall perform necessary proof check for the detailed design and drawings for the work before Good for construction Drawings at his own cost. All the expenses incurred by the Technical Consultant for various activities will be borne by the contractor only.
- c) It should be noted by the bidders that the information, size, specifications, design & dimensions mentioned in this Volume and drawings, are indicative. As in EPC Contracts, the successful bidder shall workout detail design & drawings during detail engineering stage meeting the functional, operational & performance requirements & as per relevant IS standards, well within the sanctioned estimate, and submit the fresh design & drawings for approval to employer.



- d)** The project involves installation of Mobile Hopper, Conveyor, tripper etc. for handling of bulk cargo upto the stock yard. It is also envisaged that suitable dust control systems and other ancillary systems shall be provided, wherever required to mitigate completely the environmental pollution and consequential effects of the facility to comply with state and central pollution control norms. The facility shall be designed to handle bulk cargo through mobile hopper & conveyor system and other relevant equipments on the facility.
- e)** The tenderer shall execute the work at site as per Employer's approved drawings only. Photocopies shall not be used at Site. The drawing for all the works shall be developed by the contractor and submitted to Employer for approval in four copies, which will be scrutinized and corrected. After incorporating corrections indicated in corrected drawings 6 prints shall be submitted by tenderer for issuing as approved drawings which only shall be used at site for carrying construction.
- f)** The scrutiny/approval of drawings by Employer does not absolve the tenderer in any manner from owning complete responsibility towards performance, safety and security of all the systems designed and constructed by them. Safety, security and adequacy of all civil structures from design, construction and erection point of view lies entirely with the contractor even after approval of drawings by purchaser.
- g)** Preparation and submission of all operating and maintenance manuals as well as 'As -built' drawings are included in the engineering services.
- h)** All erection drawings/instructions/manuals shall be submitted by vendor.
- i)** List of spares and manufacturing drawings of fastwearing parts/items.
- j)** Preparation of Project Completion Report which will include specification of plant and equipment as installed with quantity and weight, compliance of guarantee parameters, inspection certificates, reports of all critical measurement/ survey carried out during erection and commissioning, status of compliance of design and guarantee parameters.
- k)** Furnishing detailed schedule of submission of drawings and documents.
- l)** Submission of quality assurance plan.
- m)** Preparation and submission of master network (Level-1 and Level-2) and detailed network (Level-3).
- n)** Submission of weekly exception report in addition to submission of monthly progress reports with corrective measures for timely completion of the package.
- o)** Submission of construction management manual along with organization set up and responsibility of various agencies.
- p)** Compliance of statutory and safety requirements as required.

#### **2.1.5.2. Supply of plant and equipment**

- a)** Supply and storage at site of all equipment, technological structure, non-standard equipment, plant electrics, instrumentation, automation, cranes & hoists, communication, water system, utility system, power system etc. and any other equipment which according to tenderer are necessary for completeness of the plant and for meeting the guarantee parameters.
- b)** All items shall be complete with auxiliary, accessories, liners, safety items etc.

- c) Commissioning spares, special tools, tackles, foundation bolts, embedment, inserts, anchorage, first fill of oils, grease and lubricants.
- d) Tenderer shall have to ensure completeness of each unit separately and the complete plant collectively. If any item/unit is excluded from tenderer's scope but are needed for the completeness of the unit or the plant the same shall be specifically mentioned in exclusion list without which it will be construed as part of tenderer's scope.

#### 2.1.5.3. Erection, testing and commissioning

- a) Tenderer is required to quote for erection, testing and commissioning of the complete plant. Shipping with adequate packing, transportation, loading, unloading, and storage at site are in the scope of tenderer. The erection, testing, commissioning and demonstration of performance guarantee test shall be responsibility of Tenderer and carried out under expert supervision. Tenderer to submit the commissioning & load trial procedure of entire plant for Employer's approval.
- b) Painting of all plant and equipment and structures are in the scope of tenderer. All equipment shall be shop painted and touch-up painting shall be done after erection. Similarly, all structures shall be erected after final painting and touch-up painting shall be done after erection.
- c) All Civil work, structural work, as required.

#### 2.1.5.4. Manpower and training

Tenderer shall indicate the operational and maintenance manpower required for the plant. Successful tenderer shall have to arrange for in plant training of Employer's personnel during commissioning of the plant. Tenderer shall also consider Operation & Maintenance training for Employer team or Employer designated team for TWO (2) Months after successful commissioning.

#### 2.1.5.5. Performance guarantee

Demonstration of performance guarantee test shall be as per requirement mentioned in this Tender.

#### 2.1.5.6. Relocation of affected Utilities, Roads (-Deleted-)

All utilities and Infrastructures (Road etc.) affected due to construction shall be temporarily relocated in an effective manner so that no hindrance caused to the present operation. After construction work in that particular portion, the temporary relocated utilities shall be placed in original corridor/ location.

#### **2.1.6. Battery Limits.**

The battery limits shall be referred with Layout diagram attached with this tender document. Bidder shall identify and consider any interface activities work required for completion of Tender scope with existing facilities i.e. Jetty, Road, Railway, Utilities, Electrical system etc. as bidder's scope of work.

Battery limit for various facilities shall be considered as described below:

##### 2.1.6.1. System battery limit

- 2.1.6.1.1. After unloading of Cargo from Ship via Mobile Harbour Cranes onto Mobile Hopper. Battery limit starts after transfer of Bulk cargo onto mobile hopper and then via Conveyor system to the dedicated stack yard.
- 2.1.6.1.2. The project involves installation of hopper, Conveyor, trippers for shifting of bulk cargo to the the stack yard. It is also envisaged that suitable dust control systems and other ancillary systems shall be provided, wherever required to mitigate completely the environmental pollution and

consequential effects of the facility to comply with state and central pollution control norms.

- 2.1.6.1.3. All the facilities & works required to be done within Berth-8 & 9 for mechanization (as shown in attached Drawing) shall be scope of tenderer.

#### 2.1.6.2. Electrical and Automation

- 2.1.6.2.1. Battery limit for electrical starts from 11kV Cable termination at existing 11kV Panels at existing nearby Substation.
- 2.1.6.2.2. Battery limit for Automation starts from existing PLC/SCADA terminal (hook up). This will include modification (hardware and software) in existing Automation system, if any.
- 2.1.6.2.3. Vendor shall draw 11KV HT supply by laying two (2) nos. of HT cables from existing nearby switch yard substation by using separate route up to proposed new substation near Berth-8 & 9. Vendor shall consider cleaning of existing trench and crossing, construction, modification, repair of existing cable trench and crossing for laying of new cables as per site condition and instruction of Employer Site In-charge. Road crossing of the cable shall be done with HDD machine without excavation and blockage of the road.
- 2.1.6.2.4. Final length of the route shall be derived after detail route survey and engineering by successful bidder in consultation with Employer. It is recommended vendor to visit the site and provide best optimized layout option with combination of underground and overhead installation for cable routing from switch yard substation to new sub station of Berth-8 & 9 and onwards to the mechanization system for the power supply and its control.

#### 2.1.6.3. Utility – Firefighting/ Dust suppression/ Air ventilation/ Utility Buildings,

- 2.1.6.3.1. Water supply at single point near to Berth-8 & 9 boundary will be provided by Employer, if available. Vendor shall install the Water supply for dust suppression system by adding necessary pipe line and pump as required.
- 2.1.6.3.2. Vendor shall design and construct the further storage and distribution of water for following applications:
- Dust Suppression System.
  - Potable water usage.
- 2.1.6.3.3. Sewage and Effluent shall be collected at single point and evacuation provision via Road Tanker shall be provided. Also, provision of connecting the collected point with existing available sewage line of DPA shall be provided.

Required Water storage tank and Pump house for above application shall be design and constructed by vendor.

#### 2.1.6.4. Berth-8 & 9 Jetty Interface Battery Limit:

- 2.1.6.4.1. There is no Utility Ducts, Cable Trenches or Electrical Pits provided in Jetty Design. Hence, successful bidder shall consider design for Shore Power Supply i.e., Cable Drums, Trailing Cables, JBs, Electrical earthing, etc. with sufficient space and route for vehicle movement i.e. Cargo vehicles and Maintenance vehicles are available.

- 2.1.6.4.2. The is no specific provision for foundations of Transfer Towers and Conveyors provided on Jetty. Indicative locations of Transfer Tower and Conveyor footings shown in attached Tender Drawing. Successful bidder shall consider Load capacity of Jetty in detail engineering and installation of Transfer Towers on Wharf area, if any.
- 2.1.6.4.3. There is no provision made for Conveyor footings on Jetty. Successful bidder shall consider using of Pile Junction and Design load capacity of Jetty during detail engineering and installation of Conveyor Gallery columns with appropriate methodology.
- 2.1.6.4.4. Vendor shall refer the available Berth-8 & 9 Jetty Design & drawings for detail engineering and installation work on Wharf area. Any modification and installation on Wharf area is subject to compliance of Design basis report of jetty and Employer approval.

### **2.1.7. Information to Be Furnished with the Offer**

The tenderer shall submit the bid section wise as per this specification complete in all respect including all technical details, drawings, sketches, and design parameters etc. which are necessary for providing clarity of the offered system/items. The general details to be provided in the offer are listed below.

- a) General description of the system along with detailed flow sheet, layout, plan and section of each unit to enable the EMPLOYER to have a proper understanding of the system offered.
- b) List of all the equipment and facilities envisaged for the system offered for each unit, general description of the equipment offered specifying the important feature including operating parameters and materials of construction etc.
- c) Complete motor list for each unit along with electrical load list.
- d) System parameters and consumption of utilities, electric power and other media for each individual unit.
- e) P&I diagram for each section and list of instruments.
- f) Indicate separately the measures taken for fulfilling safety requirement and statutory regulations of concerned authorities.
- g) Makes of all bought-out items shall be indicated.
- h) Reference list of similar experience.
- i) List of imported equipment/components.
- j) Information on pollution norms and facilities.
- k) Information on energy saving devices.
- l) Implementation/delivery schedule.
- m) The tenderer shall also submit the information as specified in this document and Volume-1.
- n) Proposed organization structure and execution plan of the tenderer.

### **2.1.8. Deviation and Exclusion**

Generally, the tenderer shall submit his offer in line with the indicative tender specification. However,

in case of any necessary deviation and exclusion, the same shall be indicated in a separate list with adequate reasons. Any deviation and exclusion not specifically mentioned in this list will not be considered. However, all such deviation and exclusion shall be discussed during Pre-Bid meeting prior to submit with bid.

#### **2.1.9. Priority of Requirements**

In case of any variation and discrepancy in condition between the Job Specific Requirement, this specification and codes, order of priority shall be as under :-

- a) Special conditions
- b) This indicative specification
- c) Drawings in NIT
- d) Codes

#### **2.1.10. Spares**

The tenderer shall submit with his tender, quotation for various spares in accordance with the relevant clauses of the General Conditions of Contract. Required commissioning spares shall be in tenderer's scope of supply.

##### **2.1.10.1. Commissioning spares**

Provision shall be made for all spares required for commissioning of the equipment and for its efficient operation until provisional acceptance after demonstration of satisfactory performance and in accordance with the guarantees. These items shall be based on the tenderer's experience in commissioning similar plants in the past. The commissioning spares are to be included in the main offer along with the list and must be at site along with the main equipment. The successful tenderer shall be responsible for having the required items at site in sufficient quantities which shall be finalized with them. All the left over commissioning spares shall be handed over to the Employer without any extra charges.

##### **2.1.10.2. Spare parts for two (2) years' normal working**

The list of recommended spare parts for two (2) years' normal working of the plant shall be submitted in accordance with the relevant clauses of the General Conditions of Contract however required commissioning spares shall be in tenderer's scope of supply.

##### **2.1.10.3. Drawings for Wearing Parts**

Tenderer should include the manufacturing drawings of fast wearing parts/items under the scope of engineering.

#### **2.1.11. Drawings and Documents**

- a) All data, drawing, documents, calculations, manuals, instructions etc. shall be in English language and in metric units.
- b) Tenderer shall submit a list of categories of drawings and documents to be supplied by them under basic engineering scope and detailed engineering scope. The list of drawings and documents to be submitted will include general arrangement, design calculations, selection of components etc.; this complete list of deliverables shall be approved by Employer.
- c) The contractor has to appoint a Technical Consultant at his own cost to prepare & review the detailed design and drawings and for their internal quality check & assurance for the work with approval of Engineer-In-Charge. Contractor has to appoint their consultant for his internal works and materials for confirming their internal quality policy. The appointed

consultant of the contractor shall perform necessary proof check for the detailed design and drawings for the work before Good for construction Drawings at his own cost. All the expenses incurred by the Technical Consultant for various activities will be borne by the contractor only.

- d) Tenderer shall submit fabrication drawings to Employer / Employer's engineer prior to execution for their review.
- e) Tenderer has to ascertain a required concurrence between mechanical, civil-structure and electrical engineering function during engineering of project & equally during execution at site.
- f) Drawings prepared by Tenderer shall be suitable for transmitting electronically and digitization for storage.
- g) All erection drawings shall contain relevant safety instructions "DO'S" and "DONT'S" for erection, testing and commissioning.
- h) Integrated technological shop drawings, equipment layout drawings (plan, elevation, sections) etc. shall contain all dimensions and BOM with weights and quantities.

#### **2.1.12. Tools and Tackles**

The tenderer shall include in his tender special tools and tackles that shall be required for normal operation and maintenance of the equipment as per relevant clauses of the Invitation to Tender and General Conditions of Contract.

#### **2.1.13. Consumables and Operating Supplies**

The offer shall include information on the specifications including equivalent brand names and quantities of all consumable materials such as lubricants, flushing oil, resins etc; required during start-up, commissioning, initial filling and yearly requirements for normal operation. Itemized unit prices shall be quoted for these items. The successful tenderer shall supply such materials required for start-up, commissioning, and initial filling and performance tests.

#### **2.1.14. List of Preferred Make**

The equipment manufactured by the tenderer shall normally be offered for supply as a part of the system. In the event of the tenderer not having particular equipment in their range of manufacture, the same shall be offered as bought out from among the list of preferred supplier. List of preferred make of bought-out Items/components are given respective sections of this tender enquiry documents. Make of any equipment not covered in respective sections shall require approval of Employer.

#### **2.1.15. Implementation/Delivery Schedule**

The proposed plant **shall be commissioned in Twelve (12) months** from commencement date. Tenderer shall indicate in a bar chart the implementation schedule starting from placement of order date specifically indicating the time for the following activities. However, tenderer is required to adhere to the dates mentioned against certain critical activities. The schedule shall be updated by the successful tenderer from time to time during implementation.

- a) Basic engineering
- b) Detailed engineering for proprietary and indigenous items
- c) Order Placement, Manufacture and supply

- d) Inspection by EMPLOYER/Consulting Engineers/ PMC/ TPIA
- e) Mobilization to site
- f) Storage and security of equipment at site
- g) Civil work
- h) Structural fabrication work
- i) Structural erection work
- j) Erection of plant and Equipment
- k) Commissioning & preliminary acceptance (PAC)
- l) Final acceptance (FAC)
- m) As-built drawings, final documentation etc.
- n) Completion report
- o) Demonstration of performance guarantee to be performed within three (03) months from date of commissioning of the plant along with associated facilities mentioned in this specification.

#### **2.1.16. Progress Report**

The successful tenderer shall submit the Monthly Progress Report which shall primarily consist of:

- a) Project Time Schedule
- b) Status of Engineering
  - Basic
  - Detail
- c) Procurement Status
  - Order Plan
  - Actual Ordering
- d) Inspection and Manufacturing Status
- e) Shipping Plan
- f) Erection Status

The successful tenderer shall also submit the relevant daily/weekly progress reports for site activities. Please refer separate section for more details.

The successful tenderer shall follow Employer reporting format as provided and / or submit the reporting formats for employer approval. Vendor shall submit the native file (editable soft copy) of reports to Employer.

#### **2.2. Detail Scope of Work and System Description:**

The scope of work outlined in this section is for overall understanding of the works, and does not absolve the Contractor from successful commissioning and operation of the works with best available latest technology.

Brief requirement for proposed system is as mentioned below:

### 2.2.1. Engineering, Procurement & Construction Requirement

The Employer's Requirements are that the Contractor shall carry out Design, Engineering, Procurement, Manufacturing, Supply, Erection, Commissioning and Performance trial of works. Successful Tenderer shall also consider providing Operation & Maintenance training to Employer's team or to Employer's designated O&M team for Two (2) Months after successful commissioning. Contract defined hereunder including all associated works and integration with the existing plant to provide fully commissioned and operational facility that will perform as specified in the Tender documents.

- a) The scope of work outlined in the table below is for overall understanding of the works, and does not absolve the Contractor from successful commissioning and operation of the works with best available latest technology. The Contractor shall provide a complete system listed below but not limited to:

**Table 2-1: List of Minimum Facilities Required**

S. No.	Description	Qty	Unit
1.	<b>Culvert at road Crossing (12.4 x12)m x 2m High</b>	1	Lot
2	<b>Conveyor Foundation (6m x 6m)</b>	1	Lot
3	<b>Foundation for Trestles (4m x 2m)</b>	1	Lot
4	<b>MCC room with Toilet (250Sqm)</b>	1	Lot
5	<b>Mobile hopper (Package)</b>	4	Nos.
6	<b>Belt Conveyor 1800 mm wide at Berth</b>	415	Mtrs
7	<b>Belt Conveyor 1800 mm wide at After Berth</b>	1820	Mtrs
8	<b>Tripper Conveyor 1800 MM WIDE TC 1, TC 2, TC3</b>	4200	Mtrs
9	<b>Transfer Towers TT-1 to TT-10 with sheeting &amp; Stair Case</b>	10	Nos.
10	<b>Trestles for Conveyor (740 Ton)</b>	1	Lot
11	<b>Dust Suppression System at Loading Point</b>	4	Nos
12	<b>Belt Scale</b>	2	Nos
13	<b>In Line Magnetic Separator</b>	2	Nos
14	<b>Electric Hoist at TTs , Cap 5 ton</b>	8	Nos.
15	<b>Metal Detector</b>	2	Nos
16	<b>MCC with UPS &amp; Automation</b>	1	Nos
17	<b>Control Desk</b>	1	Nos
18	<b>Cable with Cable Tray</b>	1	Lot
19	<b>Cable Reeling Drum</b>	3	Nos
20	<b>CCTV at Berth, Trippers, JT's with DBR</b>	21	Nos
21	<b>Hooters, Public Announcement System</b>	1	Lot
22	<b>Air Ventilation System at MCC Room</b>	1	Lot
23	<b>Transportation</b>	LS	LS
24	<b>Erection and Commissioning</b>	LS	LS

- b) The Contractor shall provide complete Electrical, Instrumentation & Automation works for all equipment as required.
- c) All Earthing protection works as per IS code.
- d) Following activities/ services shall be covered with respect to this contract:
- Detailed design and engineering of all the equipment and system(s).
  - Complete manufacture including shop testing/ type testing.
  - Providing engineering data, drawings, commissioning procedures and O&M



manuals, etc. for the Employer's review, approval and records.

- Packing and transportation from the manufacturer's works to site including transit insurance, customs clearance/ port clearance, if required.
  - Pre-construction work required at site if any.
  - Receipt, unloading, storage, preservation, conservation and insurance of equipment at site.
  - Fabrication, pre-assembly (if any), erection, testing and putting into satisfactory operation of all the equipment.
  - Associated civil, structural and electrical works.
  - Installation / erection procedure.
  - Commissioning and completion of facilities and Performance Guarantee Tests after successful completion of initial operation.
- e) The Contractor will be responsible for interconnecting the existing and proposed system with minimum possible modifications, down time & cost.
- f) Contractor shall arrange required utilities during construction and commissioning, i.e. Construction Power, Water, Welfare facilities etc.
- g) It should be noted by the bidders that the information, size, specifications, design & dimensions mentioned in this Volume and drawings, are indicative. As in EPC Contracts, the successful bidder shall work out detail design & drawings during detail engineering stage meeting the functional, operational & performance requirements & as per relevant IS standards, well within the sanctioned estimate, and submit the fresh design & drawings for approval to employer.
- h) The indicative specifications provided in the tender together with enclosed drawings outlines the functional requirements and the operating characteristics which the system/ equipment must fulfil.
- i) Any item / equipment not listed but required for completion of the works shall be considered as included in the scope of the Contractor.
- j) The Contractor shall be deemed to have examined the site & reference drawings attached with tender and should have familiarized, study & understand with all existing site conditions. He shall accept the site in the existing condition at the time of award of the Contract and throughout the execution period of contract. The Successful Tenderer shall consider designing of system with respect to site condition.
- k) The contractor has to appoint a Technical Consultant at his own cost to prepare & review the detailed design and drawings and for their internal quality check & assurance for the work with approval of Engineer-In-Charge. Contractor has to appoint their consultant for his internal works and materials for confirming their internal quality policy. The appointed consultant of the contractor shall perform necessary proof check for the detailed design and drawings for the work before Good for construction Drawings at his own cost. All the expenses incurred by the Technical Consultant for various activities will be borne by the contractor only.
- l) Load-Testing of the facility in accordance with the mutually agreed program shall be undertaken for which cargo will be arranged by the EPC contractor. The contractor shall give written request upon readiness of entire system in totality for requirement of Cargo Vessel

for Performance-Tests. Employer will arrange the Cargo vessel for performance-tests based on availability. The contractor shall ensure unloading of cargo from vessel as per Port / Employer guideline and predefine time line, it is to be noted that in case of delay in unloading of cargo from Vessel, applicable demurrage / penalty charges will be charged to the contractor same will be deducted from the contractor payment.

- m) The Contractor shall adhere to and honors the Conditions of Contract in all respects up to satisfactory completion of the contract.
- n) A list of the Start-up spare parts and adjustment tools for maintenance, along with quantities shall be provided with the Tender.
- o) Defect Liability Period shall be provided as per the Contract Conditions.

**NOTE:**

Upon successful completion of installation, Dry / No Load Test of entire system, for Internal tests and Load testing, the sufficient cargo will be arranged by the EPC contractor on prior approval of employer. However, in case, employer i.e. Deendayal Port Authority arranges the cargo for Internal & Load tests depending on the availability, the contractor has to bear any penalty / demurrages arises (if any) due to failure / non-performance of the system / plant / equipment. After load- tests, for Performance test with minimum 03 full ship as in proposed tender docs, cargo would be arranged by the Traffic Deptt. of DPA by directing the 03 Nos. Ship of bulk cargo (as per availability) to Berth No.8 and 9. In this case also, the contractor has to bear any penalty / demurrages arises (if any) due to failure / non-performance of the system / plant / equipment and same will be deducted from the contractor payment.

**2.2.2. Operation and Maintenance Training:**

The contractor has to provide operation and maintenance training to Employer's staff or to Employer's designated O&M team for **TWO months** after successful commissioning of the plant.

Contractor needs to deploy sufficient skilled man power for supervision and training for Operation and Maintenance of system atleast for **2 (TWO) months** duration.

**2.2.3. Mobile Hoppers: 4 (Four) Nos**

Mobile Hopper with capacity of 100 Ton capacity will receive the material from Mobile Harbour Cranes. The material shall be unloaded into a mobile hopper through Mobile Harbour Cranes. There shall be a provision in the mobile hopper to transfer the material to belt conveyor through a chute below or transfer the material to the elevated conveyor through a reversible belt feeder conveyor. Vendor shall provide Mobile Hoppers as per specification provided in this document and completed in all respect.

The Successful bidder shall consider design and size of Jetty (Berth-8 and 9) and Conveyor system shall be designed according to the design and size of Berth-8 and 9.

There are no Utility ducts, no Cable trenches or no Electrical Pit provided on Jetty, hence Contractor shall consider appropriate arrangement for Shore power supply i.e. trailing cable drums, JB, Panel and earthing for Mobile Hoppers. All electrical and earthing arrangement shall be made in such way that sufficient space and route available for vehicles movement for Cargo operations and maintenance (Trucks, Dumper, Pay loaders, Hydra & other Maintenance equipment(s)).

Kindly note that Two nos of Rail Slots have been provided on Jetty as provision for fixing and laying Rail. Vendor shall consider the design, supply, fixing of suitable Rails for Two nos. of Mobile Hoppers. Earthing provision shall be extended from Backup yard as earthing provision is not available in Jetty.

Mobile hopper with Reversible Belt feeder is considered to feed the cargo either to Conveyor system or to Dumper on Wharf area. However, vendor shall consider the best possible arrangement for evacuation of cargo from Mobile hopper to Dumper on Wharf area and continuation of Vessel unloading operation in case of failure of Reversible Belt feeder.

#### **2.2.4. Conveyor System with Transfer Towers:**

##### **2.2.4.1. Scope of Work:**

This section of Technical Specification covers design, engineering, procurement, manufacture, supply, storage and handling at site, fabrication, assembly, erection, testing and commissioning including establishment of performance guarantee tests of conveyor system with associated equipment for handling bulk cargo from proposed Mobile Hoppers on Berth-8 and 9 to the stack yard. Belt conveyors shall be with associated electrical, auxiliaries and facilities to make the system complete in all respects.

Associated equipment [In-line Magnetic Separator (ILMS), Suspension Magnet (SM), Belt Weigher, Metal Detectors, Diverter Gates, Movable Head etc.), Electric hoist on TT's etc, as per requirement and specification provided in this document.

The scope of design under this document includes Civil, Architectural, Structural design and services of building envisaged.

Vendor to offer the material handling system to deliver the desired capacity for handling of bulk cargo.

The Tenderer shall study the Specification and satisfy himself thoroughly on the requirements covered herein and shall take full responsibility for guaranteed operation of the entire system as regards performance and smooth reliable working. If the Tenderer feels that any design data/technical particular/ layout drawing for the conveyors, equipment included is in his opinion unsuitable to meet the specification requirements, he shall indicate the same in his offer and submit an alternative proposal with lay out, relevant details and associated drawings on the basis of the system design he considers suitable and capable of meeting the required operating parameters.

The Successful bidder shall consider design and size of Jetty (Berth-8 and 9) and Conveyor system shall be designed according to the design and size of Berth-8 and 9.

It is envisaged to have conveyor in two parts, Berth Conveyor on Berth-8 and 9 and Yard conveyor transferring cargo to stock yard with tripper arrangement in the stack yard.

Regarding berth conveyor, it is to be ensured that design of Transfer Tower and Conveyor Gallery structures are in line with Load capacity of Jetty (Berth-8 and 9). Foundations and Structure column shall be positioned / design so as load distributed on Pile Junctions instead of Slab of the Jetty.

It is to be noted that there are no Utility ducts, no Cable trenches or no Electrical Pit provided on Jetty, hence Contractor shall consider appropriate arrangement for Shore power supply and earthing for Conveyor system. All electrical and earthing arrangement shall be made in such way that sufficient space and route available for vehicles move ment for Cargo operations and maintenance (Trucks, Dumper, Pay loaders, Hydra & other Maintenance equipment(s).

Berth conveyor system shall be designed such way that sufficient height clearance available below Conveyor Gallery for Cargo and Maintenance vehicles i.e. Trucks, Dumpers, Hydra, Pay Loaders etc.

Conveyor Gallery shall be considered to be covered appropriately.

#### 2.2.4.2. Scope of Supply

All items of the belt conveyor system, associated equipment is section of Technical Specification shall be complete in all respects and any item or accessory not specifically mentioned/covered, but essential for proper design and operation, shall be deemed to be included under the scope of work by the Tenderer.

The Tenderer shall quote for the equipment considering the makes of components as listed in other respective sections of this tender. The Employer reserves the right for selecting the manufacturer of items/components from a particular source for the sake of standardization and the Successful Tenderer shall supply the item of that make if so required.

#### 2.2.4.3. Standards

In general, the conveyor system, associated equipment and its components shall conform to the relevant.

Standards published by The Bureau of Indian Standards (BIS). The mobile storage yard equipment and wagon loader shall also be designed as per relevant Indian Standards as applicable. For details refer other section in this tender.

Wherever Indian Standards, do not exist, the equipment and its components shall be designed, assembled and tested in accordance with the latest international standards published by The International Organization for Standardization (ISO) or National Standards Institution (NSI) of the country, where the items/ components shall be manufactured or procured from.

All equipment and installations shall comply with the statutory requirements of the Government of India and the Government of Gujarat. Wherever required by regulations, the Successful Tenderer shall have to obtain Factory Inspector's approval of relevant are as as appropriate. Any change required by the said Inspection Agencies shall be carried out by the Successful Tenderer and expenditures, if any, in this regard shall be to his account only. The same condition shall also be applicable for obtaining the approval of other statutory authorities.

#### 2.2.4.4. Brief System Description

The Capacity of the conveyor system from berth to stockyard end shall be 2000 TPH (designed). Bulk cargo unloaded from vessel shall be transferred to berth conveyor belt on Jetty via mobile hopper reversible conveyor. Berth conveyor will transfer the bulk cargo to yard conveyor belt via TT's at end of Jetty.

At transfer tower TT with staircase and sheeting arrangement shall be provided. The cargo shall be stacked in the stackyard through a travelling tripper install at the yard at a height of about 10 m from the floor level. Conveyor layout drawing shall be referred for reference (TT's to be provided as per the reference drawing).

Vendor shall provide the conveyor system with transfer towers, equipment(s), and accessories as mentioned in the indicative specification provided in this document and complete in all respect.

#### 2.2.5. Travelling Tripper (03) no:

Travelling Tripper shall be installed on yard conveyor provided in the stack yard (Refer drawings). The cargo shall be stacked in the stack yard through a travelling tripper install at the conveyors in the stack yard with rail arrangement.

Vendor shall provide the Travelling Tripper system with equipment(s), and accessories as specified in

specification provided in this document and complete in all respect.

**Note: The tripper design should be designed by the vendor by considering additional provision of booms/ shuttle conveyors for proper distribution/stacking of Bulk Material in each plot for better utilization of stack yard, which will be incorporated in Phase-II of the development by DPA.**

#### **2.2.6. Transfer Tower (10) no:**

Transfer tower at berth works as a junction between the Berth conveyor system and Main conveyor system for transferring the cargo from conveyor belts at berth to another conveyor belts of Main conveyor system. Provision is made for flexible transfer of cargo from 2 berth conveyor belts to 2 numbers of main conveyor and then to 2 numbers of yard conveyor belts.

Vendor shall provide the Transfer Towers system with equipment(s), and accessories as specified in specification provided in this document and complete in all respect.

#### **2.2.7. Building for Substation cum Control Room / Operation Room:**

##### **2.2.7.1. Sub Station Building - Ground Floor**

###### **a) Introduction**

The scope of design under this document includes Architectural, Structural design and services of buildings envisaged. This document is in relation to the basis of design of the Substation building envisaged for the operational and service requirement of the port.

###### **b) Description and Scope of Structure**

Design & construction of Utility Buildings consisting of following spaces with clear plan dimension mentioned against them. These Substation buildings are SMRF concrete structures of ground floor only. Roof height shall be around 4.5 mtrs (FFL to Bottom of Beam) and finished floor level of building shall be 500 mm above FGL. The building shall be provided with firefighting system (Fire extinguishers). Inlet and out let Cable trench/ cable cellers (approximately 3m height) shall be considered for S/S room. Air Conditioning of adequate capacity shall be provided in VFD room, RIO room and PLC-UPS room. Panel bottom entry shall be considered. Civil details shall cater to bus duct of Distribution/Power/convertor duty transformer. Civil and structural details shall consider pressurised ventilation system for areas other than VFD panel room, PLC-UPS room and RIO panel room.

###### **c) Indoor Environment and Quality Standards**

While orienting and designing a schematic, the desired indoor quality of environment shall be kept in mind and certain key features shall be combined along with the Architecture. Open areas, closed areas, glass areas etc. are the important things that are kept in mind

###### **d) Architecture:**

Once the primary functional needs and schematic design is completed, the building is shaped and idealized for architectural purposes based on the latest codal provisions. The look, feel, shape and finishes are given due value to arrive at a sustainable Architectural design. The Landscaping in and around the building shall be combined with the building to give it a natural existence.

###### **e) Utilities and Services:**

Various utilities for building projects in terms of various services related to buildings such as MEP (Mechanical, Electrical & Plumbing), HVAC (heating ventilation & air conditioning), Firefighting, Fire alarm system, IT/ELV systems with required public address system, acoustical requirements Etc

shall be designed in accordance with relevant IS & Other codes.

User input shall be taken for the layout & IT systems. The utilities and services shall include all services pertaining to complete building for occupancy.

Storm water drainage shall be provided to drain the runoff to the nearby storm water drain.

#### 2.2.7.2. Operation and Control Station building (First Floor):

- a) First floor of the building is to be utilized for office space and control room operational space.
- b) Here the floor would be bifurcated into operational and functional zones with toilets, pantry, server room, meeting rooms, ups/it room as common utility space.
- c) Panels for Operational area and functional area must be within the zones.
- d) The floor will be well ventilated and illuminated mechanically as well as naturally.
- e) Fire safety and fire escape routes must be provided for emergency situation.
- f) Raised floor must be provided for Server and operational rooms.
- g) Health hygiene of the employees must be taken care of.
- h) Interior paints, flooring, exterior cladding, glass partitions, ventilators, windows must be provided as per standards and specification mentioned under relevant sections of this tender.
- i) False ceiling, HVAC, Utility ducting, Rain water harvesting, waste disposal, interior partitions for cubicles and workstations and other must be provided as a part of interior furniture.
- j) Surveillance system for the operation rooms must be provided.

#### 2.2.8. Dust Supression System:

##### 2.2.8.1. Dust Suppression system

##### 2.2.8.2. Scope of Works

Sr. No.	System	Area	Broad Scope
1	Dust Supression system	Mobile Hoppers, Transfer Towers, tail houses, drive houses, Travelling Trippers	Dust suppression system with water sprinkler/dry fog suppression system arrangement shall be provided for all the discharge and receiving point of conveyors and mobile hoppers. The dust suppression system shall be designed by EPC contractor based on input data of MHS system mentioned elsewhere in the tender specifications. The dust extraction system shall be suitable for bulk material handling. EPC contractor shall provide calculation and detailed specification of dust extraction system for Employer's review and approval in detailed engineering

In addition to the above, scope of work shall also include engineering design, procurement, supply, erection, testing & commissioning of the full proof dust extraction system inside the battery limit in accordance to CPCB norms and prevailing statutory regulations, as applicable.

#### 2.2.8.3. Documentation

Submission for Employer Review and Approval

- Documents under approval category Basic layout (General arrangement Drawing)
- Detailed Engineering Design Report
- Process calculation
- P & I, HFD and PFDDiagram
- SLD and Control wiring
- Piping Drawing
- QAP
- Data Sheet and Technical Specifications of Electromechanical Items
- GAD of all equipment, electrical and Civil items
- Structural Drawing of civil items
- Operation Philosophy and Automations

Submission for Employer Information and record

- Bill of quantity
- MTO
- IDC check (Mechanical, Electrical, Piping and Instrumentation) for ensuring foul check
- O & M Manual
- As Built Drawing

#### 2.2.9. Electrical, Instrumentation & Automation Works:

The project scope for electrical includes detail engineering / Design, Procurement, Construction/Erection/Fabrication and Commissioning of following systems;

- Vendor shall draw 11KV HT supply by laying two (2) nos of HT cables from existing nearby switch yard substation by using separate route up to proposed new substation for Berth-8 & 9. Vendor shall consider cleaning of existing trench and crossing, construction, modification, repair of existing cable trench and crossing for laying of new cables.
- Extension/Installation of existing 11kV breaker panel at the nearby Switch Yard substation.
- Step down & Distribution of power for Material handling system and general power

& Lighting.

The scope of works for Electrical & Automation system mainly comprises of;

**a) External power**

- Vendor shall draw 11KV HT supply by laying two (2) nos of HT cables from existing nearby switch yard substation by using separate route up to proposed new substation for Berth-8 & 9. Vendor shall consider cleaning of existing trench and crossing, construction, modification, repair of existing cable trench and crossing for laying of new cables.
- Step down & Distribution of power at 3.3KV and/ or 415V for Conveyors, Cranes & Equipment and other related auxiliaries, general power & Lighting.

**b) New 11 kV Substation**

- Incoming power supply from existing 11 kV Source located at existing nearby Substation in Port up to 11 kV Breaker panel of proposed Substation.
- HT Breaker panel, Power & Control cabling.
- Power Transformers, Distribution Transformers, and Lighting Transformer
- HT APFC
- PCC
- MCC
- MLDB
- ACDB & LDB
- Battery & Battery charger with DCDB
- UPS system
- Building, Operational, (Conveyor Gallery/ Walkway/ Platform etc.) and area lighting
- Safety equipment
- Civil for electrical
- Fabrication work for electrical
- Pressurization system
- Fire-fighting / suppression system for substation and transformer yard
- PLC system & control room
- Communication system (Public Address)
- Security system (CCTV and Access Control System)

**c) Power distribution network & Illumination of open area/roads/transfer towers/conveyor galleries/various structures, Substation building & other utility building lighting. Dock area lighting/illumination should be complied by considering the dock safety regulation**

**d) Any steel fabrication work related to electrical equipment installation.**

**e) Testing and Commissioning of HT & LT motors including motor**



- f) Earthing of motors and equipment supplied and installed by the others.

## 2.3. Key Design Parameters:

Bulk cargo mechanization system shall be design to handle 24.53 MMTPA of bulk cargo. The cargo characteristics to be considered for the design of Mechanization of handling of bulk cargo is given in Table below:

**Table 2-2: Cargo Characteristics**

Material		Coal
Material size (max)	mm	100
Bulk Density	Kg/m <sup>3</sup>	800
Temperature	Deg	Ambient
Moisture Content	%	10 % max

### 2.3.1. Performance Parameters:

Key performance parameters for design of system are mentioned in Table below:

**Table 2-3 Key Performance Parameters**

I. No.	Particulars/Facilities	Specifications
<b>1</b>	Operating Days	
<b>a</b>	Ship Unloading	330 days available in a year
<b>b</b>	User Plant Operation	365 days planned in a year
<b>2</b>	Operating Hours per Day (effective)	20 hours
<b>3</b>	Shift Operations	
<b>a</b>	Ship Unloading	3 shifts daily (round-the-clock)
<b>b</b>	Stockpile – receipts and despatches	3 shifts daily (round-the-clock)
<b>4</b>	Design Vessel Size	
<b>a</b>	Coal	80000 DWT (Panamax) 35000 DWT (Handymax)
<b>5</b>	Night Navigation	No restriction
<b>6</b>	Additional time considered per ship for approach, berthing, de-berthing, departure and paper works	6 hours
<b>7</b>	MHC	4 Nos. Combination of 1050 TPH capacity each
<b>8</b>	Mobile Hopper	4 Nos. @ 100 MT capacity each
<b>9</b>	Berth/Yard Conveyor System	2000 TPH design capacity
<b>10</b>	Ship arrival pattern	Generally regular with possible variation in mean inter-arrival time.
<b>11</b>	Service Time (Berth Time)	Function of ship size, handling rates and efficiencies.
<b>12</b>	Cargo Storage area available (L*B= 7158.36*65)	Stockpile area of 4,65,293 Sqm.

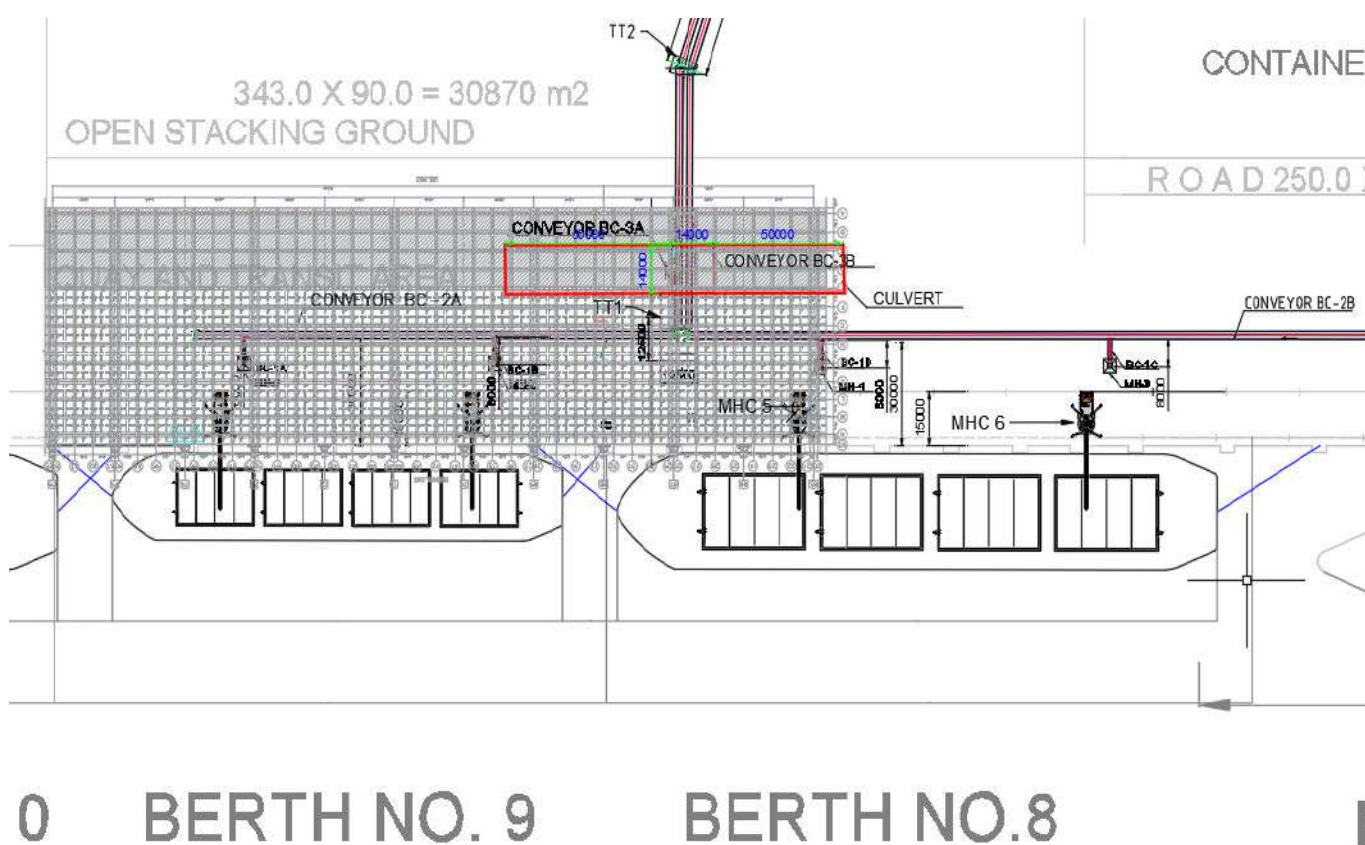
### 3. Indicative Technical Specifications of MOBILE HOPPER

#### 3.1. Overview

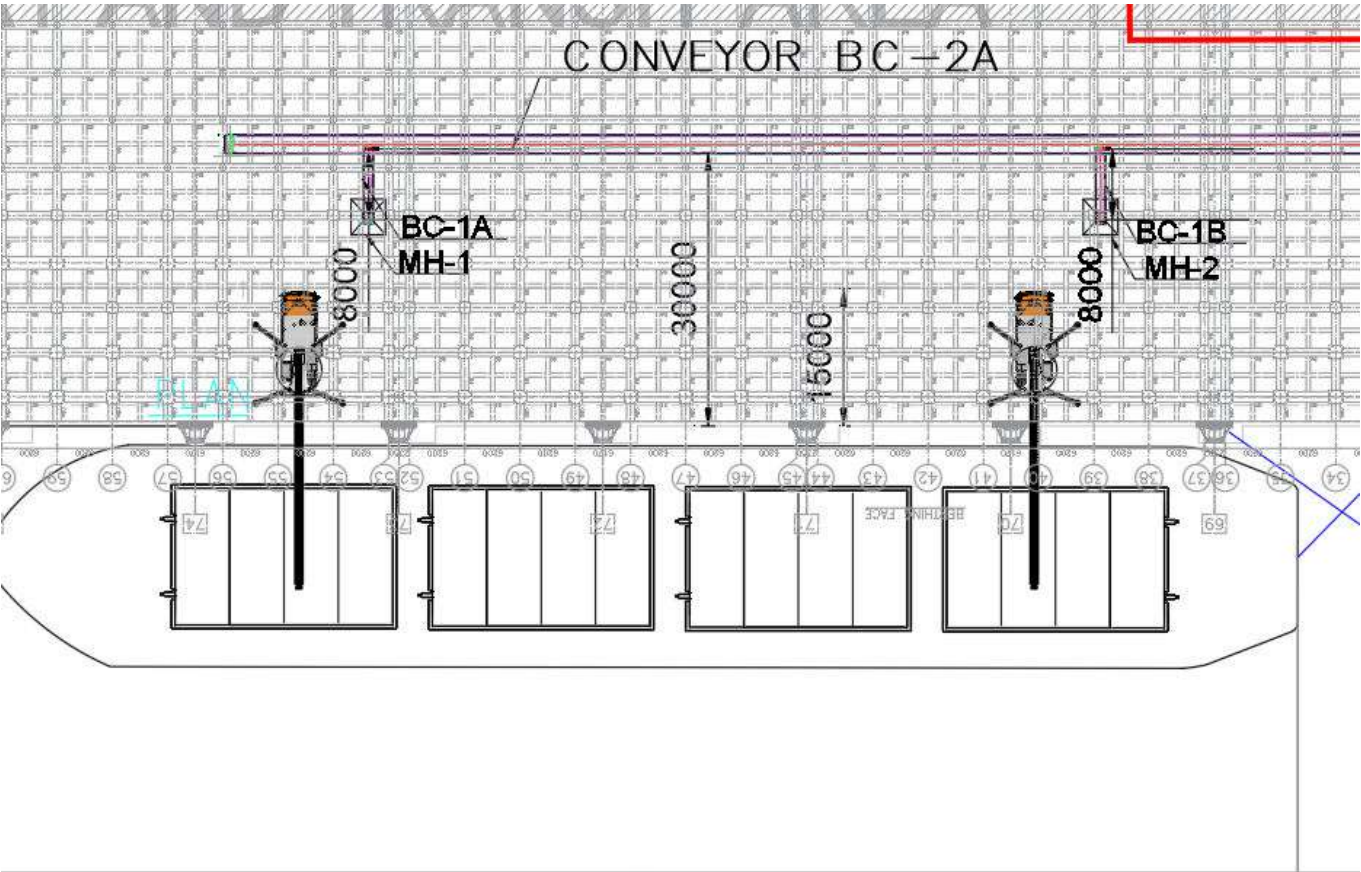
Deendayal Port Authority is one of the major ports among 13 declared major ports of India and situated along the Western bank of Kandla creek. Deendayal Port Authority has decided to undertake the development, operation and maintenance of Dry bulk cargo handling facility at Berth-8 & 9 inside Port on EPC basis. The proposed terminal is located at western bank.

The Deendayal Port Authority has decided proposed development of Dry bulk cargo handling facility by maximum vessel size of 80,000 DWT with (-) 12.5 m CD dredged depth. Keeping these factors in view the proposal is to develop the dry bulk cargo handling facility with design handling capacity of 24.53 MMTPA cargo.

The tyre mounted hopper placement on the berth 8 & 9 is to utilize maximum. The GA below is for understanding.

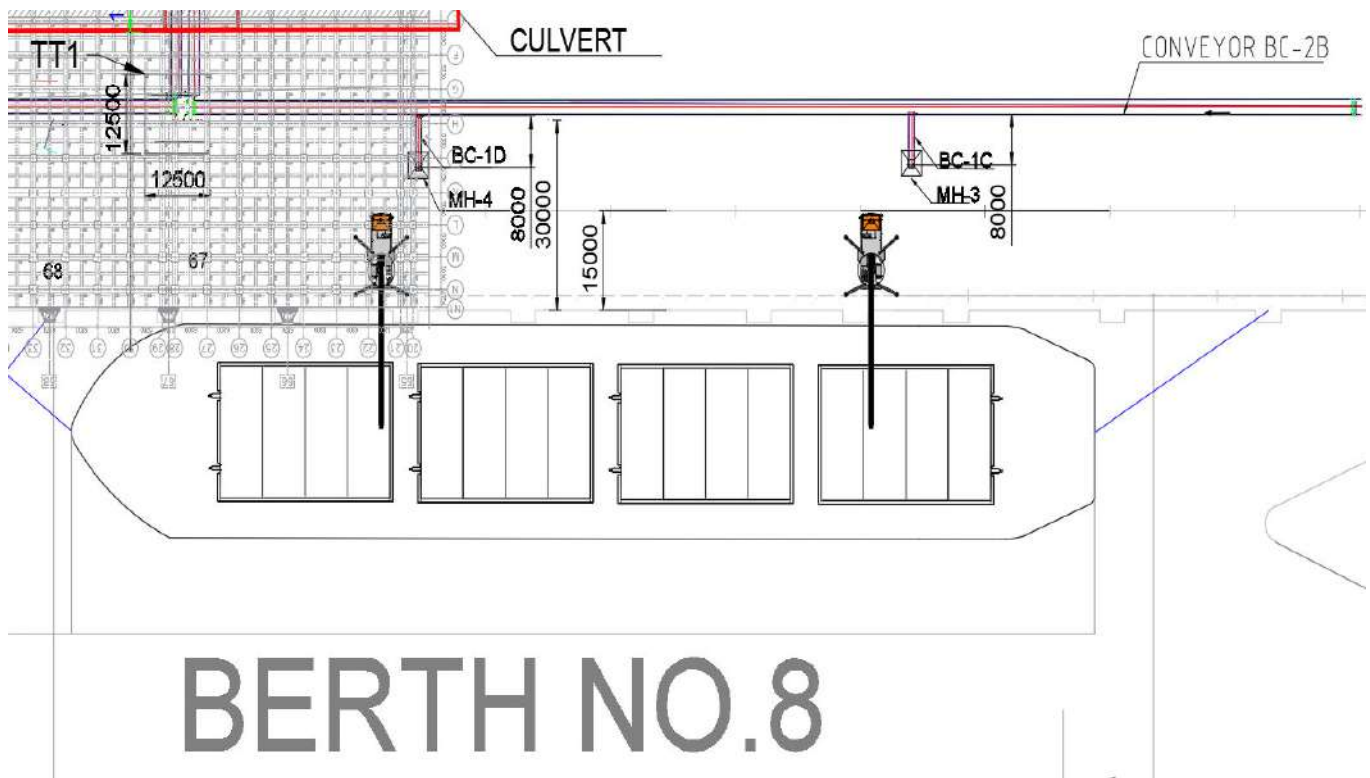


Mobile Hopper Placement on Berth 9 is shown bellow:



# BERTH NO. 9

Mobile Hopper Placement on Berth 8 is shown below:



The Berth-8 and 9 shall be equipped with two tyre mounted mobile hopper each. These hoppers shall move on berth on both directions as required and feed the berth conveyor.

These hoppers have drive arrangement through electric motor with brakes and will receive unloaded material from the vessel through Mobile hopper crane and feed the material onto the berth conveyor.

The equipment shall comprise a platform, grating, ladders, hand railing etc.

The crane shall be equipped with an operator's cabin in accordance with the requirement. The operator safety is considered in the design.

The guidelines in this document set the scope, philosophy, equipments quality, and standards to ensure that the equipment projects requirements are met. The design criteria in this document establish the basis for the design of the equipment and are minimum standards that guide:

- Equipment(s) specification and their functions usage.
- Safety features and maintenance facilities.
- Operating Performance.
- Standardization
- Environmental design features.
- Selection of code, law and regulations.

## 3.2. Operational Requirement

### 3.2.1. Specification of Cargo

Typical characteristics of the cargo to be handled are given below. Depending upon the source, the characteristics may vary.

**Table 3-1: Cargo Characteristics**

Material		Coal
Material size (max)	mm	100
Bulk Density	Kg/m <sup>3</sup>	800
Temperature	Deg	Ambient
Moisture Content	%	10 % max

### 3.2.2. Design Vessel Size:

Bidder shall consider vessel size while selecting and designing the Mobile Hopper Feeder.

Type of Vessel	Weightage	Vessel Size (DWT)	Parcel Size	LoA (m)	Beam (m)	Laden Draught (m)
Handymax	6%	35,000	25,000	150	25	7
Super Panamax	94%	80,000	50,000 to 60,000	200	32	12

### 3.2.3. Key Performance Parameters:

Bidder shall consider following key performance parameters while selecting and designing the Mobile hopper feeder.

Sl. No.	Particulars/Facilities	Specifications
<b>1</b>	Operating Days	
<b>a</b>	Ship Unloading	330 days available in a year
<b>b</b>	User Plant Operation	365 days planned in a year
<b>2</b>	Operating Hours per Day (effective)	20 hours
<b>3</b>	Shift Operations	
<b>a</b>	Ship Unloading	3 shifts daily (round-the-clock)
<b>b</b>	Stockpile – receipts and despatches	3 shifts daily (round-the-clock)
<b>4</b>	Design Vessel Size	
<b>a</b>	Coal	80000 DWT (Panamax) 35000 DWT (Handymax)
<b>5</b>	Night Navigation	No restriction
<b>6</b>	Additional time considered per ship for approach, berthing, de-berthing, departure and paper works	6 hours

7	MHC	4 Nos. Combination of 1050 TPH capacity
8	Mobile Hopper Feeder	4 Nos. @ 100 MT capacity each
9	Berth/Yard Conveyor System	2000 TPH design capacity
10	Ship arrival pattern	Generally regular with possible variation in mean inter-arrival time.
11	Service Time (Berth Time)	Function of ship size, handling rates and efficiencies.
12	Cargo Storage area available (L*B= 7158.36*65)	Stockpile area of 4,65,293 Sqm.

### 3.3. Scope of Work

#### 3.3.1. General

- a) The equipment specified herein shall be designed and built mainly for the above specified cargo.
- b) The equipment and materials covered by this specification are subject to the referenced attachments. The tenderer shall be responsible for and governed by all the requirements of this specification and General Conditions of Contract which shall be a part of this document.
- c) The Scope of Work is for the engineering, design, manufacture, delivery to site, erection, testing and commissioning upto handing over of the following equipment.

Sr.No	Item Description	Qty
1	Rubber tyred Mobile Hopper electrically driven and equipped with on board Diesel engine Power for full speed operation when shore power system fails.	4 Nos.

- d) The equipment described and specified herein is electric powered, rubber tyred type for handling dry bulk materials as specified. The interfaces with the overall bulk material handling facilities are described within this specification.
- e) The equipment shall be complete and shall include everything necessary to provide fully commissioned and operational machines that will perform as specified. Overall dimensions (boundary dimensions) and functional requirements as shown on the drawing(s) and/or specified shall be adhered to as far as possible unless in the opinion of the tenderer it is necessary to change the dimension(s) to meet the operational requirement.
- f) All works incidental to the above including additions, substitutions and modifications, if any.
- g) Consider the Tenderer as a potential party for annual maintenance contract to be entered at a later date.
- h) Tenders based on International sources shall have due consideration for maximizing components, which have service / support in India. Tenderers shall list out the availability of such facilities and the details of arrangement the Tenderer could arrange in the event of award.
- i) All necessary Accessories of mobile hopper feeder for break bulk cargo handling is in the scope of supplier.

#### 3.3.2. Work Included



Work shall include, but not be limited to the following:

- a) All technical information required by others, for the design and installation of civil, structural, mechanical and electrical work at the equipment interfaces, and in accordance with the Documentation Schedule.
- b) Management, coordination, planning of the work at all locations of the work including occupational health and safety, quality control, cost control, design, manufacture, delivery, inspection, erection, testing, commissioning and training.
- c) Supply, erection and delivery of all temporary structures, tools, rigging, erection, machinery, temporary power for erection, testing, adequate site lighting, temporary water supplies, transport logistics, etc.
- d) Supply of all engineer and labour for design, manufacture, delivery, erection, testing and commissioning of equipment, including transportation as required, housing, security, temporary sanitation and safety requirements, up to handing-over of equipment.
- e) All consumable materials including filters, lubricants, hydraulic fluids, electrical fuse, temporary loads; up to equipment handing-over.
- f) Cleanup at site of all debris and temporary structures on a daily basis and final cleanup at handing over.
- g) All electrical safety requirements during erection, testing and commissioning, including adequate earthing of erection equipment and machines.
- h) Proper safe storage of all equipment and materials delivered at site, in areas designated by the Engineer/Employer in line with customs regulations if applicable.
- i) Labour tools and materials for connection of equipment to permanent power and yard controls.
- j) Manuals for installation, operation, maintenance spares, along with drawings as required.
- k) Operation and Maintenance Training to Employer's personnel and O&M Contractor's Personal (appointed by Employer) shall be provided.
- l) Supply of spare parts as required upto Performance Guarantee Test and Taking-over and for two years operation after Taking-over.
- m) Civil works up to and including the equipment support and structures as required for anchoring the equipment during non-operating conditions.
- n) Trailing power and control cable support and trays.
- o) All HT / LT Power and control cables works.
- p) Foundations for anchoring devices, jack-up points and end buffers.
- q) Supply of water pipeline.
- r) Other than on-board Fire Fighting and Dust Suppression System.

**Note:** Design load details and typical arrangement drawings shall be furnished by this Contractor(s) to the Engineer/Employer within 30 days of award of the contract for all the interfaces.

### **3.3.3. Attached Drawings**

Berth Layout and cross-section drawings are attached here with to get the overall view of handling system.

### **3.3.4. Construction**



- a) An approx. 100 T capacity hopper shall be provided for receiving bulk cargo discharge from the grab of the unloading crane. The hopper shall mount on the rails and connected to the trolley of the unloading crane to synchronize the movement of the hopper with that of the crane.
- b) The hopper shall be fabricated with not less than 10 mm thick M.S plate, with adequate stiffeners welded on. The hopper shall be welded structure and shall be provided with necessary cleats for attachments to supports. Hoppers shall be designed with a valley angle of not less than 65° to the horizontal. The required flanged opening shall be provided for attaching shut-off gates. The design of the hopper shall be such that the problems of formation of arch are eliminated. All steelwork required for support and access for opening and maintenance shall be provided. This shall include platform, grating, ladders, hand railing etc.
- c) The grids of the hoppers shall have square opening with adequate designed flats and rods supported on the steel beams. The grids shall be arranged in removable sections.
- d) The entire unit shall be built with low center of gravity so that the unit travels effortlessly.
- e) Suitable local control panel shall be provided to control the various functions so that the Mobile Hopper/ belt feeder work smoothly in conjunction with the Mobile Cranes & berth conveyor.
- f) The hopper shall discharge other dry bulk cargo onto belt feeder below it. Suitable discharge chute at feeder end shall be provided so that it can feed smoothly the berth conveyor. Also for maintenance of belt feeder, suitable rod gate shall be provided at the bottom of the Hopper. Belt feeder shall be reversible type so that in case of need it can discharge to truck loading system i.e. hydraulic operated sector gate.
- g) Reversible Belt Feeder shall be designed as per Indian / international standard and calculations shall be submitted for engineer's approval.
- h) Reversible Belt feeder shall discharge on one end to Jetty conveyor and other discharge shall to truck feeding chute having hydraulically operated sector gate. The chute at truck discharge shall have adequate chute volume for truck changeover.
- i) Belt feeder shall have hydraulically operated Take-Up unit.
- j) Tie rod (free issue part) shall be provided between Crane and Hopper for the movement of hopper with crane during operation. Appropriate arrangements shall be made in movable hopper.
- k) Long Travel drive of movable hopper shall be selected so that 50% of travel drive can able to move the hopper. Travel speed shall be variable from 0-20 meter/min. Clutch mechanism shall be provided to disengage the Long Travel Drive during operation.
- l) 2 nos. Of replaceable type Grizzly shall be provided as below With 150mm X 150mm opening
- m) Vendor shall consider the Berth-8 and 9 Jetty Design load capacity while designing the equipment(s).

### **3.3.5. Dust Control**

- a) The dust control system shall be suitable for bulk material.

- b) Provision of space shall be kept for dust Extraction system.
- c) Hose along with reeling drum shall be provided at suitable location having minimum 60m of reach.
- d) Ship unloading is especially susceptible to the creation of dust as the systems are not totally enclosed. The hoppers are designed to suit the characteristics and flow properties. Typically, the dimensions at the top will be suitable for accommodating the grab in the fully open position while discharging. The hopper design will take into account the key function of providing a high-capacity dust free interface between ship and shore systems.
- e) Dust Extraction system at hopper top shall synchronize with grab operation to optimize operation.
- f) At Belt feeder discharge and hopper discharge dry fog type dust Extraction system is to be arranged.

### 3.3.6. Electrical Equipment:

The Mobile Hopper shall use the shore power for main power source. The downstream of the drive may be electrical drives or Hydraulic drives. The downstream drive mechanism shall have adequate control and design features to have smooth motion of all the Mobile Hopper mechanism. This shall include the acceleration and deceleration of drives smooth and without jerks.

The all field instruments shall be of IP 65 class and junction boxes of Stainless steel SS-304 and class IP 65.

### 3.3.7. Power Supply:

The Mobile Hopper shall be equipped with composite Cable Reeling Drum. Vendor shall make arrangement for the trailing cable from the CRD with guide arrangement properly as there is no under deck cable trench made available on the wharf. The guide shall be so designed to have +/- 100 mm track tolerance of crane travelling track to cable trench. The guide shall not offer any obstruction to the movement of the crane forward/backward and propping/un-propping operations.

The shore power shall be made available and terminated in the junction box mounted in the crane power. The trailing cable passed through cable guide arrangement and funnel to tension relieve drum to junction box. The trailing cable shall have power leads, earthing lead for earthing and FO.

Arrangement for Trailing Cable guide, CRD and JB's shall be made by contractor in such way that there is no obstruction for Vehicle movement on Wharf area. Contractor shall consider sufficient space and route for free movement of Cargo vehicles and Maintenance vehicles from back up to Wharf and Wharf to back up area.

## 3.4. Technical Data Sheet for Mobile Hopper

TECHNICAL SPECIFICATION OF MOBILE HOPPER		
1	QTY	100 T x 04 nos.
2	TYPE	RECTANGULAR CONICAL BOTTOM
3	MATERIAL	Bulk Cargo (Coal)
4	PLATE THK	10 MM THK + 6 thk sail hard Liner
5	BOTTOM OPENING	TO SUITE
6	GRIZZLY OPENING	150 X 150

ROD GATE		
1	SIZE	TO SUITE
2	LOCATION	BELOW HOPPER
3	MOC	MS Construction
R&P GATE		
1	SIZE	TO SUITE
2	LOCATION	BELOW ROD Gate
3	MOC	MS Construction
MOBILE ARRANGEMENT		
1	CASTED WHEELS	PROVIDED
2	DRIVE ARRANGEMENT	THROUGH ELECTRIC MOTOR WITH BRAKES

### 3.5. G. A. Drawing & Manuals

The supplier shall submit G.A drawing of the Crane, and grab along with the tender.

The supplier shall submit 02 soft copies and 06 Hard copies of the G.A drawing of the mobile hopper and Operation Maintenance manuals with its delivery.

## 4. Indicative Specifications for Conveying System and Equipment(S)

### 4.1. System Description:

Proposed system description is briefed here below.

- a) Mobile Harbour cranes will unload the bulk material into mobile hoppers placed on the berth. The conveyor BC-2A and BC-2B will receive the material from mobile hopper through belt feeder.
- b) The Capacity of the conveyor system from berth to stockyard end shall be 2000 TPH (designed). Bulk cargo unloaded from vessel shall be transferred to conveyor belt BC-2A and BC-2B on Jetty via mobile hopper feeder conveyor. BC-2A and BC-2B will transfer the bulk cargo to conveyor belt BC- 3A and BC-3B via TT1 located on the jetty.
- c) At transfer tower with diverting gates, sheeting, staircase and dust suppression system and other equipments as mentioned shall be provided which will discharge the cargo onto conveyor connecting chute of conveyor BC-2A and BC-2B & BC- 3A and BC-3B which will be pass through the culvert and feed the cargo on to BC 4A and BC 4B via TT2 then onto BC 5A and BC 5 B via TT3. The cargo will further travel on to BC 6A and BC 6B via TT 4.
- d) BC 6A will discharge the cargo on Tripper Conveyor TC 1 via TT 5. This yard conveyor will be provided with the tripper to stock the material onto the yard.
- e) BC 6B via TT 6 will discharge the material onto TC 2 onto the yard and the rest of the material will further be transferred onto TC 3 from TT 7 and then the tripper arrangement on the TP will stack the cargo on to the yard.
- f) As indicated in drawing, the conveyor arrangement and the transfer tower is shown in the attached drawing.
- g) Vendor shall provide the conveyor system with transfer towers, equipment(s), and accessories as mentioned in the indicative specification provided in this document and

complete in all respect.

#### **4.2. Duty**

All equipment(s) including belt conveyors shall be designed and built to operate under outdoor conditions at Design capacity furnished in this specification considering continuous duty of 24hr/day, ambient temperature up to 50° C and under climatic and ambient conditions at site.

#### **4.3. Material handling equipment and conveyor system indicative description:**

- a) Conveyors will be designed in accordance with IS 11592: 2000.
- b) Conveyors must be capable of starting under all operating conditions, including plugged chute condition.
- c) Belt drift times shall be considered for emergency stop scenarios.
- d) Belt Conveyors shall be complete in all respects and shall include but not limited to idler rolls with supports, pulleys, drive units with base frames, belting, head and tail frames, take-up units including winch (take-ups as applicable) including tensioning winches, skirt boards, scrapers, transfer chutes, stringer frames, short supports, deck plates, gates, etc. and all bolts including anchor bolts.
- e) All conveyors have been planned with normal speed as specified in annexure attached with this technical specification .
- f) Belt sag on the carrying side shall not exceed 1.5% of idler spacing. Maximum operating tension in the belt shall not exceed eighty (80) percent of maximum allowable working tension of the belt at the specified load. Sag value should be considered in the starting and stopping and braking condition also. Selection of counter weight should meet the sag value limit specified above and also meet the braking force required for coasting time calculation.
- g) The drive unit components of belt conveyor shall be designed so as to be able to start the conveyor with material load either at any zone of the belt conveyor or with material lying on the entire length of the belt conveyor. Minimum angle of wrap of belt on drive pulley shall preferably be kept 210 degree. However for the design purpose maximum wrap angle of 210 degree shall be considered. The diameter of drive pulley shall be sufficient enough to accommodate the above wrap angle maintaining normal carrying belt to return belt distance of the conveyor.
- h) Motor rating shall be selected with 10% of margin over absorbed power.
- i) The drive unit location shall be selected such that the maximum belt tension of the conveyor is limited to optimum/ minimum value unless such location is disadvantageous from layout point of view. Normally, the belt conveyor shall be of single pulley drive. However, where larger wrap angle is required and for long distance conveyors, multiple pulley drives shall be used. Arrangement of multiple pulley drive shall be such that only clean side of the belt is wrapped with the drive pulleys and the drive pulleys shall preferably be driven by separate motors coupled electrically for same rotational speed, starting and stopping characteristics. The drive unit shall be selected such that the starting tension of belt does not exceed 150% of allowable belt tension.
- j) The conveyor shall be designed such that similar components are interchangeable as far as

possible. Special emphasis shall be given for standardization of pulleys, idlers/ rollers, bearings for idlers/ rollers and pulleys, gearboxes, hold backs, couplings and brakes. Idlers/ rollers shall be identical for same belt width.

- k)** Conveyor frames shall be made of joists and/or channels suitably stiffened and braced. The spacing of supports shall suit to gallery profile. Generally spacing shall be kept ~3000 mm. Frames shall be connected to floor beams of junction house by bolting.
- l)** The drive base frame, preferably common for motor, gear box, brake and coupling guard, shall be made of welded steel rolled sections and plates. The top surface of the drive base frame shall be made from single piece plate properly machined, after fabrication of the complete frame, to facilitate proper sitting and alignment of the components. Base frame shall be stress relieved prior to machining operation. Packing plates/ strips shall be used as required for true alignment of the drive unit components.
- m)** Sizing of brake, counter weight and flywheel is very important and due considerations shall be given in the design of conveyor to avoid the slip, spillage of material and avoid operational problems.
- n)** All Chutes shall have flow model analysis and submitted for review. Liners are designed and arranged such that to allow free unrestricted flow across coal size spectrum and moisture of respective Dry bulk cargo. All chutes shall be inspected for defects by Employer, such as gaps between liners, liners are flat & uniform or not, no raised edges should be there etc. Nuts shall not be used for levelling; shims shall be used & grouted when finished.
- o)** All technological structures (all pulley frame, take-up tower & platforms, stand & short support etc.) shall be design with structural analysis (STAAD model) and submitted for review.
- p)** All conveyors brake & counter weight shall be design with coasting time calculations & selection shall be in line with the requirements. Concrete block shall be housed in Counter weight box only.
- q)** All Skirt design shall be Modular type and spill free assembly only.
- r)** For all conveyors starting & stopping curve with Brake & without Brake shall be submitted for review.
- s)** Mechanical design and mechanical components shall be rated for continuous heavy duty operation with due consideration to impact, possible overheads, environmental conditions, cycles of stress application and physical properties of the material (especially ductility, toughness, endurance limit and stress concentration due to geometric shape of components) and maintenance access.
- t)** All equipment must comply with the codes and standards applicable for the occupational health, industries safety and protection of the environment.
- u)** The equipment must be of proven design and not be prototypes.
- v)** The mechanical components must be specified for heavy duty service.
- w)** All mechanical equipment must be sized to satisfy the operating conditions without overloading and conserving the design safety factors.

- x)** All equipment must be shop assembled as much as practical. There should be minimum assembly on site.
- y)** The design must consider the frequent stoppages and starts of equipment.
- z)** All fabricated steel including supports, frames, and equipment bases and siding elements must be prepared and covered according to the project technical specifications before transporting.
- aa)** Machinery that produced vibration must be designed such that the construction system eliminated the transmission of undesirable movement and noise to the structural supports. Where required, shocks absorbers shall be provided that reduce the amplitude of vibration generated by these equipments.
- bb)** All equipment shall be provided, as minimum requirements, with seals to control dust around all moving parts. Where required, oil seals shall be supplied to retain lubrication and prevent the entrance of contaminants to the internal parts.
- cc)** Bearing rating must be according to the latest edition of the ANSI B 3.15 and B 3.16 specifications and the life (L10) shall be not less than 60,000 hours with the velocity and design loads. It shall be fitted using hydraulic nuts on taper sleeve arrangements.
- dd)** Field assembly must be maintained to the minimum required.
- ee)** Equipment access doors or openings in the sides of structures must be provided with a landing on the exterior of the opening for the full width with removable handrail sections & with ease of maintenance & cleaning in mind.
- ff)** All drive floors shall be RCC type.
- gg)** All chutes are properly designed with DEM and feeding of material in the receipt conveyor is such that there should not be any impact and also least acceleration of material.

#### **4.4. Belt**

##### **4.4.1. General**

- hh)** Belting shall be EP type suitable for heavy duty application having Oil resists, DIN 22102-1 standard. Bottom cover shall be E.O.B. The Belting shall be of molded edge construction. Belting shall conform to IS: 1891 (Part-I) / International Standard. All fabric belting shall be minimum 4 ply belt.
- ii)** Belt covers shall be made of synthetic rubber The rubber used for cover shall be of high quality which has a tensile strength of not less than 2.5 kg/mm<sup>2</sup> and an ultimate elongation of not less than 450%. All belting shall be pre-stretched. Belt construction shall be such that in case of edge damage, ingress of moisture does not occur.
- jj)** Belt shall not blister or separate in the plies or at the seams. It shall not stretch more than 2.5%. Belt construction shall be such that in case of edge damage, ply separation and ingress of moisture do not occur.
- kk)** Belt Joining Procedure approval from Employer is mandatory before starting belt jointing. Belt joint shall be properly vulcanized and finished. Belt shall have hot vulcanized joints

after erection. Vulcanizing shall be done on single setting. Vulcanizing chemicals, splicing tools and equipment shall form part of the belting supply. A length allowance for field joints and also for test samples shall be added to all belt lengths. Joint efficiency of fabric belt shall not be less than 90%. A Procedure shall be qualified for belt jointing for Pull off test.

ll) Ratio of maximum breaking strength to working tension shall be minimum 9 for EP belt. Belt rating shall satisfy the requirement of trough ability & load support.

mm) No longitudinal joint shall be permitted in belts.

nn) Top cover thickness shall be minimum 6 mm & bottom cover thickness shall be minimum 3 mm, however for steel cord belting the cover thicknesses shall be kept as required according to relevant Indian/International standard for selected steel cord diameter.

oo) The belt Supplier shall design the splice and recommend the minimum splice dynamic efficiency. Splice design shall be warrantable by the Supplier for 70% fatigue strength efficiency with respect to the belt's breaking strength for no less than 15,000 load cycles. Supplier is encouraged to provide belt reels that minimize field splices. Racetrack and double reel cassette type rolls can be quoted for the longer belts. All the belt splices shall be identifiable with Date, Splice No., Vulcanizer's initial.

#### **4.4.2. CONSTRUCTION REQUIREMENTS**

##### **4.4.2.1. Belt Dimensions**

- a) Belt Width: Supplier shall provide a full belt width as manufactured in one fabricating press. The slitting of fabricated belt to a lesser stock width or making of two belts in one belt press is not acceptable. The belt shall have molded edges. The manufactured belt width tolerance shall not exceed +25 mm/-0 mm within a roll
- b) Belt Thickness and Weight Belt thickness and weight will be dependent on selected ply sizes and top and bottom cover requirements. The Supplier is required to provide revised values for the estimates of these dimensions given in the Design Data Sheets. Thickness of belting shall be measured in accordance with IS:1891 / International standard.
- c) The whole belt shall be cured or vulcanized together in accordance with the best manufacturing practice. The belt edges shall be completely sealed against ingress of moisture by elastomeric compounds.
- d) The surface of finished belting shall be free from blisters, pitting or other major surface flaws and shall be completely sealed against ingress of moisture.

##### **5.5.1.1 Rubber Covers**

- a) Top cover minimum thickness is 6 mm (min) and bottom cover 3 mm (min). These thicknesses shall be reviewed by the Supplier in regards to warranted wear requirements. The belt cover thickness and physical properties shall be sufficient to meet the structural requirements and wear criteria set forth in this specification.
- b) Since the cover rubber wear is mainly due to abrasion damage from rock impact and sliding damage at the transfer-loading station, the Supplier is encouraged to provide the best compound that meets the tonnage warranty. A natural rubber shall be specified with

superior tear and abrasion resistance. Bottom rubber compound shall be Energy efficient and result into reduction the energy consumption.

- c) Supplier has to provide the RRF curve with tan delta at 10 Hz and 2% strain at every 5 deg temp interval.

#### 4.4.2.2. Rubber Properties

Belt covers shall have the following minimum properties at 20°C:

- a) Tensile Strength DIN 53504 25 N/mm<sup>2</sup>
- b) Hardness DIN 5350560 ±5 Shore A
- c) Tear resistance DIN 53507 15 N/mm
- d) Abrasion Resistance AS 1683-21 100 mm<sup>3</sup> (max)
- e) Elongation @ Break exceeds 450%
- f) Cover Separation Strength DIN 22131 15 N/mm (min.) (Cover to bonding rubber)

**Note:** Manufacturer may recommend alternative specifications to these stated values that result in verifiably superior performance for guaranteed life of top cover and low rolling resistance of bottom cover. Belt cover grade shall be approved for mine service with a minimum DIN-X rating. Mildew and ozone protection shall be included in the rubber compounding. Surface blemishes must be minimized. Excessive blemishes indicate poor quality and may compromise the belt life and necessitate added maintenance. Supplier shall provide a description of the build-up on idler shells from press release compound (silicon, etc.) and/or agents that will plate on roll surface during normal operation (i.e. waxes, oils, etc. al.) Plating of press release agents, waxes, plasticizers, etc. onto idler rolls shall not exceed 0.5 mm thick. Manufacturer shall be responsible for cleansing rolls where belt residue plating or build-up exceeds 0.5 mm. splicing of cover sheets, after curing, shall not be obvious to the eye. Manufacturer shall warranty for life of belt against de-lamination of cover sheets and of separation of joint seams. Manufacturer shall state, with bid, corrective action if flaws occur.

#### 4.4.3. Idler

- a) Idler & Idler Assembly includes idler roll with frame and support bracket for belt widths stipulated. The idler assembly shall comprise of;
  - Carrying Idlers Assembly:
  - Transition Idlers Assembly:
  - Impact Idlers Assembly:
  - SA Idler Assembly (carrying side) / True Track:
  - Return Idler Assembly:
  - SA Return Assembly / True Track:
  - Self-cleaning return disc assembly
  - Belt Scale Idler Assembly shall be balanced as per ISO 1940 G16.
- b) Shell thickness shall be kept minimum 4.85 mm for roll diameter up to 139.7 mm. The shell thickness shall be minimum 5.4 mm for roll diameters above 139.7 mm.



- c) The idler unit shall be extra heavy duty type and shall be suitable for continuous operation at high capacities. The Troughing idlers having rolls of equal length, the rolls as well as the roll components shall be interchangeable.
- d) Idler rolls shall not exceed the T.I.R value more than 0.6mm for carrying side roller & 0.8mm for return roller and weigh class idler it should be less than 0.3mm. Standard idlers must comply fully with the 0.6mm run out. The supplier shall test 100% of the supply to ensure this criterion is met or bettered. Employer's QA shall random test 25% of each size supplied; if any discrepancy are found to spec. the supplier shall correct this at his cost.
- e) Self-cleaning return idler - 1 number near discharge pulley having same specification of impact idlers.
- f) All idlers shall be fitted with either heavy-duty deep grooved ball bearings or seize resistant ball bearings taper roller bearing. The bearings shall be held positively on the spindle.
- g) Multi-labyrinth seals shall be used for retention of grease. All bearings shall be greased and sealed for life against ingress of dust, water and escape of grease.
- h) Idler bearings shall be either SKF or FAG make only.
- i) Flat return idlers only shall be used under the "V" scrapers and in high-tension areas.
- j) Other conveyors are with fixed idler in carrying and return. Belt tracking idlers are provided in all conveyors at following locations:
  - After loading point at carrying side
  - Before drive pulley at carrying side
  - Before take-up pulley at return side
  - Before tail pulley at return side
- k) All idlers shall be made out of ERW tube and shall conform to IS: 8598 . Mechanical properties of ERW tube shall be equal to or better than YSt 210 grade [IS: 9295]. Idler drag value shall not be more than 3.4 N/roll at 650 rpm, 20deg C as per DIN 22112. For standardization of idlers, all rollers shall be identical and interchangeable type for the same category. Idlers shall be easily removable type. Idler Spacing for carrying Idlers shall be 1.1m & for return idlers spacing shall be 3.3 m.
- l) Idler bearings shall be 'sealed and lubricated for life' provided with double labyrinth seal and rain cap to prevent entry of dust & moisture. Deep groove ball bearing (630 series) with nylon cage of SKF/FAG make only shall be used. The bearings shall be chosen for life L-10 of 60,000 hours minimum. Deflection for idler spindle shall be less than 5mm under full load condition.
- m) Sufficient number of adjustable type transition idlers with 10-degree steps, shall be provided adjacent to terminal pulleys. Minimum three trough (transition) idlers shall be used at the head end of each conveyor. Transition length shall be provided as recommended by the belt manufacturer.
- n) Suitable deflector roller of at least 250 mm OD on 90mm dia.[min] shaft at hub mounted on Plummer block and lagged with 6mm thk. Neoprene rubber lagging shall be provided for

each conveyor at discharge end.

- o)** At convex curve; spacing shall not exceed 50% of the normal idler spacing.
- p)** Minimum of six (6) set of impact idlers shall be provided at each loading point of the conveyor with maximum spacing of 400 mm.
- q)** The internal rolling friction co-efficient of the idler unit shall not exceed 20 to 30% of the composite friction factor 'C' which is taken as 0.022 for normal speed conveyors. Weight of revolving parts of the idler shall be kept to minimum.
- r)** The Tenderer shall submit the sample manual calculations for shaft/spindle, bearing diameter and idler frame on the basis of provided technical data and a computer printout of other idler on similar basis for Engineer's consideration.
- s)** All Idler Rolls shall be free in rotation.
- t)** Idler Frame shall be made from rolled sections. The plate thickness shall be minimum 10mm.
- u)** Idler Roll shall be tested for Run out, Friction, Dust proof (Cargo fine dust) & Water proof test as per Employer QAP approved by Engineer.

#### **4.4.3.1. Following idler test shall be carried out.**

- a)** Idler friction factor test
- b)** Dust (With cargo fine dust) and Water proof test. (Employer approved Closed chamber with sufficient pressure and fine dust)
- c)** Diametric run-out check
- d)** Bearing Noise Check and Physically verification by random idler destructive testing.
- e)** Any other tests as per relevant codes & standards. (DIN 22122)
- f)** Balancing wherever applicable
- g)** For weigh class idlers ISO: 1940 G16 to be followed.

#### **4.4.3.2. Carrying Idler Assembly [Garland type/35° troughed]**

- a)** Idlers shall be minimum 152.4 mm dia. three roll in line and interchangeable roll s garland type having freedom of movement in both vertical and horizontal directions.
- b)** Quick release suspension shall be provided to allow the idlers to be lowered away from belt contact for replacement idlers. Idlers shall be assembled with frames.

#### **4.4.3.3. Carrying Idler Assembly [Fixed idler, 3 rolls, Min. 152.4 mm dia. 35° troughed]**

All roller brackets shall be fabricated from steel plate sections of adequate strength. Brackets shall be mounted on inverted steel channel frame. Adequate arrangement for proper alignment of the brackets over supporting steel frame shall be provided. Fixing arrangement of roller with brackets shall be drop in slot type. Idlers shall be assembled with frames.

#### **4.4.3.4. Impact idlers: FIXED Impact Idlers (Retractable Modular type):**

- a)** Idlers shall have heavy duty bearings.
- b)** Idlers shall be removable without removal of skirt plate for ease of maintenance &

replacement.

- c) Impact type idlers shall be provided with number of tough rubber discs with minimum shore hardness of 55 to 60 deg on shore 'A' scale.
- d) Impact idler frame shall be inverted channel only. Rubber ring dia. shall be 190 mm O.D., ERW tube shall be 139.7 mm.
- e) Idlers shall be assembled with frames; idler frames shall be retractable type so that idler replacement / maintenance can be done without dismantling of skirt board system.

#### 4.4.3.5. Return idlers

- a) Garland Return idlers: It shall be V type, minimum 139.7 mm dia. two rolls, with minimum 15° incline to the horizontal with articulated joints with freedom of movement in both vertical and horizontal directions.
- b) Additional clit shall be provided for the mounting of return idler for the belt training purpose.
- c) Flat idler wherever required in the return side at Tail and take-up shall be provided as per the conveyor profile and design requirements to suit V-Plough.
- d) Fixed return idler: Standard fixed frame return idlers shall be V type mounted on fixed supports. For both types the rolls shall be identical. (minimum 139.7 mm dia, two rolls, 15 deg T.A)
- e) 8 Non-magnetic idlers made of aluminum tube lagged with 5mm neoprene rubber lagging shall be provided in conveyor portion where inline magnetic separator is magnetic zone. Rubber lagging hardness to be mentioned.

#### 4.4.4. Pulleys

- a) Pulley assembly shall be complete with pulley, Plummer block, adopter sleeve, bearings, keys etc. required for its completeness.
- b) Pulleys shall be engineered class suitable for use with NN/ EP / Steel Cord conveyor belt as applicable and designed for a fatigue life of 20 years. Pulley diameters including lagging shall be within the tolerance limit as per IS 8531:1986. Pulleys and shafts shall be designed in such a manner that they can safely withstand the maximum inclusive transient forces that are imposed during acceleration and braking. Maximum deflection shall be in accordance with the requirements of the shaft locking assembly.
- c) Pulley face width will be belt width plus 200mm. The tolerance of pulley along the face width shall be +3/-0 mm on the nominal width.
- d) All pulleys shall conform to the requirement of IS: 1891/ IS: 8531. Pulleys shall be of welded steel construction (MS: IS: 2062 Grade B Killed) having continuous rim and two end discs fitted with hubs and the internal stiffeners. The use of approved type of clamping hubs ((Imported Ring feeder type of Ring Feeder make 7015.0, Bikon / Dobikon type 1015.0)) allowing easy removal of shaft from the pulley assembly is required for all pulleys.
- e) Pulley assemblies are having turbo diaphragm i.e. end disc made from one piece of steel - steel castings. "T"- bottom full penetration weld onto shell shall be done.

- f) Welding on the pulley shell shall be tested radiographically or by ultrasonic method. Pulley shafts shall be ultrasonically tested.
- g) All fillet welds of pulley shell to diaphragm shall be of bevel fillets to ensure minimum joint efficiency. All butt joints shall be R.T/ultrasonic tested and fillet joint must be MPI and D.P tested
- h) Pulleys shall be duly stress relieved before machining. Hubs shall be of forged steel. Hubs and end discs shall be accurately machined for concentricity. All pulley shafts shall be EN-8 (subjected to fine grain control and Normalized, hardened and tempered minimum) or equivalent.
- i) All pulley shafts shall be designed in accordance with CEMA (latest Edition) considering minimum service factor of 1.5 for bending and 1.0 for torsion. Shaft deflection shall not exceed eight (8) mm for non-drive pulley and five (5) mm for drive pulley and five (5) mm where pulley is to be assembled through clamping hub. The deflection slope of pulley shaft at bearings shall be restricted to 1/2000 under rated load condition. All shafts shall be tested independently mechanically; Charpy values may be taken as 15 J at 0 deg C.
- j) All pulley shafts shall not have step down more than 10% and to have better stress concentration factor all step down shall have concave and convex radius machining for smooth profile.
- k) All pulleys shall be straight faced and pulley faces shall be lagged with hot vulcanized rubber lagging as follows:
- l) All drive pulleys/ discharge pulleys shall have 16 mm thick herring bone grooved lagging at 120°, 6 mm wide x 6 mm deep spaced at 30 mm centers around the circumference. The apex of the herringbone grooving should be in the direction of the belt travel. The rubber hardness shall be IRHD 60(55-65 shore A).
- m) All non-drive pulleys shall have plain lagging of minimum 12 mm thick. The rubber hardness shall be IRHD 45(40-50 Shore A).
- n) Pulley assemblies shall be statically balanced and run concentric when mounted on shaft. Balancing weight shall not exceed 0.5 percent. Out of roundness of any pulley shall be within  $\pm 0.5\%$  of diameter without lagging. All drive pulleys shall be dynamically balanced as per ISO 1940-1 and ISO 1940-2 G40.
- o) All pulleys shall be shop assembled with shaft, bearings, Plummer blocks etc. and shipped as complete assemblies.
- p) One longitudinal weld on pulley shell per pulley shall be permitted and the weld shall be R.T and ultrasonically tested.
- q) In case of turbo pulley circumferential weld shall be ultrasonically tested.
- r) The shafting shall be supported by heavy duty antifriction -double row self-aligning spherical roller bearings with adaptor sleeve (SKF / FAG make only) with double labyrinth with synthetic seals and grease nipples suitable for use in saline atmospheric condition. Bearings shall be housed in horizontally split type Plummer block (SKF / FAG only) equipped

with four fixing bolts and complete with side covers. Plummer blocks shall (Plummer blocks with minimum 04 nos. bolts) be of cast steel construction with suitable provision of greasing nipple. Minimum 2 nos. of adjustable screw and lock nut shall be provided on one side of Plummer block for alignment purpose. Vendor shall ascertain pulley diameter, shell thickness and shaft diameter and suitable calculations shall be submitted for approval during detailed engineering. Pulleys shall be standardized to the extent possible and the relevant details furnished. Life of bearing shall be 60000 hrs. Minimum.

- s) The shell of drive/head pulleys having overhead inline magnetic separator [if provided] shall be made out of non-magnetic material that is Stainless Steel SS-304 of minimum 12 mm thk.
- t) Pulley Bearing Centers for Drive & Non Drive pulley shall be identical. Bend/Tail/ Take-up pulley shall be kept identical in all respects.
- u) Necessary safety guard of exp. metal shall be provided for the pulleys. Pulley guard shall have adequate opening to allow greasing of pulley bearings.
- v) Pulleys to be standardized in dimensions as far as possible to keep the pulleys across the plant to one-six types for a specified width of the belt.
- w) Maximum permissible stress for shaft design :
  - Shear stress : 600 Kg/cm<sup>2</sup>
  - Bending stress : 840 Kg/cm<sup>2</sup>
  - Bending stress for plates : 948 Kg/cm<sup>2</sup>
  - For Key Way reduce above values by 25%
- x) All plummer block shall have four bolt mounting arrangement. All plummer blocks shall be supplied with base plates and locking screws, either SKF or FAG types are preferred. The base plates shall be minimum 20 mm thick with M16/M24 locking screws two number each side of each plummer block.
- y) Tenderer shall submit the sample manual calculation for Shaft diameter at hub, shaft diameter bearing, and Diaphragm & Shell thickness on the basis of provided technical data for Engineer's consideration and proof checking. Detail FEM analysis for each type of pulley with maximum load case shall be submitted.
- z) All assembly nut and bolts fasteners shall be hot dip galvanized with coating 60-80 micron and screw shall be min cadmium coating of 20 micron. Fasteners min grade should be mentioned
- aa) Torque testing shall be carried out for assembly tightening.
- bb) Pulleys shall be stress relieved in closed furnace.

#### **4.4.5. Skirt Plates**

- a) Skirt board of 8-10 mm thk. MS lined with 10 mm thk. SS 309. Length [at each loading point] shall be five (5) times of belt width, to accommodate the dust Extraction system in covered skirt boards. Minimum height of skirt plate shall be 800 mm. Inside Clear width between skirt boards shall be 2/3rd of belt width. Skirt shall be of modular design.

- b) Skirt board shall be covered from top and provided with necessary flanges for connecting to feed chute. 5mmthk MS cover plate along with 3mmthk neoprene rubber gasket, bolted to skirt flanges shall be provided for dust tightness. Rubber curtain shall be fixed at skirt board end for reducing dust nuisance.
- c) The skirt board shall be totally covered and shall be provided with heavy duty sealing arrangement for the gap between the skirt and the belt shall be closed or controlled. Rubber sealing shall be minimum 175 mm deep x 20 mm thk modular mono block type such that one person can replace and adjust mono block. The rubber sealing shall be held in position by steel clamps on the outside of the skirt box and have quick release fixtures for ease of maintenance. The rubber sealing shall be adjustable for minimum height of 100 mm. The skirt rubber sealing shall have 50-60 degree durometer hardness on shore 'A' scale. The fixed liner in skirt shall be 20 mm clear from belt.
- d) It shall have vertical rubber curtains at 1000 mm interval along the length to arrest fugitive dust.
- e) Continuous skirt boards shall be provided suitably for adjacent loading points and belt feeders. Conveyor structure shall be suitably strengthened in the loading point area.
- f) The lower edge of the Skirt boards shall have 25 mm clearance between the metal part of the skirt and the belt surface.
- g) Distance between steel clamps shall not exceed 300mm.
- h) Liner of skirt boards shall be fixed with button head Allen bolts in countersunk drilled liners.
- i) The skirt board shall be complete with its mounting bracket and fixing accessories in modular construction.
- j) All skirt boxes are required to be spillage free.

#### **4.4.6. Deck Plate**

Continuous deck plate- self-cleaning inverted V- deck type made out of minimum 2 mm thick MS sheet for full length of jetty, tripper and yard conveyors and road crossings. For other conveyors deck seal plate shall be provided at loading point only. Suitable ribs for adequate stiffness of deck plate shall be provided.

#### **4.4.7. Take-Up Device**

- a) Each belt conveyor shall be provided with a gravity/motorized winch take-up as per system design requirements.
- b) The take-up shall include the counterweight or winch assembly, sheaves, steel wire rope, attachments etc. to maintain the required belt tension under all operating conditions. Wire rope shall be from Employer approved vendor and breaking testing shall be witnessed. Standardization for wire rope sheaves & pin shall also be taken in to consideration. Sheaves shall be supported on Ball / Roller bearings.
- c) For Gravity/winch T.U device, Take-up travel shall be 2.5% minimum for EP belting.
- d) All Take-ups shall be design to accommodate the elastic & permanent stretch of the belt, allowance shall be made for sufficient movement for splicing.

- e) Suitable exp. metal guards and access platform & stair with handrails shall be provided for maintenance. To measure Counter wt. Travel, suitable scale shall be provided in addition to limit switches for T.U travel.
- f) The pulley slide frame shall be self-cleaning type. The pulley slide carriage shall be equipped with Vee type wheels [attached to shaft] running on guide rails. Suitable guide wheels shall also be provided to arrest uplift of carriage. Buffers/limit switches shall be provided at both ends of take-up travel.
- g) All areas shall be freely available for maintenance and should the counterweight be suspended adequate access must be installed for maintenance purposes to ensure a safe working area.
- h) Counter weight shall be arranged having units of identical mass and geometry systematically arranged in side counterweight box having top covered to avoid ingress of foreign particles which may add on undesirable weight. Total weight must be clearly marked on the box. In all cases space shall be provided in counter weight box for an addition of 25% of the design counter weight.
- i) All take-up towers shall have duly arranged with motorized winch system to lift the counter weight box.
- j) All guides shall on piece of steel, no raise joints shall be allowed.

#### 4.4.7.1. Vertical Gravity Take-up

- a) Counter weights shall be made out of C.I with standardized denominations. Weight of individual piece shall not exceed 30kg. In all cases space shall be provided in counter weight box for an addition of 25% of the design counter weight. Provision shall be made for dismantling the counter weight or relieving the tension in the belt. Height of the take-up guide steel sections frame shall be sufficient to allow the take-up main pulley at the time of belt jointing to get the required loop.
- b) Each gravity take-up unit shall have a 0.75 m deep sand pit provided under the counter weight. The area below the counter weight shall be guarded to a height of 1.8 m above any access level by suitable fence. Where it is not feasible to provide sand pit suitable impact beam shall be provided below the counter wt. box in addition to safety guard
- c) The design of the counter weight assembly shall have a self-cleaning top
- d) A lifting beam of capacity about twice the total weight of counter wt unit shall be provided, located on the center line of the take-up unit.
- e) All guides shall on piece of steel, no raise joints shall be allowed.

#### 4.4.8. Seal Plate

5mm thk. -Seal plate shall be provided where conveyor gallery crosses roads, buildings, and railway tracks extending an additional three (3) meters on both sides of crossing. 5mm thkx3m long seal plate for gallery shall also be provided at entry/exit of transfer tower also.

#### **4.4.9. Drive unit**

- a) The drive shall be complete with motor, gear reducer, L.S & H.S. coupling with guards, hold back device, brake [as applicable] etc. mounted on steel fabricated base frame. All components of drive unit shall be designed based on 50°C (maximum) ambient temperature and continuous duty of 24hrs operation per day with temperature rise less than 30° above ambient.
- b) Drive unit shall have common base frame of welded steel construction, designed with sufficient depth and stiffness to ensure rigidity of drive assembly. Base frame shall be fabricated to achieve accurate alignment of the various components of drive unit. All machinery mounting surfaces shall be machined after duly stress relieved. Base plates shall be suitable for erection on both concrete and structural steel base. Base plates shall be provided with lockable adjustment screws to facilitate alignment of heavy gear reducers and motors in the horizontal plane. All equipment shall be totally enclosed and completely sealed against dust & moisture. Necessary Electric hoist with monorails for lifting of drive unit components/drive pulley shall be provided. Equipment shall be designed to operate with a noise level not exceeding 80 db measured at a distance of 1 Meter in any direction and vibration level not exceeding satisfactory limits of ISO / International standards. Drive unit with its base frame shall be mounted on heavy concrete block. Only high tensile bolts (Grade 8.8/10.9 with 60-80 Micron Hot dip galvanized) shall be used for fixing drive component to base frame and base frame to the concrete block or steel surface.
- c) The type and horse power rating of drive units for all the equipment shall conform to the load and duty requirements.
- d) Drive train of the equipment should be analyzed for critical speeds, and any coincidence with operation speeds should be avoided. If necessary, anti-vibration blocks / isolators are to be installed.

#### **4.4.10. Reducers**

- a) Bevel-helical gearbox, natural/fan cooled and of reputed & approved make shall be provided for conveyor drive. Make of all bearings shall be SKF /FAG only. Water –cooled gearbox will not be accepted. Bevel Helical /Helical type gear box shall be decided by Engineer/Consultant during detail Engineering.
- b) Service life for gears (G1) and bearings (L10) shall be minimum 100,000 hours. Speed reducers shall meet or exceed the requirements of AGMA Standard 6010-E88, or its latest edition. The maximum noise emission at 1 m distance shall be below 85 dB (A) when measured by the methods of AGMA Standard 297, latest edition.
- c) Gearbox mechanical power rating shall not be less than 1.6 times of the motor name plate rating (KW). Thermal rating shall be adequate and if required only fan cooling shall be provided. All gear boxes shall be selected for continuous 24 hours operation and AGMA standards. Gear box shall be design to operate from creep speed to 100% speed; lubrication system should also be design accordingly. If required forced lubrication system shall be installed to meet the requirement of lubrication to operate the conveyor at slow speed, this shall be achieved via flow transducer by interlocking with conveyor. This is subject to purchaser's approval. Input kW rating/Thermal rating/Reduction ratio/selection calculation's



etc for gearboxes shall be submitted for approval by Engineer/Consultant. Splash type lubrication shall be provided for gear box. Thermal rating of gear box shall be more than motor KW.

- d) Gear Box Casing shall be of steel fabricated construction duly stress relieved. Casings shall be sufficient to ensure effective cooling. Suitable ribs shall be placed under the bearing seats for strength to withstand the most severe stress encountered during operation. Gear box shall have oil filling cap, adequate air breathing arrangement, visible oil indicator & oil drain plug, inspection openings, lifting lugs. All bearings shall be splash lubricated and gear box casing shall have adequate oil reservoir. The base of the housings shall be machined and shall be suitable for bolting to base plate. All speed reducers shall be equipped with temperature gauges and Resistant Temperature Detectors. Over temperature shall signal an alarm.
- e) Gear & pinions shall be manufactured out of high tensile carbon/alloy steel, duly hardened and ground to withstand operating conditions. Forged/Alloy Steel shafting to suit shall be provided. Shaft ends shall be properly sealed for protection from any ingress of dust. Antifriction ball/roller bearing of ample size shall be incorporated.
- f) Hold back device external to gear box built in with gear box shall be provided for all incline conveyors. Where ever the rating of hold back is very high for high inclined conveyor, external hold back mounted on pulley shaft shall be provided. Hold back service factor shall be min 1.5 based on max torques from driven equipment.
- g) Hold backs shall be fully enclosed roller or sprag type. The design of the hold back shall be such that its operation is not affected by dust, grease, moisture and extreme temperature conditions.
- h) Back stops shall be mounted on drive pulley shaft, opposite to drive end,
- i) The base of the housings shall be machined level and shall be suitable for bolting to a base plate.
- j) Bearings shall have labyrinth seals (Taconite type) to prevent oil leakage and ingress of contaminants into the bearings. All bearings shall be SKF/FAG make only.
- k) Recommendation of Lubrication oil.
- l) Back lash and contact pattern shall be recorded & witnessed by Employer or their representative.
- m) Vibration acceptance limit shall be in-line with satisfactory limits of ISO / International Standards during No-load testing, load testing & Pre commission / commissioning / Operation at Employer's place.
- n) Following construction features shall be taken care over and above all.
  - Conveyors shall be driven through totally enclosed fan cooled / fan with cooling coil reduction gearing having anti-friction bearings with oil seals at shaft projection. Necessary measures shall be provided to prevent ingress of dust and water.
  - Oil temperature shall not exceed 80°C.
  - The transmission efficiency of the gearing shall not be less than 0.98 per stage.

- All gearboxes shall have permanent magnet plugs.
- Fluid coupling / scoop coupling between motor and gear box and Geared coupling between gear box and drive pulley have been envisaged. Gear boxes and shaft projection beyond casing shall be suitable for the above purpose.
- Gear box housing shall be split horizontally at each shaft centre line & fastened and arranged so that the top half can be removed for inspection and repair without disturbing the bottom half. The joints of the casing and bearing hub covers shall be oil tight and dust proof.
- The gear boxes shall be provided with breather vents, oil level indicators, dip stick inspection covers, dowel holes. These items shall be suitably placed for better functioning and easy accessibility. Dowel pins shall be supplied with gear boxes.
- Radial clearance between the gear box inner surface and the outside diameter of the gears shall be at least 1.25 times the depth of the largest gear tooth inside the gear box or 20 mm whichever is higher. The facial or side clearance between the inner surface of the gear box and the face of the gear or pinion shall be at least 20 mm.
- All gear boxes shall have machined footing.
- Gear boxes shall be provided with heavy duty lugs (minimum two) for handling by the hoists.
- The design, manufacture & performance of the gear boxes shall comply with all currently applicable statutes, regulations & safety codes in the locality where the equipment will be installed. The gear boxes shall also conform to the latest applicable Indian or International Standards. Copies of International Standards intended to be used shall be furnished in English language along with the offer.

All relevant tests to be performed under various load conditions for gear box acceptance as per Employer's requirement.

#### **4.4.11. Couplings**

- a) All couplings shall provide for lateral, angular and longitudinal misalignment of shafts.
- b) Couplings requiring lubrication shall have protection against dirt and dust incorporated in the design.
- c) Hydraulic couplings shall be equipped with adjustable controlled torque transmission and remote/auto device. It shall be possible to start the drive on no load. It shall be possible to stop and re-start the driven machine keeping the motor running.
- d) Particular attention shall be given in selection of casing material of hydraulic coupling in view of chemical properties of different materials to be handled.
- e) All the couplings shall be of heavy duty, shock absorbing and shall satisfy the kW requirements of the particular drive.

#### **4.4.12. High Speed Couplings**

##### **4.4.12.1. Flexible Type**

- a) High speed couplings shall be flexible type. The coupling shall have a torque service factor of 2 with respect to the motor's nameplate.
- b) High speed couplings shall be selected of a natural frequency such that no resonance can occur at any operational speed.
- c) Non lubricated SAMI FLEX or WRAP FLEX couplings shall be preferred.

##### **4.4.12.2. Scoop Controlled Fluid Coupling:**

- a) For conveyors having above 160 Motor KW, Scoop Coupling shall be provided.
- b) Fluid couplings shall be suitable for providing controlled starting for conveyor driven by direct online squirrel cage induction motor. Starting torque applied to conveyor shall at no time exceed 140% of the torque corresponding to the full load belt kW. Actuator operated scoop type fluid coupling, shall be equipped with adjustable controlled torque transmission and remote/auto device. It shall be possible to start the drive on no load. It shall be possible to de clutch the driven machine keeping the motor running. Particular attention shall be given in selection of casing material of Fluid coupling in view of chemical properties of materials to be handled by the conveyor.
- c) Running slip vs torque characteristic Curve of fluid coupling shall be such that slip across the coupling is not more than 3%.KW. Rating of fluid coupling shall not be less than the connected motor kW rating.
- d) Coupling shall be dynamically balanced as per ISO1940.
- e) Housing shall be so designed that effective cooling can be ensured. Provision shall be kept so that oil quantity inside housing can be adjusted at site. Water-cooling is not acceptable.
- f) The equipment shall be suitable for full load, part load and no-load starting of the drive equipment without hampering safety of the motor and rate of acceleration.

##### **4.4.12.3. Slow Speed Couplings**

- a) Low speed coupling shall be mounted on conveyors drives between gear box output shaft & drive pulley. The selection of couplings shall be done keeping in view of application of the same. The couplings are to be supplied with finished bore and key way.
- b) The low speed coupling shall be maintenance free voith BR type (preferred) or a Geared Couplings or equivalent connecting the reducer shaft directly to the pulley.
- c) The coupling is thermally hydraulically applied and removed. The necessary tools and fittings are provided with the coupling from the manufacturer. The mechanical service rating is 2 times the motor nameplate torque.
- d) Coupling shall be able to absorb parallel and angular misalignment.
- e) Coupling shall have crowned external teeth, which engage, with the straight internal teeth of the sleeve. The pressure angle, the amount of crowning & backlash value shall be selected to achieve the best results in load carrying capacity.

- f) Lubrication arrangement shall be adequate to ensure silent operation and minimum wear of gear teeth. Coupling shall be dust proof and suitable sealing device shall be provided. Permissible parallel & angular misalignment shall be within 0.3-0.5mm & (+/-) 1.5degree respectively.
- g) Service factor shall not be less than 2.0 times of motor name plate.

#### **4.4.13. Brakes**

- a) Hydraulically operated Thruster brake or disc brake [mounted on brake drum coupling] shall be provided, based on the costing time requirement and braking torque required to stop the conveyor.
- b) Brakes shall be equally effective in both directions of shaft rotation and shall be progressive type.
- c) Brakes shall generally be mounted outside either on HS coupling or on high speed shaft of reducer. If required brakes can be mounted on tail pulley shaft based on the sag generated during braking of conveyor.
- d) Rating of brakes for conveyor drives shall be adequate to stop a fully loaded conveyor belt before the successive conveyor stops. While computing conveyor coasting time least practicable resistance shall be considered.
- e) Hydraulic Thruster operated brakes shall be spring set double shoe floating type. Barring any specific requirements all brakes shall be thruster type.
- f) The thermal capacity shall be adequate to limit the contact surface temperature within the permissible limit recommended by brake liner manufacturer for similar application.
- g) Suitable devices/Proximity switches shall be incorporated to ensure that motor does not start before the brake is released.
- h) Brakes for drive units other than conveyor drives shall be capable of exerting a restraining torque of minimum 150% full load motor torque.
- i) All pins to be of stainless steel because of corrosive properties of cargo in coastal regions.

#### **4.4.14. Bearings, Bearing Seals & Pillow Blocks**

- a) Wherever practicable, bearings shall be of the antifriction type, with a minimum life expectancy compatible with the class of the mechanism with which they are used, unless specified otherwise.
- b) Suppliers shall be SKF or FAG.
- c) On shafts supported by two bearings, one bearing shall be fixed type and the other floating type to allow for thermal expansion of the shaft
- d) All bearing housings and pillow blocks shall be fitted with labyrinth-type seals, suitable for operation in an atmosphere containing very fine and abrasive dust and saline water spray.
- e) All spherical roller bearings in pillow blocks shall have taper bores and adapter sleeves for locating on shafts.

- f) Pillow blocks shall be of cast steel construction. Base plates for pillow blocks shall be provided with lockable adjusting screws for accurate bearing alignment.
- g) Plain bearings shall have bronze bushings. The bearing pressure on plain bearings shall not exceed the manufacturers recommended ratings for the material used and the application conditions.
- h) The plain bearing shall have grease grooves and preferably a labyrinth type of seal to prevent entry of dust particles to the bearing.
- i) The conveyor drive units generally as shown on the drawings shall comprise driving motor, speed reducer, flexible coupling base frame along with anchor bolts and safety covers. Brakes and hold backs as required shall also be provided to meet the operational requirement.
- j) The mounting base shall be rigidly constructed and stress relieved before machining, adequately braced and provided with finish pad for mounting the motor with separate reducer unit.

#### **4.4.15. Belt Cleaner/Scraper**

To ensure proper cleaning of belt, belt cleaners shall be provided as stated below. Each belt cleaner shall be of tested and proven design suitable for belt conveyors handling bulk cargo. All belt cleaner/scrapers shall be modular design easy to replace for maintenance, supported in India and spare parts readily available in India. All the Belt cleaners shall have 95 to 100% efficiency.

##### **Primary & Secondary Scraper**

- a) The Cleaners shall be located beneath the overhang defined by the discharge pulley drum. It engages the curved surface of the conveyor belt passing around the drum directly on the face of the pulley.
- b) The scraper shall be positioned in such a way that all material from both the primary and secondary scrapers fall directly into the chute below.
- c) All scrapers shall have ample access to maintain from outside the chute without creating spillage.
- d) The cleaners shall consist of adjustable frames, rigidly mounted to the conveyor. It shall have two transverse support bars and a number of diagonally extending cleaning members between the bars. The uppermost support bar is located inwardly of the over-hang portion of the pulley and the lower support bar is located near the tangent of the belt and the pulley.
- e) A flexible cleaning member shall be used so that the elastic tension in the flexible cleaning member translates to a thrust on the conveyor belt surface.
- f) The primary scraper (Pre Cleaner) shall be provided for removing the heavy residue of materials adhering to the belt surface on the return side of belt.
- g) The blades of primary scraper shall be made of abrasion resistant polyurethane material, inclined against the direction of belt travel, ensuring maximum cleaning with minimum wear and tear of belt surface.

- h) The primary scraper shall be self-adjusting, compatible with reversible belt, easy to install and minimum maintenance.
- i) The secondary scraper (Main Scraper) shall be provided with automatic adjustment function (Elastomount) which helps in maintaining permanent contact with the belt.
- j) The cleaning member of secondary scraper shall comprise of a series of scraper elements of tungsten carbide, threaded onto stainless steel flexible base. The scraper elements are separated by stainless steel spacer springs so that the scraper elements are kept perpendicular to the belt surface but allow the elements to deflect to permit obstructions, such as mechanical fasteners, to pass without snagging and damaging the belt or the scraper assembly.

The belt cleaners shall be designed considering the following:

- Operate on the face of the discharge pulley.
- Compatible with reversible belt.
- Withstand temperature as specified.
- Withstand corrosion.
- Resilient to obstructions and safe for the belt.
- Large number of small, thin blades.
- Ensure contact of the blades at all points across the dirty section of the belt.
- Simple to maintain and maintenance free for a minimum period of 6 (six) months. Shall be easily maintainable from outside without any interference with the chute arrangement and assembly.
- The modular units shall be easily replaceable.
- Efficient at variable belt speeds and at any moisture content.
- The wear and tear of the top belt cover shall be minimum so that belt life is enhanced.
- Abrasion resistant
- Self-adjusting.
- Easy to install.
- No carry-over from secondary scraper.

#### 4.4.15.1. V-Plough (Internal Scraper)

The V-Plough (internal) Scrapers shall be fitted in front of tail pulley and take-up pulley to prevent the material which is falling on the top surface of return belt. This scraper should be V-type with 60° included angle and vertex should point to the head-end of the conveyor. It should ride on and be supported by the conveyor belt.

V-Plough (internal for cleaning the interior surface of the belt shall consist of following:

- Elastomount arrangement fitted with an automatic locking device to prevent the rigid cleaner parts from coming into contact with the belt and damaging it after the cleaner blade is worn away.
- Self-adjusting torsion arms to maintain cleaning pressure.
- Suspension arrangement to keep the plough parallel to the belt.
- Easily replaceable cleaning blade – Polyurethane.
- Provision of chain to maintain constant pressure and contact with the belt.
- Provision should be made so that the metallic parts do not touch the belt in case of belt worn out.
- Arrangement of scrapper should be such that, after wearing out of plough supporting steel section should not touch/damage the belt.
- Additional safety chains to be fitted to support the scraper in the event of the scraper fixtures failing.

#### **4.4.16. Chute**

- a) All chutes shall be properly designed with Flow model analysis (flow dynamics). Due care shall be taken while designing the chute, to avoid the impact of material on the receipt belt and also least acceleration of material at receipt point.
- b) All Chutes shall be welded steel construction. The material of construction shall be as per Data Sheet below. Curved deflector plate/curved chute piece (spoon type) at chute bottom shall be provided for each discharge chute and it should be fully adjustable.
- c) Liners shall enhance the flow and prevent blockages taking into consideration of cargo type and fines. The Liners/ceramics shall be maintainable and follow the curve of chute. Liners shall be provided at all the sides of chute.
- d) Each chute shall have adequate cross sectional area with minimum sloping angle of 60° degrees or more to ensure smooth flow of material. Belt loading chute shall be designed so as to ensure centralized loading of material on the receiving belt to prevent off centre loading/excessive swaying of belt.
- e) Each chute shall be made in a suitable number of units complete with matching flanges. These units shall be suitably bolt jointed. Minimum bolt size shall be 16mm or spacing shall be less than or equal to 125mm C-C. Each joint shall be made dust leak proof by providing rubber gaskets. Dust tight-hinged inspection doors/bolted removable covers/manhole covers at strategic locations shall be provided to facilitate inspection and to clear jammed cargo in the chute.
- f) Chute plug switch shall be provided at proper location.
- g) Chute brackets shall be welded to the main plate and suitably anchored to the floors/platforms.

Technical Data	Description
Location	As per flow diagram and Scope Work

Material of Hood above C.L. drive/ head pulley/	5 mm thk, MS (IS: 2062 Grade B Killed)
Material of parent plate	Min.10 mm thk, MS (IS: 2062 Grade B , Killed)
Liner for Chute	Min 5mm thk sail hard Liner to be bolted with counter sunk bolt.

- h) In chute layout- inspection door, poking holes etc. shall be provided suitably, inspection doors especially at head area & discharge area shall be provided, doors should be of robust hinges & lined if required. The discharge chute shall enclose the snub pulley preferably. Otherwise separate dribble chute shall be provided (5mm thk, MS, IS: 2062 grade B killed) below snub pulley so as to direct the scrapped material into the main chute.
- i) Where inline magnetic separator is provided, chute made out of nonmagnetic material (parent plate) of minimum 8mm thk SS-304 steel for a distance of 1.5m [minimum] from magnet face shall be provided.
- j) Adjustable baffle plates shall be provide at the discharge of every transfer point.
- k) The weight of any one plate of liner shall not exceed 20 kg. The liners shall be fixed to the chute by countersunk hot dip galvanized/ Cadmium coating screw. Maximum size of the liner shall be mentioned and it should be such that if it falls off it shall pass through system without jamming.
- l) Drip pan and collection chutes to be provided wherever necessary for collecting dirty water at every floor of each building for discharging the dirty water either to drainage system or to sump pit. Drip pans and collection chutes to be made of structural steel. Collection pipe shall be extended up to the ground level.
- m) Suitable openings shall be provided for connecting dust Extraction system where necessary.
- n) The discharge chute of a conveyor to extend backward to contain both belt scrapers and snub pulley if used, to collect the dribble released by the snub pulley, return belt if any.

If found necessary, the conveyor elevations shall be suitably modified.

#### 4.4.17. Hoist

**General:** Each Hoist shall be sturdy, compact unit complete with all the needed accessories and shall conform to duty Class-II as per relevant Indian Standards. Each Hoist shall be tested as per relevant Indian Standards. Hoist for Suspended Magnet shall be complete with festooning arrangement and shall be certified.

Monorail Hoists/Cranes shall be provided in towers, transfer towers, drive houses, and other areas, as required, where equipment parts heavier than 200 Kg are to be handled for maintenance. Units shall be certified & tested to designed weight, beams to be marked with S.W.L. prior to handover.

The lifting hook of the cranes/hoists shall as far as possible be able to reach vertically above the components to be handled. The cranes/hoists shall be able to lift/lower the components from/to the ground up to/from the required floor.



As far as possible the lifting tackles shall be standardized.

Hooks shall be forged with ultrasonic and DP tested and hook shall be proof load tested, after proof load testing respective hook shall be UT, MPI and DP testing. All beams to be load tested and certified beams to be clearly marked with SWL.

Electric hoist along with its monorail shall be provided as stated below:

- If unit load is equal to or more than 3T, provide electric hoist.
- If lift for unit load is equal to or more than 10m, provide electric hoist.
- If unit load is less than 3T & lift is less than 10m, provide manual hoist.

#### 4.4.17.1. Electric Operated Hoists:

Type	: Electrically operated Hoist & Trolley with Pendant switch, pendant to be of DEMAG plastic type, control cables to have moulded catenary wires in sheath.
Class/ Duty	: Class 2, Indoor, IS: 3938
Mono rail size/Travel length	: To suit
Hoist Speed	: 3.15 M/Min (min)
Carriage travel speed	: 10 M/Min (min)
Brake type	: To suit duty and of adequate rating
Brake for Hoist & Trolley	: To be provided
Bearing	: Ball/ Roller of reputed make viz. SKF/FAG/NTN Subject TO vendor evaluation.
Lubrication	: Oil/Grease
Motor	: Suitable for hoist duty, 415V+/- 10%, 50Hz+/- 5%, 3 phase AC supply
Type of power feeding arrangement	: Festoon cabling.
Type of limit switch	: Over lowering and over hoisting and for over travel at end position
Control Station	: Weather and dust proof with specified Degree of protection in electrical specification, DEMAG type
Pendent Cable	: Pendent cable with moulded catenary wires for support.
Necessary Electrical Protective devices provided:	Yes, to be provided
Tests	: All tests as per relevant codes and Standard, manufacturer's standard shall be

Conducted Over load test (125% min of SWL) as per IS:832 shall be conducted.

**Material of Construction:**

Drum	: M.S. as per IS: 3938
Sheave	: Cast Steel as per IS: 3938
Load Hook	: As per IS: 3815
Wire rope	: Construction 6x37 as per IS: 3938 with Hemp core regular lay with min. Strength of 160-175 kgf/sq.mm
Gear	: Forged / Cast steel

## 4.5. Safety Requirements

### 4.5.1. Stairs, Cross-Overs And Walkways

Inclined walkways shall utilize grating 100x40 with high grip bars to prevent slips and falls. Walkways friction shall not change significantly within any direction of travel. Access shall be provided to both sides of the conveyor. Width of walkways shall be considered minimum 800 mm minimum having toe guard, hand railing etc. along with safety and protection sign shall be provided at appropriate place. Consideration to be taken into account for maintenance access and physical working in and around the equipment is a must. Cross over shall be provided as per IS:11592.

#### 4.5.1.1. MINIMUM CLEARANCE

The following minimum clearance shall be generally applicable. Any reduction in clearance requires prior approval.

**Vertical Clearance**

Drives	:	3000 mm
Walkways, platforms	:	2500 mm
Vehicle	:	7000 mm

**Horizontal Clearance**

Drive end of equipment	:	1500 mm
Non-Drive end of equipment	:	1000 mm
Central Walkways, Platforms	:	1000 mm
Vehicle	:	4000 mm

#### 4.5.1.2. Machinery Guards

Rotating & moving machinery hazards shall be prevented with bolt-on guards. Guards shall be painted as per standard painting specification. Bright orange and be user friendly as in weight and

handling e.g. one man operation. They must not hamper visual inspection of equipment being guarded.

Guards shall be applied to:

- Take-up Counterweight,
- Take-up carriage, surrounding all motion,
- Pulley nip point, where operator access permits,
- High speed and low speed drive/brake shaft access areas,
- Non-driven pulley access
- Couplings

**Note:** Cut outs are provided in the guards where required for access and mounting of proximity sensors and belt slips switches.

Walkways and platforms shall be protected from spillage from overhead conveyor spills.

#### 4.5.1.3. Signs

Warning and protection signs shall be placed on guards, fences and hazardous areas, such as counterweights, nip areas and stored energy.

#### 4.5.1.4. Name Plate / Tag

Each item of equipment shall have a stainless steel name plate tag, 1 mm thick, affixed in a conspicuous location showing name and address of manufacture, model, serial number, date of manufacture, weight if over 50 kg and other significant facts for operator safety and that the manufacturer considers necessary. The tag specification callouts shall be a minimum of 12 points pica capital size embosses or larger for clarity with painted letters.

### 4.6. Travelling Tripper

#### 4.6.1. Scope of Work

The scope of work of the tenderer shall consist of design, engineering, manufacture, painting, inspection, packing, loading, transportation, erecting, testing, commissioning and handover of 3 (three) number of Travelling Tripper as per indicative technical features mentioned in subsequent pages.

The travelling tripper shall be complete with

- a) Moving tripper assembly
- b) Structural frame.
- c) Buffers having adequate size to absorb kinetic energy of moving tripper. Maximum force exerted on end buffer shall be limited to design of stationary end buffer & structure, without damage to the structure.
- d) Idler & idler frames, (shall be same as tripper conveyor (TC) conveyor)
- e) Discharge & bend pulleys with rubber lagging, (shall be same as tripper conveyor (TC) conveyor)

- f) Plummer block, (Make : SKF or FAG or MASTA )
- g) Two Hydraulically operated flap gate for two way discharge chutes,
- h) LT drive system complete with brake, VFD drive, variable speed motor, bevel helical gear box /geared motor.,
- i) Crossover platform, maintenance platform & walk ways on inclined tripper structure.
- j) Power & control supply system through cable reeling drum or through sliding arrangement
- k) Limit switches, control switches, tripper position indicating switch etc. Junction box shall be fabricated from stainless steel 304 having IP65 rating, only magnet switches shall be used.
- l) Rail, rail supporting structures for travelling tripper and end stopper.

Electrical panel housing, main power disconnecting switch with fuses, main line contactor, control transformer with cut outs on primary & secondary sides, individual mechanism motor control units and set of power & control terminals, to IP55 minimum.

Suitable system for monitoring position of tripper shall be provided. In addition, travel end limit switches and end stops shall also be provided. Tripper shall slow down before it reaches to operational end limit, three switches in total, op slowdown, op stop and e/stop over travel.

Item-wise rate of supply of spares required for 2 years trouble free operation shall be submitted separately.

Necessary tools and tackles required for maintenance. The list of such tools shall be furnished along with the quotation.

Erection instructions / manual, Spare parts manuals, all other drawings & documents as required by the purchaser / his consultant. Drawing shall include BOM fully documented and linked to all GA drawings.

Items to be fully described, manufacture's part no., no in-house and or vague description.

The scope of work shall stand supplement by such details as are given in specification or purchase order or contract or general specifications.

**Note: The tripper design should be designed by the vendor by considering additional provision of booms/ shuttle conveyors for proper distribution/stacking of Bulk Material in each plot for better utilization of stack yard, which will be incorporated in Phase-II of the development by DPA.**

#### **4.6.2. Technical Specification (Indicative)**

##### **4.6.2.1. Mechanical**

The tripper shall be designed as per IS: 14386-1996. Pulleys, idlers, belt cleaner , gear box, motor, wheel and axles, brake, guards, hood and chute , hand rails, platform etc shall be as per specification for "Belt conveyor System" unless otherwise specified in this specification.

Travel drive of trippers shall have individual wheel drive, independent of the main conveyor drive and shall be through electric motor, bevel / helical gear box or bevel helical geared motor having integral AC brake per driving wheel. Chain drive shall not be used. Tripper shall be provided with A.C. integral brake for stopping the same at desired location. Travel speed of trippers shall not exceed 20 m/min.

The traveling tripper shall consist of one primary and one secondary belt scrapper with adjustable wear strip, rubber lagged discharge and bend pulleys complete with shaft bearings, chutes, stops and limit

switches, brakes etc.

The tripper shall have two-way discharge chute which shall be capable of discharging the incoming material to either side of belt conveyor all along tripper travel or bypass to head pulley of conveyor. The two-way discharge chute will be provided with two motorized flap gate for diverting the material into the dedicated path.

Traveling trippers shall be of adequate length with proper slope of conveyor idlers to match with the flow properties of material being handled. The maximum inclination of the conveyor belt on the tripper shall not be more than 140.

Tru-track type idlers shall be provided to control sway and holding down pulley to control uplift of the belt in unloaded condition.

Wheels shall be single flanged with taper parallel tread running on anti-friction bearings and shall have minimum hardness of 350 BHN. Material of wheel shall be forged steel / cast steel. Rail size shall be given by tripper supplier.

Traveling trippers shall be equipped with manually operated rail clamps, rail cleaners and jacking pads. Jacking points to be clearly marked on both the drawings and structure.

Power supply to the tripper shall be given through motorized Cable Reeling Drum (CRD) or through sliding arrangement with trailing cables, cable trays for resting the trailing cables and end limit switches for protection against over travel of the tripper. CRD shall be mono spiral the cable reeling drum and trailing cable of each tripper shall be suitable for the entire length of Godown including maintenance space. The cables shall have copper conductors, proper insulating material and braided armouring in accordance with IS: 691.

Position indicators shall be provided as per requirement of control logic so that the tripper can be stopped at discrete location through limit switches (preferably magnetic switches) and starting upon manual, local or remote signal. Operating push buttons for local control and emergency stop shall be within easy reach of the operator on the main conveyor walkway.

The rating of tripper travel motor shall be adequate to move the tripper smoothly either in forward or opposite direction to belt direction under fully loaded conditions. Coefficient of friction for rail adhesion shall be taken as maximum 0.12.

Minimum two drive axles (4 driven wheels) shall be provided for tripper travel. In case of failure of one drive, the tripper shall be in position to travel. Provision shall be made without affecting operation the removal of one drive per side.

Arrangement shall be provided at the starting point of the tripper to avoid folding of belt.

In case of tripper running at a speed more than its rated speed due to chutes jamming or other reason, conveyor shall trip and annunciation shall appear.

The supporting structures for the rails with necessary end stops shall be supplied by purchaser.

Suitable belt hold down guide pulley shall be provided over the concave curve of belt over tripper.

Suitable dust cover shall be provided over tripper discharge pulley. Serrated rubber seal shall be provided at open side to prevent dust nuisance. Suitable dust tight access doors shall be provided. One primary and one secondary external belt cleaner shall be provided at tripper discharge pulley to clean carrying side of the belt.

The tripper shall run on rails of ISMB 200. Rails for tripper shall be mounted on supporting structure of respective conveyors and will be provided by vendor.

Suitable system for monitoring position of tripper shall be provided (on non-drive wheel). In addition, travel end limit switches and end stops shall also be provided.

Suitable access platform of hot dip galvanized grating 50x50 with ladders, hand railings and walkways on both sides shall be provided for access / maintenance of equipment on tripper. Also crossover platform shall be provided with tripper so that operator can cross the belt through the same. Needed guide rollers, bearings, brackets, safety guards etc. shall be provided by the tenderer.

Suitable rail cleaners shall be provided on leading and trailing edge of tripper for either track. These should be applied to rail by self-weight. Minimum 4nos rail cleaners are required to run on rails.

The traveling tripper shall consist of spring bladed belt scrapper with adjustable wear strip, rubber lagged head and bend pulleys complete with shaft bearings, flap gate (if any), chutes, stops and limit switches, brakes etc. The tripper shall have three-way discharge chute which shall be capable of discharging materials into either side of conveyor or bypass to head pulley of conveyor.

#### 4.6.2.2. Two Way Discharge Chute

Two way discharge chute assembly for tripper shall be provided with flap gates. The chute wall shall be of minimum of 10 mm thickness and shall be lined with minimum, 10mm thick SS-304 / 25mm thick UHMWPE. Chute shall be design and guaranteed for spillage free and blockage free operation for the bulk cargo.

#### 4.6.2.3. Hydraulically operated flap gates

Hydraulically operated flap gate shall be complete with hydraulic cylinders, power pack, pipe and pipe fittings, solenoid operate valves, operating console or self-contained hydraulic actuator etc. The gates shall be of robust construction and suitable for trouble free operation. The flap gate shall be used to divert the flow of material received from feeding conveyor. A hydraulic cylinder shall operate the gates. The actuators / cylinders shall be mounted on the chute body / or on a working / maintenance platform.

The gate shall be fabricated out of 10-mm thick MS plates and shall be lined with minimum, 10mm thick SS-304 / 25mm thick UHMWPE (material handled bulk cargo). The gate shall be capable of changing the direction of material on remote mode of control even when the material is being discharged from the feeding conveyor pulley. Preferably the gates and its hydraulic actuator or cylinder shall be mounted on the operating floor and shall be fully accessible.

The equipment shall be capable of being operated for at least 15 switching/hour at rated load and thrust and shall be suitable for 10 numbers consecutive switching at rated load and thrust. The equipment shall be shop tested to prove the requirement. Hydraulic actuator / cylinders shall be so selected as to provide sufficient thrust (minimum 2500 kg) for operation of the gates against the moving weight of material and/or flap gate. The flap gate travel shall be in the range of 60°. Proximity switches having not less than IP65 protection shall be provided to indicate extreme positions. Lever arm shall be provided between actuator / cylinders and the gate shaft for obtaining required thrust. Each gate shall be provided with a shaft, a hand lever and self-aligning type anti-friction bearings with adequate sealing for dust proofing.

The actuators / cylinders shall be capable of preventing any over travel. Suitable travel dependent proximity switches controlling the travel of the gate on either direction shall be provided. These shall

be placed internal to the cylinders and shall be completely dust-proof. The proximity switches shall be capable of adjustments to vary to total length of travel of the gates.

Suitable stiffening arrangement shall be provided between the two faces of the gate plate. At the end of the travel the total length of edge of the gate shall rest on a suitable projected surface from chute to prevent leakage of material through the available clearance between chute and flap gate. Suitable self-aligned double row ball bearings of approved make in dust tight housing shall carry the gate shaft. Suitable provision for re-greasing shall be provided.

For standardization purposes, only one standard type of hydraulic actuator hydraulic cylinders (Min. 2500 kg thrust load) of flap gates shall be provided. Flap gate hydraulic actuator / cylinders as a whole and individual component wise shall be completely interchangeable (in case more than one gate is considered).

The material of shaft shall be EN-8 or equivalent material. The diameter of the shaft shall be suitable for motor stalled conditions and associated twisting.

#### 4.6.2.4. Idlers / Idlers Support:

Idler and idler supports shall be in line with specification followed for belt conveyor system and shall same as belt conveyor tripper conveyor.

#### 4.6.2.5. Pulleys

Pulleys shall be in line with the specification for belt conveyor system and shall same as Head pulley of conveyor tripper conveyor.

#### 4.6.2.6. Gear Box

Traveling tripper shall be driven through bevel helical geared motor with integral brake.

#### 4.6.2.7. Coupling

Motor shaft shall be connected to the gearbox-input shaft through flexible shock absorbing coupling. Use of pin bush type coupling is not acceptable.

The couplings shall be made of cast or wrought steel and are to be designed to suit the maximum torque required to be transmitted or to suit the total braking torque of the mechanism whichever is higher. 3.15-mm thick sheet steel hinged covers for safety shall suitably cover rotating parts. Coupling shall be WRAPFLEX or SAMIFLEX only should the geared motor not be feasible.

#### 4.6.2.8. Safety Features

Detachable safety guards shall be provided for pulleys, couplings, drive etc.

#### 4.6.2.9. Lubrication

Manual lubrication of the bearings in different location.

#### 4.6.2.10. Structural

##### **Tripper Frame**

A structural assembly of rolled steel section of St-42 Fe-410 WA quality conforming to IS: 2062. FEA analysis for complete tripper structure shall be furnished for EMPLOYER'S review.

##### **Ladder & Platform Assembly:**

Platform and approach ladder shall be provided on to the belt tripper to facilitate approach for operation and maintenance purpose and shall be consisting of a structural assembly of rolled steel sections and tubular. Checkered plate shall be provided to the maintenance platform.

### **Stability**

The belt tripper shall be stable both during operation & movement. Successful bidders shall submit the stability calculations for purchaser's approval.

#### **4.6.2.11. Electricals**

The standard supply voltage 415V  $\pm 10\%$ , 50Hz  $\pm 5\%$ , 3 Phase 4 wire solid earthing shall be adopted for travelling tripper.

Power supply to the tripper shall be given through cable reeling drum arrangement and necessary electrics for traveling trippers such trailing cables, cable trays for resting the trailing cables and end limit switches proximity type 25 mm sensing gap for protection against over travel of the tripper. CRD shall be mono spiral. The trailing cable of each tripper shall be suitable for the entire length of travel.

The cable reeling drum will be complete with stalled torque motor, suitable slip ring and brush assembly, cable guides for proper paying in / paying off cables, protection against over-tension, under tension of cable of cable, limit switches, end limit switch for CRD, etc.

Slip-ring and brush-gear assembly of cable reeling drums will have dust and wear proof enclosure having inspection window suitably located.

The cable reels shall be actuated automatically as soon as the travel drive is active.

Position indicators shall be provided as per requirement of control logic by the purchaser. However the tripping lever to be located in the tripper car shall be provided by the supplier and its location to be finalized during commissioning. Operating push buttons for local control and emergency stop shall be within easy reach of the operator on the main conveyor walk way or on the travelling tripper is preferable.

The rating of tripper travel motor shall be adequate to move the tripper smoothly either in forward or opposite direction to belt direction under fully loaded conditions.

Minimum two drive axles (4 drive wheel) shall be provided tripper travel.

### **Standards**

The equipment shall be selected as per the guide lines provided in the latest edition of the relevant Indian Standards. The equipment shall also conform to the latest Indian Electricity Rules & Regulations as regards to safety requirements, earthing and other essential provisions specified therein.

### **Power supply collection & distribution**

Incoming power supply from purchaser's power outlet shall be made available in shop.

### **Limit switches**

Travel motion shall be provided with magnetic switches to limit the position. Travel control shall be operational slow down, operational stop and emergency over travel at each end.

### **Motors**

Motor shall conform to separate specification for motor all motors shall be totally enclosed fan cooled



enclosure IP-54 squirrel cage induction type. It shall be ensured that these are special

motors suitable for 150 starts/hr crane duty with pull out torque of not less than 275% of the rated torque.

The cycle duty factor for each motor shall not be less than 40%. The motor selected shall be for frequent reversal, braking & acceleration. Motors shall have class "F" insulation with max. Utilization to within class "B" admissible temperature rise corresponding to ambient air temperature.

Each motor shall have a robust terminal box accurately fixed to the frame. Each Terminal box shall have ample room for termination of the aluminium conductor cables.

### **Brakes**

Brake shall be integral to geared motors. Brakes shall be connected so as to apply automatically when power supply fails or when the push button is released or with adjustable delayed time lag preceded by electrical braking when the push button is released.

### **Wiring**

All cables shall be installed with adequate protection against mechanical damage & damage from weather. Alternatively, multi-core armored power & control cables, suitably clamped, may be used. Suitable clamping lamps should be provided at both ends of each multi-core cable.

All power & control cables shall be tagged at both ends (as per approved drawings) for quick identification. The cables & wiring system for each motion shall be independent & common runs shall be avoided. Power cables & control cables shall be effectively separated & all connections shall be terminated to terminal box suitable for outside connections.

Cable runs shall be avoided, at locations where high temperature & mechanical damage are likely to be experienced under service conditions.

### **Cables**

The cables for power connection up to electrical panel shall comprise multi-strand PVC insulated & sheathed, copper conductor, 1.1 kV grade cables. Solid or single strand conductor cable shall not be acceptable. The conductor sizes shall be selected after derating for the high ambient temperature, grouping & deposition of cables & keeping the voltage drop within the permissible limits & shall have a minimum cross sectional area of 2.5 mm sq. copper.

Conductor for control cables from electrical panel shall be made of copper with standard construction & with a sectional area not less than 1.5 mm sq. Festoon flexible cables for power & control applications shall have butyl rubber / EPR insulation & CSP sheathing

Flexible cables shall be of finely stranded copper conductor having a min. conductor section of 2.5 mm sq. copper for power circuits & 1.5 mm sq. for control circuits.

All cables shall be adequately protected against mechanical damage, radiant heat and oil as applicable.

### **Power collection system for Traveling Tripper control unit**

Travelling trippers and its control unit shall be through cable reeling drum system shall be mono spiral. The necessary electrics for traveling trippers shall be trailing cables, cable trays for resting the trailing cables and end limit switches proximity type 25 mm sensing gap for

protection against over travel of the tripper. The trailing cable of each tripper shall be suitable for the entire length of the bunker bay.

One end of the cable shall terminate in main cable junction box. The other end shall terminate on to the main power disconnecting switch located in the control panel. The trailing cable shall have ample length to cover full track length.

The above arrangement shall be guaranteed for 24 months of trouble free operation. Alternatively, vendors have to quote power / control CRD arrangement.

### **Earthing**

TN-CS type of earthing shall have provided. This would require a separate earth conductor in the power cables, both for fixed wiring as well as for CRD. Earth connection shall be across every mechanical pivot to ensure good earth across the entire structure.

#### **4.6.2.12. Inspection and Testing**

Inspection & testing of equipment shall be carried out by Purchaser or an authorized agent of Purchaser at the works of supplier during manufacturing and on final product to ensure conformity of the same with the acceptable criteria of technical specification, approved drawings, authenticated manufacturing drawings and reference national / international standards.

The Purchaser or any one or more authorized by him, shall have the right to visit contractor's / sub-contractor's premises to check the physical progress of work, inspection, testing etc., of the contract items or any part thereof at any time during all stages of manufacture. The contractor shall extend all necessary facilities for carrying out such inspection and check of progress of work.

Inspection of equipment by the purchaser / engineer shall be only with a view to ensure that the equipment is fabricated / manufactured, assembled, tested as per approved drawings and prescribed specifications. Inspection by the purchaser / his representative shall in no way relieve the supplier of his responsibility as per the contract and shall be in no way binding on the purchaser / engineer.

Immediately after approval of drawings / documents, the supplier shall give six (6) sets of all such drawings / documents along with the soft copy to the purchaser to enable the purchaser / engineer to carry out inspection of the equipment.

Purchaser / Engineer may reject the whole or any part of the equipment at any time if after inspection / testing. Purchaser / engineer at their discretion determine the equipment or any part thereof to be unsatisfactory or does not fulfill the terms of the contract, purchaser's / engineer's decision regarding rejection shall be final and binding on the supplier.

Vendor to perform a mechanically run performance test to verify capacity at his workshop. Vendor shall notify EMPLOYER'S prior to the test and submit test procedure for review. EMPLOYER'S shall reserve the right to witness such test and request copies of the test results.

Manufacturer's test certificates shall be furnished by the supplier for all bought out materials, components etc.

Wherever such test certificates are not available, the item shall be got tested by the supplier at his own expense at government recognized authority on mutually agreed upon.

#### 4.6.2.13. Delivery

All the equipment covered under this specification shall be delivered to site stores of EMPLOYER'S and as per the address and delivery schedule to suit commissioning of plant.

##### **Identification, tagging, marking, packing and storing**

Inscription on equipment (labels) shall be in English.

Unless requested by Purchaser, supplier shall dispatch equipment with all its attachments , parts, components, spares, documents etc as a single lot with logical identification of packing.

All items supplied shall be packed for a long storage under the climatic conditions prevailing at the site. Each item shall be clearly marked with its description, purpose and plant designation code as applicable. When more than one item packed in a single case a general description of the contents is to be shown on the outside of each case and detailed list to be enclosed. All cases and other packages must be suitably marked and numbered for identification purpose.

##### **Preparation for shipment:**

The Tenderer shall be responsible for ensuring that all accessories of Travelling tripper are carefully and / or suitably packed for shipment, so that they arrive at site in good conditions and remain so during storage at site.

Tenderer will be responsible for all damage due to improper preparation of the goods for shipment. All openings shall be covered or plugged to prevent entering of dirt and moisture to interior. Threaded connections shall have thread protectors that will exclude dirt and moisture.

#### 4.6.2.14. Painting:

Shall be as per Employer's approved scheme.

#### 4.6.2.15. Workmanship and Performance Guarantee

The material used shall be new and best of its kind available and shall confirm to relevant latest Indian and international standards.

The warrantee shall cover faulty design / material / workmanship. All rectifications or replacement under the warrantee shall be done by the supplier free of cost.

The supplier shall warrantee for satisfactory performance of the facilities for a period of 18 months from the date of receipt at site by the purchaser or 12 months from the date of commissioning whichever is earlier.

The tenderer shall prepare and submit draft performance test procedure for approval.

#### 4.6.2.16. Special Instructions to Tenderer

The vendor shall design the equipment considering the "site conditions" and for indoor installation.

Metric system shall be followed and English shall be the language of all communication.

The tenderer shall satisfy the Purchaser that he possesses the necessary technical experience and qualification and that he has at his disposal suitable modern facilities and staff of specialized employees to ensure that his contract work is of best quality and workmanship, according to the latest engineering practice. The tenderer shall furnish necessary particulars in this behalf with tender.

The vendor will be fully responsible for both the product and its relevant compliance with the present specification. All provisions included in the present specification will not be limitative to the scope of supply. The vendor will provide for those further activities in order to improve the quality of the product.

In case the equipment mentioned in this specification use imported equipment, component & / or spares for installation of the equipment, the tenderer should indicate the foreign exchange component along with the expenditure involved. In case of need, the tenderer shall make arrangement of foreign exchange for them.

The successful tenderer shall communicate, prior to award of contract the names of sub-contractors/suppliers proposed to be engaged by him for approval by Purchaser. The successful tenderer shall also intimate the Purchaser the names of his personnel (including sub-contractors/suppliers) and their addresses with telephone/telex number from whom information/data can be obtained by purchaser regarding progress of works, arrangement of inspection, testing and all other work in respect of the contract.

The break-up of plant and equipment shall be indicated in the following two broad categories.

- Those to be manufactured in India.
- Those to be procured from the foreign sources.

In both cases where the equipment is to be procured from India or abroad, the successful tenderer shall be responsible for design, generation of all data and design drawings required by him for manufacture/fabrication.

No foreign exchange and import license for import of technical know-how or equipment, components, spares or materials will be arranged or provided by the Purchaser

The tenderer shall separately quote for all the bought out items other than his manufacture.

In case of usage of special motors are involved in the system/package, same shall be in the scope of the tenderer.

All bought out items shall be as per the preferred makes of PURCHASER / Engineering Centre.

**Note: The tripper design should be designed by the vendor by considering additional provision of booms/ shuttle conveyors for proper distribution/stacking of Bulk Material in each plot for better utilization of stack yard, which will be incorporated in Phase-II of the development by DPA.**

## **4.7. Conveyor Accessories**

### **4.7.1. In-line Magnetic Separator**

- m) Magnetic separator shall be electromagnetic type, with oil-cooled design. All equipment shall be totally enclosed. Magnet Circuit comprising of insulated copper adequately

impregnated with epoxy resin making it impervious to moisture shall be provided. One

Electric Hoist with monorail beam shall be provided suitable for handling/ removal of magnetic separator for maintenance. Tramp iron chute are required along with ILMS

- n) Each Magnetic Separator shall provide for continuous and automatic extraction and discharge of tramp metal (magnetic pieces) from cargo mass on the given belt conveyor (refer Data Sheet).
- o) The magnetic separator unit shall be mounted from structural member from the top. The required turnbuckle arrangement to facilitate the necessary adjustments during operation shall be provided. The unit shall be complete in all respects including all electrical ancillaries, viz. local control panel, ON/OFF control push buttons and indicating lamps etc.
- p) Magnet core material shall be of pure annealed iron or equivalent having high magnetic permeability. The coil shall be of copper wire with Class 'H' insulation.
- q) Dimensions and shape of the core and side poles shall be optimized to obtain wider, deeper field ensuring large force index to effect higher lifting capacity over wide area.
- r) Magnetic pieces picked by magnetic separator shall be discharged into tramp metal chute located suitably.
- s) Suitable arrangement shall be provided in the magnet for keeping the coil of magnet dry from atmospheric condition when the magnetic separator is not in use.
- t) The other mechanical components of the Magnetic Separator like pulleys, bearing blocks, drive, belt etc. shall be liberally designed to ensure trouble free operation. The motor and gear reduction unit for driving the belt shall be adequately sized.
- u) The separator belt shall be designed to withstand high temperature at the bottom of the magnet and also to withstand impact of the sharp edges of the tramp iron pieces. The belt shall be provided with suitably spaced built in ribs.
- v) Belt protection devices for belt sway shall be fitted.
- w) All the equipment and accessories shall be proven design and manufactured to the best engineering practice.
- x) Each magnetic separator shall be suitable to lift the following tramp iron piece from the given belt.
  - MS cube of 20 mm size
  - 250 mm x 250 mm x 50 kg. M.S. plate
  - MS round bar of 50 Kg with L/D ratio of 5(min)
  - MS Bolt of M12, M16, minimum length equal to 5 times the size
  - Shovel teeth & spikes.

#### **4.7.2. Belt weigher**

- a) The belt weigher shall consist of the carriage/ weighbridge assembly, belt speed sensor and the electronic cabinet (Totalizer or Integrator Unit). The weighbridge shall be of multi idler system. Frictionless pivots-trunnion type suitably sealed shall be provided which shall be impervious to vibration, moisture and material deposits. The weighbridge shall be of rigid frame type having no moving parts and it shall maintain alignment permanently. It shall be

of unitized construction for quick and easy installation in the field.

- b) The speed sensor mechanically connected to tail pulley/deflector roller shall provide a stream of pulses, frequency of the pulse stream being proportional to belt speed. The Totalizer Package (Integrator Unit) shall provide the necessary intelligence to the system. The integrator receives the output signal from the weighbridge & the speed sensor and adds them to the total on the Master Counter. Flow rate is displayed by computation against a time base. The Integrator shall have feature such as automatic span and zero calibration and self-diagnostics facility.
- c) The digital speed sensor shall be packaged in rugged cast aluminum housing suitable for outdoor installation. The speed-sensing element shall employ a brushless pulse generator producing a stream of pulses, frequency of pulse stream being proportional to true belt speed. The pulse output is fed to the Integrator Unit.
- d) All idlers shall have T.I.R. not greater than 0.3 mm. All rolls shall be "weigh class" and conform to ISO 1940=G16 on both the bed & the scales. Lead in bed frames not less than 5. Lead out frames not less than 5. Idler frames to be of robust construction and fully supported so that under full load condition the bottom span does not deflect more than 0.6mm. Weights and dimensions are critical, spacing center to center require to be exact having maximum deviation of 0.5mm. Weigh Idler Frame shall be approved before manufacturing.
- e) The Electronic Cabinet shall comprise of the Totaliser Rate Indicator etc. having microprocessor based integrator. Total material weight, the material flow rate etc. shall be displayed on eight (8) digits LED. It shall have facility such as Run/Set up/Lamp test/Auto zero/Auto Span/Enter etc. The Electronic Unit shall have facility of digital processing, tantalization of data etc. And shall have bright easy to read digital display of flow rate of material and total tonnage passed etc. Electronic cabinet shall be rugged design with IP -55 degree of protection.
- f) High precision load cell of strain gauge type or transducer fully temperature compensated shall be provided.
- g) Belt weigher shall be calibrated with static and dynamic loads and shall offer an accuracy of +/- 0.25%.
- h) The accuracy shall be guaranteed within ( $\pm$ ) 0.25 percent for all belt weighers except boom belt weigher. All electronic equipment used shall be suitable for service in dust-laden atmosphere and shall be actually tested, checked as per applicable standards to ensure continued reliability.
- i) Load cell calibration certificates to be submitted and calibration shall be checked by Employer.
- j) Belt weigher simulation and integration shall be checked at manufacturer place.

#### **4.7.3. Metal Detector**

- a) Each metal detector would comprise of:
  - 1 No. Search coil,
  - 1 No. Electronic cabinet



- 1 No. Signal horn
  - 1 No. Signal lamp
- b) Search coil unit houses an oscillator coil and a receiver coil, Oscillator coil sets up electromagnetic field which is concentrated in aperture of the search coil. In normal condition when there is no tramp metal the receiver coil is so arranged that the output from it is extremely small. When a tramp iron piece is passing through the coil, it disturbs the flux distribution and this induces a voltage in the receiver coil. This voltage is then processed in the electronic unit and a DC voltage proportional to the size and type of metal is obtained. This voltage is compared with a threshold setting voltage which is used to set sensitivity of detection. When a metal of required size passes through the coil a switching signal is available at the output of the above comparator, which drives a monostable ckt. This monostable ckt actuates the relay for a fixed time and returns back after that time. Thus a momentary change over contact is available from this relay. The contacts of this relay are rated 5A/220V AC. Suitable spark suppression is also incorporated.
- c) The metal detector shall operate on a principle that tramp metal causes a reaction in the sensing device of the detector unit, in case, tramp metal passes through without being lifted, the metal detector on sensing the tramp metal will activate the signal light and operate the sand marker device to indicate location of metal piece and will also simultaneously stop the belt. The hook of the sand bag marker is lowered by means of a relay contact. The sand bag is dropped on or near the approx. location of the metal piece. Additional security circuit is provided so that the conveyor will not start unless, the sand bag is put back again on hook of the marker.
- d) Auto testing device checks the sensitivity of the metal detector at the interval of every 3 to 4 seconds and signal for malfunctioned/loss of sensitivity of the metal detector.
- e) Metal detector shall be capable to detect ferrous metal piece of 40 cubic mm and nonferrous, metallic piece of 60 cubic mm.
- f) Functional test shall be carried out at manufacturer place in complete simulation and integration condition.

#### 4.8. Technical Data Sheet

Salient features of conveying system & equipment envisaged in the facility are mentioned in Indicative 'Technical Data Sheet' below :

##### 4.8.1. Belt Conveyor BC 1, BC 2, BC 3, BC 4, BC 5, BC 6

Conveyor No.	Unit	
Type		Troughed
Orientation		Inclined/ horizontal
Material		Coal
Material size (max)	mm	100
Bulk Density	Kg/m <sup>3</sup>	800
Temperature	Deg	Ambient
Moisture Content	%	10 % max
Capacity	TPH	2000 TPH

<b>Belt width</b>	mm	1800
<b>Troughing angle</b>	Deg.	35
<b>Length C/c</b>	<b>Mtr</b>	Drg. No. GACE/22-23/105/DTEFR/DWG/02
<b>Angle of Inclination</b>	Deg.	Drg. No. GACE/22-23/105/DTEFR/DWG/02
<b>Lift</b>	Mtr	Drg. No. GACE/22-23/105/DTEFR/DWG/02
<b>Speed</b>	m/sec	3.5
<b>Direction</b>		Uni
<b>Take Up Type</b>		GACE/22-23/105/DTEFR/DWG/02
<b>Carrying Idlers:</b>		
<b>Pipe dia x length</b>	mm	152.2 X 315
<b>Shaft dia at brg.</b>	mm	30
<b>Bearing size</b>		6206 ZZ
<b>Return Idlers:</b>		
<b>Pipe dia x length</b>	mm	114.3 X 950
<b>Shaft dia at bearings.</b>		30
<b>Bearing size &amp; make</b>		6206 ZZ
<b>Impact Idlers:</b>		
<b>Dia (Pipe/Rubber ring)</b>	mm	152.4/114.3 X 315
<b>Shaft dia at bearings</b>	mm	30
<b>Bearing size &amp; make</b>		6206 ZZ
<b>Head Pulley</b>		
<b>Dia x face X thk</b>	mm	630 X 2000 X 16
<b>Shaft dia at bearings</b>	mm	AS per Calculation
<b>Bearing Type</b>		DSRB
<b>Qty</b>	Nos	1
<b>Tail &amp; Take up Pulley</b>		
<b>Dia x face x thk</b>	mm	500 X 2000 X 14
<b>Shaft dia at bearings</b>	mm	AS per Calculation
<b>Bearing Type</b>		DSRB
<b>Qty</b>	Nos	1
<b>Bend &amp; Snub Pulley</b>		
<b>Dia x face x thickness</b>	mm	323 X 2000 X12
<b>Shaft dia at bearings</b>	mm	AS per Calculation
<b>Bearing Type</b>		DSRB
<b>Qty</b>	Nos	1
<b>Gear Box</b>		
<b>Type</b>		HELICAL
<b>Gear ratio</b>		As per design requirement (To be provided by vendor)
<b>Hold back</b>		As per design requirement (To be provided by vendor)
<b>Safety Factor</b>		1.5
<b>Motor:</b>		
<b>Rating</b>	Kw	As per design requirement (To be provided by vendor)
<b>Coupling Arrangement</b>		Geared/Pin bush/Fluid
<b>Belt:</b>		

<b>Width</b>	mm	1800
<b>Belt grade</b>		M24 , EP
<b>Top thickness</b>	mm	6
<b>Bottom thickness</b>	mm	4
<b>Safety Devices:</b>		
<b>Pull Chord Switch</b>		At 30 mtr Spacing
<b>Belt Sway Switch</b>		At 50 mtr Spacing
<b>ZSS</b>	Qty	01 Nos at Tail Pulley
<b>CHUTE BLOCK SWICTH</b>		At discharge chute
<b>Technological Structure :</b>		
<b>Stringer</b>	ISMC 125	Provided till starting point of gantry
<b>Short Support</b>	ISMC 125	Provided @3000 mm spacing till starting point of gantry
<b>Scraper Type</b>		External & Internal
<b>Deck Plate LENGTH 6 MTR</b>	MS	THK 2 MM At Feed point,
<b>Skirt Board LENGTH 3 MTR. SS409 M/SAIL HARD LINER 3 MM THK</b>	MS	THK 8 mm at feeding point, Rubber Thk 10 mm
<b>Discharge Chute</b>	MS	10 mm thk Mother plate , 5 mm thk SAIL HARD LINER shall be provided
<b>Gantry , Walkways , Hand railing ,</b>		Open Type

#### 4.8.2. Tripper Conveyor TC 1, TC 2, TC 3

Conveyor No.	Unit	
Type		Troughed
Orientation		Inclined/ horizontal
Material		Coal
Material size (max)	mm	100
Bulk Density	Kg/m <sup>3</sup>	800
Temperature	Deg	Ambient
Moisture Content	%age	10 % max
Capacity	TPH	2000 TPH
Belt width	mm	1800
Troughing angle	Deg.	35
Length C/c	Mtr	Drg. No. GACE/22-23/105/DTEFR/DWG/02
Angle of Inclination	Deg.	Drg. No. GACE/22-23/105/DTEFR/DWG/02
Lift	Mtr	Drg. No. GACE/22-23/105/DTEFR/DWG/02
Speed	m/sec	3.5
Direction		Uni
Take Up Type		Drg. No. GACE/22-23/105/DTEFR/DWG/02
<b>Carrying Idlers:</b>		
Pipe dia x length	mm	152.2 X 315
Shaft dia at brg.	mm	30
Bearing size		6206 ZZ
<b>Return Idlers:</b>		
Pipe dia x length	mm	114.3 X 950
Shaft dia at brg.		30
Bearing size & make		6206 ZZ
<b>Impact Idlers:</b>		
Dia ( Pipe/Rubber ring )	mm	152.4/114.3 X 315
Shaft dia at bearings	mm	30
Bearing size & make		6206 ZZ
<b>Head Pulley</b>		
Dia x face X thk	mm	630 X 2000 X 16
Shaft dia at bearings	mm	AS per Calculation
Bearing Type		DSRB
Qty	Nos	1
<b>Tail &amp; Take up Pulley</b>		
Dia x face x thk	mm	500 X 2000 X 14
Shaft dia at bearings	mm	AS per Calculation
Bearing Type		DSRB
Qty	Nos	1
<b>Bend &amp; Snub Pulley</b>		
Dia x face x thickness	mm	323 X 2000 X12
Shaft dia at bearings	mm	AS per Calculation
Bearing Type		DSRB
Qty	Nos	1

<b>Gear Box</b>		
<b>Type</b>		HELICAL
<b>Gear ratio</b>		As per design requirement (To be provided by vendor)
<b>Hold back</b>		As per design requirement (To be provided by vendor)
<b>Safety Factor</b>		1.5
<b>Motor:</b>		
<b>Rating</b>	Kw	As per design requirement (To be provided by vendor)
<b>Coupling Arrangement</b>		Geared/Pin bush/Fluid
<b>Belt:</b>		
<b>Width</b>	mm	1800
<b>Belt grade</b>		M24 , EP
<b>Top thickness</b>	mm	6
<b>Bottom thickness</b>	mm	4
<b>Safety Devices:</b>		
<b>Pull Chord Switch</b>		At 30 mtr Spacing
<b>Belt Sway Switch</b>		At 50 mtr Spacing
<b>ZSS</b>	Qty	01 Nos at Tail Pulley
<b>CHUTE BLOCK SWICTH</b>		At discharge chute
<b>TRIPPER</b>		
<b>Rail Size</b>		ISMB 200
<b>Square Bar for wheel</b>	MS bar	50 MM
<b>Rail Length</b>	m	Drg. No. GACE/22-23/105/DTEFR/DWG/02
<b>Travel Length</b>	m	Drg. No. GACE/22-23/105/DTEFR/DWG/02
<b>Travel Speed</b>	m/sec	0.25 m/sec
<b>Travel Wheel Dia (Drive)</b>	mm	300
<b>Travel Wheel Dia (Driven)</b>	mm	300
<b>Type of Brake</b>		Electromagnetic operated disk brake.
<b>Drive Motor for Tripper</b>	KW	TO SUITE THE REQUIREMENT
<b>Type of Drive arrangement</b>		Gear Box Arrangement
<b>Cable Reel Drum</b>		01 No. Shall be provided
<b>Limit Switch</b>	Nos.	2
<b>Rail Clamp</b>		Motor Side 02 Nos.
<b>Buffer</b>		Shall be Provided

#### 4.8.3. In-line magnetic separator:

Description	Specification
<b>Location</b>	After metal separator
<b>Material Handled</b>	Coal
<b>Lump Size</b>	100 mm
<b>Power Supply</b>	220 V Ac
<b>Detection</b>	Able to detect 25 mm ferrous particle
<b>Search Coil</b>	Totally Enclosed sealed made by fibre glass
<b>Control Unit</b>	Dust proof IP 65 , Shall have Lamp for Power On, Metal detected ,Fault, By pass

<b>Hooter</b>	Shall be provided , Range 50 mtrs
<b>Marking Device</b>	Sand Bag Marker Shall be Provided

#### 4.8.4. Belt weigher:

Sr.No	Description	Detail
1	Type of Belt Weigher	Electronic Load Cell Type, Microprocessor based
2	Designation No.	BWS
3	Number to be furnished	1
5	Capacity of conveyor (TPH)	2000 TPH
6	Weighing range	10% to 120%
7	Belt width (mm)	1800 mm
8	Accuracy over full weighing Range	Within $\pm 0.25\%$
9	Belt speed (m/sec)	As per conveyor speed
10	Totalizing Unit	To be Provided
11	Type	Eight digits, digital totalizer
13	Rate indicator	Both Local as well as remote to be provided
14	Type	Digital type
15	Location of display	Local to be provided Remote at Control Room (on mimic panel) shall be provided.
16	Calibrating instruments as required	To be Provided Master Weight to be used for calibration) .weighing clearance scope to be defined.

#### 4.8.5. Metal Detector

Location	After metal separator
Material Handled	Coal
Lump Size	100 mm
Power Supply	220 V Ac
Detection	Able to detect 25 mm ferrous particle
Search Coil	Totally Enclosed sealed made by fibre glass
Control Unit	Dust proof IP 65 , Shall have Lamp for Power On, Metal detected ,Fault, By pass
Hooter	Shall be provided , Range 50 mtrs
Marking Device	Sand Bag Marker Shall be Provided

#### 4.8.6. 2 Way Flap Gate

TECHNICAL ANNEXURE FOR 2 WAY FLAP GATE		
S. No	Parameters	
1	Location	ON BELT CONVEYOR
2	Type	----- Motorised Diverter Gate -----
3	<b>Material Handled</b>	
	Material	Coal
	Bulk Density (t/m <sup>3</sup> )	0.8
	Particle Size (mm)	60 mm Average
	Moisture Content	10 %
	Inlet /Outlet Size (mm)	TO SUITE
	Rating	As per design requirement (To be provided by vendor)
<b>Casing :</b> Shall be made out of 10 mm thk MS plate confirming to IS:2062.		
<b>Flap :</b> Shall be made out of 10 mm thk MS plate confirming to IS:2062 + Liner 10 thk sail hard		
<b>Drive Shaft:</b> Shall be provide with square bar made out of carbon steel material confirming to EN-8/C-45 grade.		
<b>Bearing :</b> The drive shaft will supported on a pair of totally enclosed, self-aligning, flange mounted, ball bearing.		
<b>Operation:</b> The flap gate will be operated with Electrical Actuator. However, it will also have provision for manual operations (in case of power failure).		
<b><u>Electrical Actuator</u></b>		
<b>Type :</b> Linear		
<b>Duty Operational :</b> ON/OFF type		
<b>Requirement :</b> The actuator shall have overload protection switch having 1 NO + 1 NC Contacts.		

#### 4.8.7. Electric Hoist

Description	Specification
Capacity	5 ton
Power Source	Electric
Control Voltage	415 V
Height of Lift	20 feet
Chain Length	6-8m
Lift speed	3m/min
Frequency	50Hz
Material Mild	Steel
Finishing	Paint coated



## **5. INDICATIVE ELECTRICAL WORKS:**

### **5.1. Design Requirements**

#### **5.1.1. General**

The contractor shall work as per the drawings and designs described in the Tender document and the best current engineering practice. Particular attention should be paid to internal and external access to the electrical equipment in order to facilitate inspection, cleaning and maintenance. The contractor shall comply with latest code of practice published by the Bureau of Indian Standards as listed in the tender document. Care shall be taken so that materials and equipment supplied by contractor will be the standard catalogued products of manufacturers regularly engaged in the manufacture of such products and will be of the latest standard designs that conform to the specific requirements.

- a) The essence of design shall be safety, simplicity and reliability in order to give long continuous service with high economy and low maintenance cost. Particular attention should be paid to internal and external access to the electrical equipment in order to facilitate inspection, cleaning and maintenance.
- b) All equipment shall be designed to minimize the risk of fire and any damage which may be caused in the event of fire.
- c) The design shall comply with relevant codes and regulations listed.
- d) All apparatus, equipment and works shall be so designed that they provide satisfactory service and without any harmful effects for prolonged and continuous periods in the worst climatic conditions, stated hereinbefore.
- e) The reference design ambient temperature for all electrical equipment shall be taken as 50°C and appropriate derating factors shall be considered for equipment as applicable.
- f) Suitable derating shall be applied based on published data against the most severe conditions encountered in the site, by reducing the permissible temperature rise above the ambient level.

#### **5.1.2. Errors, Omissions and discrepancies**

In case of errors, omissions and discrepancies between technical specification, schedules and drawings the following order shall prevail:

- a) MOM with contractor in reverse chronological order.
- b) Technical specifications
- c) Tender drawings
- d) Schedule of Quantities
- e) Bureau of Indian Standards
- f) International Standards

- g) In all case of doubt or omissions or discrepancies noticed in any item of work any drawing, the decision of the Engineer-in-Charge shall be final and binding on the contractor.

### 5.1.3. Other Technical Requirements

The contractor shall arrange all the instruments, materials and labour involved in setting out the works to the satisfaction of the Engineer-in-Charge.

### 5.1.4. Power System Description

Above mentioned System Arrangement is shown in “**Power Single Line Diagram**”.

The voltage for the different systems shall be as under:

Voltage	:	11 KV $\pm$ 10%, 415V $\pm$ 10%
Phase	:	11KV - 3 PH 3 Wires 415V – 3 PH 4Wires
Frequency	:	50 Hz $\pm$ 5%
Combined Voltage & Frequency Variation	:	10%
Fault level	:	26.3 KA for 3 seconds at 33KV & 11kV 50 KA for 1 seconds at 415V
System Earthing:		
33kV & 11kV	:	Resistance Earthing
415 V	:	Solidly Earthed
Circuit Breaker Protection & Tripping Control System	:	110 V DC, 2 Wire, grounded

### 5.1.5. System Battery Limits

All items within the system boundary limits specified under the scope of this tender shall be included. Full support to the other contractors of the project both in the form of drawings and guidance shall also be in the scope.

- Battery limit for electrical starts from 11kV Cable termination at existing 11kV Panels at existing nearby Substation.
- Battery limit for Automation starts from existing PLC/SCADA terminal (hook up). This will include modification (hardware and software) in existing Automation system, if any.

- Vendor shall draw 11KV HT supply by laying two (2) nos of HT cables from existing nearby switch yard substation by using separate route up to proposed new substation near Berth-14. Vendor shall consider cleaning of existing trench and crossing, construction, modification, repair of existing cable trench and crossing for laying of new cables as per site condition and instruction of Employer Site In-charge.

#### 5.1.6. Standards and Regulations

The design and manufacture of the electrical equipment shall conform as a minimum to applicable codes, regulations and standards published by the following bodies:

BIS	:	Bureau of Indian Standards
IER	:	Indian Electricity Rules
BSI	:	British Standard Institution
ISO	:	International Organization for Standardization
IEC	:	International Electro-Technical Commission
IEEE	:	Institute of Electrical & Electronics Engineers
NFPA	:	National Fire Protection Association
NEC	:	National Electrical Code

Following is the list of some of the directly applicable Standards particular to the equipment. Any other relevant Indian Standard, not covered shall also be applicable.

IS: 375	Marking and arrangement of Switchgear Bus
IS: 13118	Specification for high voltage alternating current circuit breaker
IS: 12729	Switchgear and Control gear for voltages exceeding 1000V - General Requirements
IS: 2705	Current transformers
IS: 3156	Voltage Transformers
IS: 335	New Insulating oils
IS: 2026	Power transformers
IS: 3639	Fittings and accessories for Power transformers
IS: 4257	Dimensions of clamping arrangement for porcelain transformer bushings
IS: 11171	Specification for Dry-Type Power transformer

IS: 10028	Code of Practice for selection, installation and maintenance of transformer
IS: 3427	A.C. Metal enclosed switchgear and control gear for rated voltages above 1kV and upto and including 52kV
IS: 8623	Specification for low voltage switchgear and control gear assemblies of switchgear & control gear for voltages not exceeding 1000V AC.
IS: 13703	Low Voltage fuses
IS: 13947	Low Voltage switchgear and control gear
IS: 1651	Stationary cells and batteries, Lead Acid Type (with tubular positive plates) – Specification
IS: 266	Specification for Sulphuric acid
IS: 3895	Mono crystalline Semi-conductor rectifier cells and stacks
IS: 4540	Mono –crystalline Semi-conductor rectifier assemblies and equipment
IEEE:484	Recommended Design for Installation design and installation of large lead storage batteries for generating stations and substations.
IEEE:485	Sizing large lead storage batteries for generating stations and substations.
IS: 1554	PVC insulated (heavy duty) electric cables for working voltages up to and including 1100 volts.
IS: 7098 -I	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100 volts.
IS: 7098 -II	Cross linked polyethylene insulated PVC sheathed cables for working voltages from 3.3 kV up to and including 33 kV.
IS: 10810	Methods of tests for cables.
IS: 418	Tungsten filament general service electric lamps
IS: 1777	Industrial luminaire with metal reflectors.
IS: 1947	Flood Lights
IS: 10322	Luminaires for street lighting.
IS: 1944	Code of practice for design of Street lighting

IS: 2206	Flame proof electric lighting fittings
IS: 2215	Starters for fluorescent lamps.
IS: 2418	Tubular fluorescent lamps for general lighting services
IS: 4013	Dust-light electric lighting fittings
IS: 8224	Specification for Electric Lighting fittings for Division 2 areas
IS: 9583	Emergency lighting units
IS: 9900	High-pressure mercury vapour lamps
IS: 9974	High Pressure sodium vapour lamps
IS: 2713	Specification for Tubular Steel Poles for Overhead Power Lines
IS: 1255	Code of practice for installation and maintenance of power cables up to and including 33 kV rating.
IS: 732	Electrical wiring installation (system voltage not exceeding 1100 V).
IS: 2309	Code of practice for the protection of building and allied structures against lightning.
IS: 3043	Code of practice for earthing.
IS:15885 (Part2/Sec13)	2012 Safety of Lamp Control Gear, Part 2 Particular Requirements Section 13 d.c. or a.c., Supplied Electronic Controlgear for LED Modules
IS:16101: 2012	General Lighting - LEDs and LED modules – Terms and Definitions
IS:16102 (Part 1) : 2012	Self- Ballasted LED Lamps for General Lighting Services Part 1 Safety Requirements
IS:16102 (Part 2) : 2012	Self- Ballasted LED Lamps for General Lighting Services Part 2 Performance Requirements
IS:16103 (Part 1) : 2012	Led Modules for General Lighting Part 1 Safety Requirements
IS:16103 (Part 2) : 2012	Led Modules for General Lighting Part 2 Performance Requirements

IS:16104: 2012	D.C. or A.C. Supplied Electronic Control Gear for LED Modules - Performance Requirements
IS:16105: 2012	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources
IS:16106: 2012	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products
IS:16107 (Part 1) : 2012	Luminaires Performance Part 1 General Requirements
IS:16107-1: 2012	Luminaires Performance Part 2 Particular Requirements Section 1 LED Luminaire
IS:16108: 2012	Photo biological Safety of Lamps and Lamp Systems
IS:60470-2000	High-Voltage Alternating Current Contactors

In addition to Codes and standards, the installation works shall also conform to the requirements of following:

- a) Indian Electricity Act and Rules
- b) Fire insurance regulations
- c) Regulations laid down by Chief Electrical Inspector of Gujarat.
- d) Regulations laid down by the Factory Inspector
- e) Regulations for the electrical equipment of Tariff Advisory committee
- f) Any other regulations laid down by the authority
- g) Regulation of Pollution Control Board of Gujarat.

#### 8.1.6.1 Standardization

Care shall be taken so that the materials and equipment are standard catalogued products of manufacturers regularly engaged in manufacture of such products and shall be of the latest standard designs conforming to specification requirements. Design shall also be based on similar types of electrical equipment supplied from one manufacturer, utilizing interchangeable parts wherever practicable. Materials and equipment incorporated shall be of a type for which spare parts and replacements are readily available in India.

## 5.2. Equipment Indicative Technical Specification

### 5.2.1. HT Switchgear (GIS Type)

#### 5.2.1.1. Introduction

This specification covers the requirements of 11kV Extension Panel complete with all accessories.

#### 5.2.1.2. General Requirements

The switchgear shall comprise of feeder(s) as per the Single Line Diagram M-010. Continuous current rating of the Switchgear shall be based on the name plate rating of the connected equipment with 20% margin, rounded off to the next higher standard rating. 11kV HT Switchgear shall be rated for short circuit withstands capacity of 26.3 kA for 3 seconds.

Bus bars, breakers and other components shall be designed for continuous operation at rated current considering temperature inside the cubicle. The inside cubicle temperature shall be considered as design ambient temperature of 50°C for maximum continuous operation rating of the equipment. For breaker control, 110 V DC supply shall be considered.

Each breaker module shall be provided with multifunction numerical relay for protection with RS 485 port for communication. Switchgear shall be provided with separate earthing trucks for cable earthing and bus earthing. The earthing truck shall be so designed that it is impossible to earth a live. It shall be provided with capacitive voltage divider and complete with audio visual annunciation.

#### 5.2.1.3. Switchgear Construction

The switchgear shall be indoor, single front, single tier, metal-clad, floor mounted roll on floor type, fully draw-out with VCB breaker. Design and construction shall be such as to allow extension at either end.

Switchgear cubicle shall be so sized as to permit closing of the front access door when the breaker is pulled out to Test position. The working zone shall be restricted within 750 mm to 1800 mm as from floor level.

Circuit breakers, instrument transformers, bus-bars, cable compartment, auxiliary control devices etc., shall be housed in separate compartments within the cubicle complying with loss of continuity LSC2B classification as per IEC 62271-200. The design shall be such that failure of one equipment shall not affect the adjacent units.

The circuit breaker and bus voltage transformers shall be mounted on withdrawable trucks. All the HV compartment design i.e. Busbar compartment, VCB compartment and Cable compartment should ensure conformity to IEC 62271-200 and must be type tested individually for Internal Arc Test for AFLR 26.3 KA for 1 second for 11 KV Panel.

All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on a control cabinet built on the front of the cubicle. Panel supplier should be the manufacturer of Vacuum Interrupter, relay and meter.

The trucks shall have distinct 'Service', 'Test' and 'Isolated' positions. The switchgear assembly shall be designed to achieve IP 4X degree of protection, with the truck in any position 'Service', 'Test' and 'Isolated' and all doors and covers closed. Relaying and Metering compartment shall also have degree of protection IP4X.

Enclosure shall be sheet steel construction Aluzinc not less than 2.5 mm for load bearing and 2 mm for non-load bearing. The switchgear shall be cooled by natural airflow. Forced cooling shall not be accepted. The Breaker and the auxiliary compartments provided on the front side shall have strong hinged doors. Breaker compartment doors shall have locking facility.

#### 5.2.1.4. Bus and Bus Taps

The main buses and connections shall be of high conductivity Aluminium, sized for specified current ratings with maximum temperature shall be as per IEC 60694. The bus bars shall be designed for a short circuit rating of 26.3 KA for 3 sec for 11 KV panel. Voltage level shall be 11 KV for all and fault level shall be of 26.3 KA for 3 Sec.

All bus connections shall be silver plated. Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and lock nuts. Bimetallic connectors shall be furnished for connections between dissimilar metals.

Busbar insulators shall be epoxy cast resin type designed to withstand stresses due to maximum short circuit current.

Busbars and connection shall be fully insulated for working voltage with adequate phase/ground clearances. Insulating sleeves for busbars and cast-resin shrouds for joints shall be provided. Cross section of the main horizontal busbar shall be uniform throughout the switchboard and continuous in one transport unit. All buses and connection shall be supported and braced to withstand stresses due to maximum short circuit current and also to take care of any thermal expansion.

Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switchgear assembly. The busbar chamber shall be provided with inter panel barrier with epoxy case seal-off bushings which the buses shall pass through so as to prevent fire from one panel to another.

#### 5.2.1.5. Circuit Breaker

Circuit breaker shall be triple pole, single throw Vacuum Circuit breaker. It shall be restrike free, trip free type. Breakers shall be suitable for switching transformers at any load. Rated operating duty shall be O-0.3sec-CO-3min-CO. Short circuit withstand/interrupting capacity shall be 26.3 kA for 3 sec for 11KV.

Circuit breakers shall be draw-out type, having SERVICE, TEST and DISCONNECTED positions with mechanical positive indication for each position. Operating mechanism shall be stored energy type.

Protection must be taken from protection core 3P and metering core shall be only use in measurement.

Circuit breakers of identical rating shall be physically and electrically interchangeable. Each breaker feeder shall be provided with the following:

- An anti-pumping relay.
- Motor charged spring operating mechanism.
- Manual spring charging
- Mechanical indication of spring charge
- Mechanical position indicator (to show whether the breaker / contactor is 'ON' or 'OFF' in the service, test and disconnected positions)



- Closing coil (100% continuous rated)
- Shunt trip (100% continuous rated)
- Manual trip pushbutton
- Operation counter,
- Locking facility to prevent breaker/contactors from being closed when it is open.
- Pressure relief device
- Safety shutters for power contacts
- Interpole insulators

For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.

Robust fail-safe mechanical and electrical interlocks shall be provided to prevent the following situations:

- Move the breaker unit from the service or disconnected position while the unit is closed.
- Move the breaker from the disconnected position to the service position while the earthing switch is closed.
- Close the earthing switch when the breaker unit is in service position or between the service and disconnected position.
- The operation of the circuit breaker while the truck is not properly installed in the service, test or disconnected position.

The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between 80 and 110 percent of the rated voltage. The shunt trip coil shall operate satisfactorily at all values of control supply voltage between 70 and 110 percent of the rated voltage.

For breakers spring charging motor shall be provided with overcurrent protection. Motor windings shall be provided with class B insulation or better.

Circuit breaker shall not produce any harmful over-voltage during switching off induction motors. Surge protective devices to limit over voltage shall be included in the scope of supply for all motor feeders.

#### 5.2.1.6. Current Transformer

The CTs shall be mounted on the switchgear stationary parts. CT secondary current shall be 1A. For metering separate core shall be provided. Core balance CT shall be provided for all the outgoing feeders. Accuracy class of the current transformer shall be:-

- a) Class PS/ 5P20 for differential relaying and REF protection (Based on type of relay)
- b) Class 5P20 for other relaying
- c) Class 0.5 and ISF < 5 for metering

**d) Class 0.2S for Energy Accounting & Audit meters**

For metering separate core shall be provided. Core balance CT and associated relay combination shall be such as to ensure a pick up sensitivity of 10A primary ground fault current for all the outgoing feeders.

Facilities for easy shorting and grounding the terminals shall be provided at the terminal block. All terminal blocks shall be of stud type with marking strip.

**5.2.1.7. Voltage Transformer**

Voltage Transformer shall be cast-resin, draw-out type and shall have an accuracy class of

0.5. Voltage Transformer mounted on breaker carriage is not acceptable in case of BUS PT. Rated secondary voltage shall be 110V centre-tapped. Accuracy class for metering core shall be 0.5, protection core shall be 3P and 0.2 for energy accounting & audit meters. High voltage windings of voltage transformer shall be protected by current limiting fuses. Fuse failure relay shall be provided on the secondary side of all voltage transformers to monitor failure of fuses. The following over voltage factor shall be considered for PT.

- 120% for continuous duty.
- 150% for 30 sec ( for 415V solidly grounded system )

High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.

Low voltage MCB's, sized to prevent overload, shall be installed in all ungrounded secondary leads. MCB's shall be suitably provided with auxiliary contacts.

MCB's auxiliary contacts connected suitably through relay shall be provided on the secondary side of all voltage transformers to monitor failure or trip of MCB's. The relay shall initiate alarm and block the tripping etc. which shall operate in case of VT MCB trip or failure.

**5.2.1.8. Relays**

Numerical multifunction relays shall be provided for all feeders. Numerical relay shall have trip circuit supervision.

All protective relays shall be of modular design, suitable for flush mounting and fitted with dust tight covers. All relays shall have built-in testing facilities. Small auxiliary relays may be of non-draw-out type and mounted within the cubicle. Relays shall have lock-out facility with manual reset. Each feeder shall be complete with necessary auxiliary relays, timers, etc., to meet the circuit requirement.

Under voltage relays shall be provided in the bus PT circuit.

Relays shall be rated for operation on 110V VT secondary voltage and 1A CT secondary current. The switchgear shall be provided with DC fail relay and DC fail indication lamp for each DC control supply in comer. DC isolation switch for each feeder shall be provided with backup HRC fuse.

Breaker auxiliary contacts used for interlocking purposes shall be multiplied using electrically latched relay.

Relay shall be considered as ABB (REF 615 RET 615), Siemens (7SJ80, 7SJ81). Outgoing

transformer feeders shall have the following minimum protection relays.

- Numerical protection relay having Instantaneous Over Current protection (50) on all the three phases, IDMT Over Current protection (51) on all the three phases, Instantaneous earth fault protection (50 N).
- Instantaneous ground fault protection through CBCT (50 G).
- Latched Lock out relay (86).
- Trip circuit supervision relay (95)
- Gas operated relay (63)
- Thermal overload relay (49)
- REF protection (64R) relay (For 16 MVA)

Self-reset auxiliary relays with hand reset flag indicator shall be provided for contact multiplication of the following:

- Transformer winding temperature indicator alarm and trip contacts.

Incomers and Tie feeders shall have the minimum following protection relays.

- Numerical protection relay having Instantaneous Overcurrent protection (50) on all the three phases, IDMT Over Current protection (51) on all the three phases, Instantaneous earth fault protection (50 N).
- Latched Lock out relay (86).
- Trip circuit supervision relay (95)

Bus PT shall have the following protections.

- Under voltage relay
- Overvoltage relay
- MCB trip

#### 5.2.1.9. Control Switches

Circuit breaker control switches shall be 3-position spring return to 'neutral' from both close and trip positions. They shall have 'Pistol Grip' handle.

The contacts shall be of silver plated, air break type. The continuous current and breaking capacity of the contacts shall be adequate for the duty involved.

#### 5.2.1.10. Indicating lamps

Indicating lamps shall be of the panel mounting, LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary. Lamps shall have translucent lamp covers of the following colors, as warranted by the application. Bulbs and lamp covers shall be easily replaceable from the front of the cubicles. Low Voltage Glow Prevention (LVGP) feature shall be provided for indicating lamps. The colour of indication lamps shall be as follows:

- GREEN : Breaker Open
- RED : Breaker Closed
- AMBER : Auto trip & all Alarm conditions

- BLUE : Spring Charged
- WHITE : For all healthy conditions (e.g. Trip coil healthy & Control supply healthy).

For each breaker feeder, Panel indication lamps shall be provided as follows:

- Breaker Open
- Breaker Closed
- Auto trip
- Motor Spring Charged
- Trip coil healthy
- Control supply healthy
- Breaker in service position
- Breaker in Test position
- Lockout relay healthy
- Any other indication, as required

For incomer & Bus, indicating lamps for R, Y, B phase shall be provided.

#### 5.2.1.11. Meters

All Indicating meters shall be digital type, 96 x 96 mm size, suitable for flush mounting with constant accuracy for the entire range of respective parameters with an inbuilt provision for calibration verification. The instruments shall have an accuracy class of 1.0. All Multifunction meters shall have digital display and communication port with true RMS measurement facility with minimum 1% accuracy level. All digital meters shall be with RS485 communication port.

For incomers following Meters and transducers shall be provided:

- Ammeter
- Voltmeter
- Multifunction meter with digital display and communication port for kW, kVAR, kWh and power factor measurement.

For outgoing transformer feeders following Meters and transducers shall be provided:

- Ammeter
- Multifunction meter with digital display and communication port for kW, kVAR, kWh measurement.

#### 5.2.1.12. Secondary wiring

The Switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and inter locking schemes. Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.

Wiring shall be done with flexible, 1100V grade, PVC insulated switchboard wires with stranded copper conductors of 2.5mm<sup>2</sup> for current circuits and 1.5 mm<sup>2</sup> for voltage circuit s. Each wire shall be identified, at both ends, with permanent markers bearing wire numbe rs as per Contractor's wiring Diagrams.

Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals. All external cable terminations shall be accessible while the breaker is in service position

#### 5.2.1.13. Terminal Blocks

Terminal blocks shall be 1100V grade box-clamp type with marking strips. CT shorting li nks, Drop link type terminals shall be provided for CT secondary leads. Not more than two wi res shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Terminal blocks shall be located to allow easy access . Wi ring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

#### 5.2.1.14. Cable Termination

Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection. All provision and accessories shall be furnished for termination and connection of cables, including removable gland plates, cables supports, and crimptype tinned copper lugs, brass compression glands with tapered washer and terminal blocks.

#### 5.2.1.15. Name plates

Name plates of approved design shall be furnished at each cubicle and at each instruments & device mounted on or inside the cubicle. The material shall be lamicoid or approved equal, 3 mm thick with white letter on black back ground. The material shall be held by self-tapping screws. Nameplate size shall be minimum 20 X 75 mm for instrument device and 4 0 X 1 5 0 mm for panels. Caution notice on suitable metal plate shall be affixed at the back of e a ch vertical panel.

#### 5.2.1.16. Space heaters and plug sockets

Each cubicle shall be provided with thermostat controlled space heaters and cubicle l amp with door switch suitable for operation from 240 V ,single phase AC supply and 5A, 3 pin plug socket. The space heater shall be located at the bottom of each switchgear compartment. Cubicle heater, Motor heater, Plug/socket circuits shall have individual MCB units. In addition, motor feeder cubicle shall be wired-up for feeding the motor space heater through suitable rated breaker auxiliary NC Contact and/or contactor.

#### 5.2.1.17. Testing and Inspection

Switchgear and all its components should have been type tested and proven type. Type test certificates shall be furnished for Purchaser's review. Switchgear and its components shallbe subjected to routine tests as per applicable Indian Standard. In addition, a ny spe ci al tes t required shall also be performed. Test reports shall be submitted for approval.

#### 5.2.1.18. Tests

The design of circuit breaker shall be proven through all the routine and type tests in accordance with IS IEC 62271-200 and any amendment thereof. Photocopy of all the test reports must be enclosed with the tender. Type test report earlier than 5 years from the date of tender opening shall not be acceptable.

The Bidder shall submit the type test reports of following type tests for approval of the Purchaser

- a) Short circuit duty test on circuit breaker, mounted inside the panel offered.
- b) Short time withstand test – on circuit breaker, mount inside panel offered.
- c) Power frequency withstand test on breaker and panel.
- d) Lightning impulse withstand test on breaker and panel.
- e) Temperature rise test on breaker and panel together.
- f) Measurement of resistance of main circuit.
- g) Mechanical endurance test on breaker.
- h) Mechanical operation test.
- i) Internal arc current (IAC) test on individual compartments i.e. Busbar, VCB and cable compartment.

#### 5.2.1.19. Spares List

Suitable number of commissioning and successful running for 2 years spares list shall be submitted for approval.

#### 5.2.1.20. Indicative System Parameters

1	Nominal System voltage	11 KV
2	Highest System voltage	12 KV
3	Rated Frequency	50Hz
4	Number of phases/ poles	Three
5	System neutral earthing (As per requirement)	As per Vector Group of Transformers
6	One minute power frequency withstand voltage	28
7	1.2/50 microsecond Impulse withstand Voltage	75 kV (peak)

8	Short time rating for bus bars, CB, CT and switchgear Assembly.	26.3 kA (rms)
9	Dynamic withstand rating	62.5 kA (peak)
10	IAC Rating	-----
11	Control supply voltage:	110VDC
11.1	Trip and closing coils	supply
11.2	Spring charging motor	AC supply
12	Maximum ambient air temperature	40 deg. C
13	Degree of Protection	
13.1	HV-live parts (for SF6 Vessel)	
13.2	For balance of SF6 enclosed Vessel	

**a) Circuit Breaker:**

1	Rated Voltage	11 KV
2	CB rated Current	
A	Incomer Breaker	1250 A
B	Outgoing feeder Breaker	630 A
3	Short circuit breaker Current:	
A	A.C. component	
B	D.C. component	As per IS:13118 or IEC62271
4	Short Circuit making Current	62.5 kA (peak)
5	Out of phase breaking Current capacity	As per IEC

6	Rated line/cable charging Interrupting current at 90° Leading power factor Angle	As per IEC
<b>Note:</b> Given details of CT, PT, Breaker are indicative. Some change be further finalized during the detailed engineering. Vendor shall submit the technical particular specific documents for approval.		
8	Rated small inductive current Switching capability with over Voltage less than 2.3 Pu	As per IEC
9	First pole to clear factor	1.5
10	Operating Duty	O-0.3 Sec-CO-3 Min-CO
11	Total break time	less than 5 cycles
12	Total make time	Less than 4 Cycles
13	Reclosing	3 phase auto Reclosing
14	Max. difference in the instants of closing/opening contact between poles at rated control Voltage and rated operating and quenching media pressures	As per IEC
15	Auxiliary contacts	8NO+6NC for future use besides scheme requirement
16	Operating Mechanism	Motor wound Spring charged stored energy type as per IEC-62271

**b) Current Transformer (Incomer and Bus coupler Feeder):**

1	Rated primary voltage	11KV
2	Rated primary current	1000/1A
3	Type of CT	1-Phase
4	Max temp rise	As per IEC:60044-1



5	Class of Insulation	Class E or better
6	One minute power frequency withstand voltage between secondary terminal & Earth	3 kV
<b>Note:</b> Given details of CT, PT, Breaker are indicative. Same shall be further finalized during the detail engineering. Vendor shall submit the technical particular specific documents for approval.		

**c) Current Transformer (Line Feeder/ trafo feeder):**

1	Rated primary voltage	11KV
2	Rated primary current	200/1A
3	Max temp rise	As per IEC:60044-1
4	Class of Insulation	Class E or better
5	One minute power frequency withstand voltage between secondary terminal & Earth	3 kV
6	No. of Secondary cores	2 Nos

**Note:** Given details of CT, PT, Breaker are indicative. Same shall be further finalized during the detail engineering. Vendor shall submit the technical particular specific documents for approval.

**d) Voltage Transformers:**

1	Rated primary voltage	11KV
2	Type	1-phase
3	Voltage ratio (kV)	$(11/\sqrt{3})/(0.11/\sqrt{3})$
4	Rated voltage factor	1.2 continuous and 1.5 for 30 seconds
5	Nos. of Secondary cores	2
6	Accuracy of Secondary core	1
7	Class of insulation	Class E or better

8	Rated output burden	50VA or cater to
	(Minimum) or to cater all Connected burdens of meters & relays.	connected load as per clause no 11.4

**Note:** Given details of CT, PT, Breaker are indicative. Same shall be further finalized during the detail engineering. Vendor shall submit the technical particular specific documents for approval.

**a) Bus-Bar Rating:**

1	Current rating of Bus bars	1250 A
2	Current rating of Bus Coupler	1250 A

### 8.2.1.2 Input Signal to System (If Required):

The following digital input of 11kV Indoor switchgear bays shall be provided through IEDs in the SCADA system:

- a) All status of CB, Isolator, Earth switch
- b) CB trouble
- c) CB operation/closing lockout
- d) Trip circuit faulty
- e) Bus VT FUSE Fail
- f) Back-up over current & earth fault protection Operated
- g) DC source fail

Above detail is indicative only, vendor shall submit the further detailing during engineering and submit for approval. Control On / Off function shall also be provided in SCADA with all the interlocks of field.

### 5.2.1.21. Multifunction Meter

The Multifunction meter shall have feature to measure KV, I, KWh, Kvar, PF, Kwhr, Kvarh with accuracy class of 0.5. Further, multifunction meter shall have bi-directional feature to register/record Kwhr values. RS 232 or RS 485 port.

### 5.2.1.22. Tests:

**a) Type Tests**

The contractor shall submit the reports for the following type tests on the equipment to be supplied under the contract:

**b) Switchgear Panel (with Circuit Breaker installed)**

- Short circuit duty test
- Short time and peak withstand current test
- Power frequency withstand test
- Lightning impulse withstand test
- Temperature rise test
- Internal Arc Test as per IEC 62271-200 (for 1 second)
- Measurement of resistance of main circuit
- Test to verify pressure relief operation of the panel **(During internal arc test)**
- Cable charging test
- Short circuit withstand test of earthing device
- Degree of protection test as per IEC

**c) Seismic Test Circuit Breaker**

- Mechanical Endurance Test

**d) Routine Tests**

All acceptance and routine tests as per the specification and relevant standards IEC 62271-200 & IEC 62271-100 shall be carried out. Charges for these shall be deemed to be included in the equipment price.

## **5.2.2. Transformers**

### **5.2.2.1. Dry Type Transformers**

This specification covers the requirements of 11/0.433 KV distribution dry type transformers complete with all accessories. The Cast resin dry type transformers shall be capable of operating continuously at its rated output without exceeding the temperature limits specified.

The transformers shall be suitable for connection to the system having short circuit level and short circuit duration as specified. The transformers shall be capable of withstanding without injury, the thermal & magnetic stresses caused by faults on any of the winding /through faults. Calculation shall be submitted along with the offer to prove that thermal as well as mechanical withstand capacity of the transformer is as per Indian Standards in the event of short circuit to the specified duration. Transformers shall be designed to withstand the thermal and dynamic stresses due to Short circuit at the terminals for 5 seconds duration with respect to fault level specified.

The impedance of the transformer shall not be less than as stated in Indian Standard at a reference temperature of 75°C.

The transformers shall be capable of delivering the rated output at any particular tap without exceeding the specified temperature limits under the following operating conditions.

- Voltage variation of  $\pm 10\%$  of rated voltage of that particular tap.

- Frequency variation of +3% to -5% of rated frequency.
- Combined voltage and frequency variation of 10% (absolute sum).

The transformers shall be free from annoying hum and vibration when it is in operation, even at 110% rated voltage. The noise level at rated voltage and frequency shall be as per NEMA-TR1 standard.

The transformers shall be suitable for over-fluxing (due to combined effect of voltage & frequency) up to 10% on any tapping without injurious heating at full load condition. The maximum flux density in any part of core and yoke under such condition shall not exceed 1.9 Tesla.

Generally, the Transformer shall have total efficiency not less than 98% at full load condition. Transformer shall be fitted with diagram and rating plates. The diagram plates shall show the winding connections and tapings in tabulated form.

Salient parameters of the transformers are as follows:

Nominal system voltage (HV / LV)	:	11/0.433K V
Vector group	:	Dyn11
Temp rise in winding by resistance method:	:	60°C over 45°C ambient
Parallel operation of transformer	:	Yes, only momentary
Short circuit withstand duration	:	2 seconds
11kV System fault level	:	26.3kA for 3sec
415V System fault level	:	50kA for 1 sec

#### 5.2.2.2. Windings

Transformers shall be connected as specified in design requirements. Winding shall comprise of high conductivity copper conductors completely impregnated and cast under vacuum in epoxy resin, fully insulated (with glass fibre reinforced epoxy insulation of very good electrical and mechanical quality), and shall be suitable for the highest system voltage. Winding shall be concentrically wound on the core, and shall be braced to withstand shocks, which may occur through rough handling during transport, switching and other transient condition during service, and also to reduce to a minimum the damage arising from stresses due to an internal fault. All windings shall be subjected to vacuum drying.

#### 5.2.2.3. Core

Cores shall be built from best quality, low loss, cold-rolled, grain oriented electrical steel laminations conforming to relevant Indian Standard. All core sheets shall be to reduce the core loss to a minimum. The flux density in core shall not exceed 1.6 Tesla under over voltage conditions and to this effect calculations shall be submitted. Maximum current density shall not exceed 2.5A per sq.mm. All joints shall be interleaved and the core shall be securely clamped so as to ensure that the noise level and the vibration are maintained at a minimum. All clamps shall be adequately insulated. The complete core shall be coated with special resin as a protection against corrosion.

#### 5.2.2.4. Temperature Indicators

For measuring hot spot temperature in the winding, 150 mm dia dial type winding temperature indicator (WTI) with adjustable potential free alarm and trip contacts, maximum reading pointer and resetting device shall be provided. Temperature sensing element shall be complete with image coil, bushing CT etc. Accuracy class of WTI shall be  $\pm 2^{\circ}\text{C}$  or better.

#### 5.2.2.5. Bushings

All bushings shall be homogenous, non-porous porcelain type, uniformly glazed and free from blisters, burns and other defects complete with suitable terminal connectors of adequate capacity. Bushings located inside cable boxes / bus-duct flanges can be epoxy- moulded types. Bushing CTs shall be provided as per system requirement. Secondary leads of CTs shall be wired upto-marshalling box. The arrangement shall be such that the CT can be removed from the transformer without removing the tank cover. Current transformers shall be cast resin type with Class E or better insulation.

#### 5.2.2.6. Terminal Arrangement

Type of terminal connection shall be by Cables on both HV & LV side. The cable box shall be suitable for the working pressure of cable with which it is associated and shall have adequate clearances for the specified voltage and cable termination kits. For cable termination, terminals of transformer shall be brought out through side wall mounted bushings to a detachable cable box with disconnect link. The cable box shall be self- supporting, weather proof, air filled type complete with all hardware such as undrilled gland plates, etc.

The design of the box shall be such as to preclude the access of water to the box. An adequate space shall be provided within the box so that the cable cores may be formed into the lugs without undue bending or stress on the lugs, and adequate clearance shall be preserved between live metal and frame such that the electrical pressure tests specified in Indian Standard are satisfied. Flexible links shall be provided between transformer terminals and cable lugs. Cable box shall have IP 55 degree of protection.

#### 5.2.2.7. Marshalling Box

Marshalling box shall be sheet steel enclosed with IP 55 degree of protection alarm & trip contacts of all the fittings & accessories and secondary leads of CTs shall be wired up to marshalling box. Cable gland plate shall be of removable type. The marshalling box shall have isolating switch & MCB for incoming power supply. Cubicle illumination lamp with door switch and space heater with thermostat and ON/OFF switch shall be provided. The marshalling box shall have 10% additional set of control terminals.

#### 5.2.2.8. Grounding

Two grounding pads, located on the opposite sides shall be provided for connection of station ground mat / overall earthing for each transformer. Grounding pads shall have clean buffed surface with tapped holes. M10 GI bolts, nuts and spring washers. Two ground terminals each shall be provided on marshalling box & cable box. For neutral connection,

two ground copper conductors of specified size shall be provided, supported on pin insulators (provided on tank) from neutral bushing to the bottom of the tank for connection to station ground.

#### 5.2.2.9. Off Circuit Tap Changer

Off Circuit tap changers shall be provided on HV winding with +/- 10% range of taps in steps of 2.5%. The tap changing shall be affected by an external 3 phase gang operated tap change switch. The operating handle shall be padlocked at any position. The mechanism shall be provided with a mechanical tap position indicator, mechanical stop to prevent over cranking of mechanism etc. A warning plate indicating 'For de-energised operation only' shall be fitted.

#### 5.2.2.10. Wiring and Terminal Blocks

All control cabinets, marshalling boxes, etc. shall be fully wired at the factory to ensure proper functioning of the control, protection and interlock schemes. All spare contacts of switches, relays and other devices shall be wired upto the terminal block.

Wiring shall be done with flexible 1100V grade HR PVC cables with stranded copper conductor of minimum size 2.5 sq.mm. Wiring shall be identified at both ends with ferrules bearing wire numbers as per approved drawings. Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

Terminal blocks shall be of 1100 V grade suitable for terminating required cable size. Terminals for CT secondary shall have provision for shorting. Not more than two wires shall be connected to any terminal. 20% spare terminals shall be provided. All devices and terminal blocks within the panel shall have identification numbers as per schematic diagram.

#### 5.2.2.11. Nameplate

Each transformer shall be provided with a nameplate of weather-resistance material fitted in a visible position showing all the 'information and additional information' as per IS: 1117.

#### 5.2.2.12. Fittings & Accessories (whichever is applicable for Dry type)

Each transformer shall be supplied with the following as a minimum:

- Two nos. Stainless steel Rating & Diagram (Hindi & English), terminal marking and danger plates.
- 3 earth terminals per transformer, each suitable for earth conductors of size 2 numbers 75x10mm GI strip for earthing of the body of the transformer and its enclosure.
- Lifting lugs for complete transformer and Core-coil assembly
- 6 numbers PT100 RTDs with Winding temperature indicator (WTI) display
- 4 nos. Jacking Pads
- 4 nos. Bi-directional Rollers / flanged wheels with stopper arrangement to lock transformer in required position
- 4 nos. Cover lifting eyes
- Marshalling box
- Cable box

- 1 no. off circuit tap changer
- 3 nos. HV Bushings with terminal connectors
- 3 nos. LV Bushings with terminal connectors
- 1 no. LV Neutral Bushings with terminal connectors
- Platform mounting channel
- 1 set LV Neutral Bushing CTs
- 2 nos. Inspection covers
- 2 nos. supports for HV cable box
- 1 Lot Interconnecting cables

#### 5.2.2.13. Testing and Inspection

Transformer and all its fittings should have been type tested and proven type. Type test certificates shall be furnished for Purchaser's review. Transformer and all its fittings shall be subjected to routine tests as per applicable Indian Standard. In addition, any special test required shall also be performed. Test reports shall be submitted for approval.

#### 5.2.2.14. Spares List

Suitable number of commissioning and successful running for 2 years spares list shall be submitted for approval.

### 5.2.3. LT Switchgear

#### 5.2.3.1. Introduction

This specification covers the requirements of 415V Power Control Centre complete with all accessories. The LV main switchboards shall be type tested assemblies (TTA) all type tests as defined in IEC 61439-1&2, built up from compartments housing circuit breakers, Control gear, relays, bus bars, controls and other items of equipment. The design of the switchboard shall be tested design from the main switchgear manufacturer and manufactured under license agreement with the main switchgear manufacturer.

#### 5.2.3.2. General Requirements

The scope of supply covers design, manufacture, testing and supply, Installations, testing & commissioning of LV PCC Panels. Panels must conform to Totally Type Tested (TTA) as per IEC 61439. Type Test Certificates for short circuit withstand of 50kA 1 sec along with ACB mounted in the Switchboards is mandatory for submission.

Switchboard shall be suitable for Seismic Zone V as per IEC 60068-3-3. This section covers the detailed requirements of low voltage switchboard for 415 volts, 3 phase, 50 Hz, 4 wire system.

Distribution Panels shall be covered under this section. Panels shall be suitable for operation on 3Phase/single phase, 415/240volts, 50 cycles, 4 wire system with neutral grounded at transformer. All LT Distribution panels shall be design and manufactured by an approved manufacturer. When the switchgear is to be provided as an integrated switchboard/MCC, this specification reference is made to "specified elsewhere or as specified".

#### 5.2.3.3. Requirement for proposed 1kV LT Panel:

Kindly refer tender SLD for requirement.

#### 5.2.3.4. Codes & Standards:

Switchgear shall be designed, manufactured and tested in accordance with the latest Relevant international Standards and Electricity Rules and Regulations and shall be as per latest applicable sections of the IEC codes. The latest edition shall always be used. Switchgear manufactured in India shall be designed, manufactured and tested in accordance with either IEC codes or standards.

#### 5.2.3.5. Service Conditions

The Switchgear (including the electronic sub-assemblies used in control/ monitoring /measurement circuits in the control compartments, etc) will be installed in a ventilated building. Where it can be demonstrated that:

The switchgear, when derated for an ambient temperature of 45°C will not meet the specified duty, or the design life of the electronic sub-assemblies is significantly reduced at an ambient temperature of 45°C then the requirement for additional cooling or air conditioning shall be clearly stated or the equipment shall be rated to this effect. Switchgear shall have a design life of at least 20 years.

#### 5.2.3.6. Construction

MLTP, Main Distribution Board, Sub Distribution and Meter Boards shall be metal enclosed, indoor, floor mounted free standing type made up of the required vertical section, which when coupled together shall form continuous dead front Distribution Board. Main Distribution Board/Sub Distribution Board shall be dust and damp protected the degree of protection being no less than IP-54 to IEC.

All Panels & Main Distribution Board shall be extensible on both sides by the addition of side section after removal of end covers. Main Distribution Board/Sub Distribution Board shall be fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness, doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shroud and partitions shall be of exterior of Main Distribution Board/Sub Distribution Board shall be smoothly finished, levelled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust excluding neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Following minimum clearances to be maintained after taking into account connecting bolts, clamps etc.

- |                              |   |       |
|------------------------------|---|-------|
| • Between Phases             | - | 25 mm |
| • Between Phases and neutral | - | 19 mm |
| • Between Phases and earth   | - | 19 mm |
| • Between neutral and earth  | - | 19 mm |

All insulating materials used in the construction of the equipment shall be of non-hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. Functional units such as fuse switch / switch fuse unit/ moulded case circuit breakers shall be arranged in multi-tier formation but All ACB panels shall be single tier only. ACB mounted in double tier is not acceptable. The design of the Main Distribution Board/Sub Distribution



Board shall be such that each fuse switch/switch fuse units/MCCB shall be fully compartmentalized. Panel height shall not exceed 2300mm including base frame

Insulated barriers shall be provided with a vertical section and between adjacent section to ensure prevention of accidental contact with main busbars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access. The panel shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables. For each cable, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be as per Panel manufacturer & should be suitable for cable sizes as mentioned in the single line diagram.

Phase separation space shall be provided with adequate space between two feeders, two phases or for two conductors. Bus bar must be insulated with high voltage sleeve.

Panel shall be provided with proper operating knob and with proper opening / closing arrangement. Bolting doors on front shall be avoided. It is to be provided with metal knob. All internal cables shall be used of FRLS only.

#### 5.2.3.7. Metal Treatment and Finishing

All metal work used in the construction of the main Distribution Board/Sub Distribution Board should have undergone a rigorous metal treatment process as follows:

- a) Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.
- b) Pickling in dilute Sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
- c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
- d) Passivating in de-oxalate solution to retain and augment the effects of phosphating.
- e) Drying with compressed air in a dust free atmosphere.
- f) Primer coating with two coats of a highly corrosion resistant primer, applied wet on wet and stove dried under strictly controlled conditions of temperature and time.
- g) A finishing coat of staving synthetic enamel paint of gray color of approved color / or powder coating.

#### 5.2.3.8. Busbars:

The busbars shall be air insulated and made of high conductivity, high strength Aluminium alloy complying with the requirement of grade of IEC. Busbars shall be colour coded for ready identification of phases. The Busbar sizes shall be determined taking into consideration the continuous rating and fault level of 50 KA (1 sec) without exceeding the final temperature of 105 C under rated current.

The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize the possibility of fault. The

main phase busbars shall have continuous current rating throughout the length of the panel. The cross section of neutral busbars shall be same as that of the phase busbar for busbars of capacity up to 500 Amp., for higher capacities, the neutral busbar shall not be less than half (50%) the cross section of that of the phase busbars. Connections from the main busbars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars shall be colour coded with PVC Sleeves.

The Main Distribution Board/Sub Distribution Board shall be designed that the cables are not directly terminated on the terminals of switch fuse/fuse switch etc. but are terminated on cable termination links. Vendor shall submit all following type test report which are less than 5 years old and as per latest & IEC Standards:

- Short Circuit withstand test for main Busbar and 100% neutral Busbar
- Temperature rise test
- IP test
- Seismic test
- Dielectric Test
- Continuity of Protective Circuits
- Clearance & Creepage distance
- No. Of Mechanical Operations

#### 5.2.3.9. Switchboards (TTA Assembly)

The LV main switchboards shall be type tested assemblies (TTA) all type tests as defined in IEC 61439-1 & 2, built up from compartments housing circuit breakers, Control gear, relays, bus bars, controls and other items of equipment. The design of the switchboard shall be tested design from the main switchgear manufacturer and manufactured under license agreement with the main switchgear manufacturer.

The LV main switchboards and the associated equipment, including switchgear, control gear and bus bar assemblies shall be certified for the category of duty specified. The LV Main Switchboard shall be identical in mechanical construction to the LV Switchboard which had been type-tested by an acceptable, accredited and independent testing laboratory for the fault conditions, temperature rise limits. Any manufacturer not having the above will not be considered for supply. The main circuits of the LV main switchboards shall have an insulation voltage of 1000 V AC.

The protective earthing configuration shall be TN-S unless otherwise specified. The design temperature for the equipment provided in the main low voltage switchboards shall be + 50 °C. The relative humidity shall be 75% at a temperature of + 50 °C.

The secure service life of equipment used for switchboards, sub-assemblies and components shall be at least 30 years. Where armoured multicore cables terminate inside the switchboard enclosure, glanding plates or glanding brackets shall be provided for securing the cables to the switchboard. Glanding plates, glanding brackets and extension boxes shall be removable and shall be of adequate size for the particular cables to be terminated. Separate current transformers shall be provided for each protection device and for instrumentation. The switchgear assembly/sub-assemblies or panels

shall be termite and rodent proof. The sub-assemblies of similar equipment shall be interchangeable. The designs of the switchboards should be with switchgear manufacturer, and all the mechanical drawings must be available in the factory beforehand. Switchboards shall have a short circuit level withstand as per Schedule of Quantities and drawings.

The enclosures shall be designed to take care of normal stress as well as abnormal electro-mechanical stress due to short circuit conditions. All covers and doors provided shall offer adequate safety to operating persons and provide ingress protection of IP 54 unless otherwise stated. Ventilating openings and vent outlets, if provided, shall be arranged such that same ingress protection of IP 54 is retained.

Switchboards shall also have test certificate for Seismic withstand upto Zone V. The switchboard along with ACBs and connections should have been been type tested design at CPRI/ERDA /Independent international test house for short circuit, temperature rise, protective earth short circuit test and dielectric tests of the ratings required .

For operator safety IP2X (touch proof) protection to be available even after opening the feeder compartment door. The compartmentalization to be achieved by using metal separators, use of PVC sheet / Hylem sheets shall not be allowed.

As specified in the BOQ the switchboard shall be form 4b. For form of separation only metallic covers shall be used. Hylem / PVC sheets shall not be allowed. Manufacturers should submit the Type Test reports atleast 5 years old and One manufacturer will be able to submit the quote with Single Make Switchgear.

#### **a) Switchboard Configuration**

The Switchboard shall be configured with Air Circuit Breakers, MCCB's, MCB's and other equipment as called for in the schedule of quantities.

The MCCBs shall be arranged in single-tier formation whereas the Air Circuit Breakers shall be arranged in Single tier formation only to facilitate operation and maintenance.

The Switchboards shall be of adequate size with a provision of spare space to accommodate possible future additional switch gear.

#### **b) Constructional Features**

The equipment shall be arranged within each compartment such that all normal maintenance can be carried out through hinged access doors or removable covers, and where possible from the front. The switchboard shall have a rated short time withstand current of 50 KA for 1 second and a fault withstand classification of Class 3 for a supply voltage of 415V AC between phases at 50Hz.

Protection against shock in normal service shall be achieved by the provision of barriers or enclosures both vertical and horizontal and between adjacent units to ensure segregation and prevent accidental contact with live parts, or by complete insulation of all live parts. Control cables shall be segregated from primary conductors.

The Switchboards shall be metal clad totally enclosed, floor mounted free standing type of modular extensible design suitable for indoor mounting. Switchboards construction shall employ the principle of compartmentalized and segregation for each circuit.

The LVSBs shall be provided with front and back access and the maximum height shall not exceed 2.60 m. All relays and indicating instruments shall be at least 500 mm and not higher than 1.8 m above floor

level. The clearance in front, back and side of all assemblies of switchgear and control gear shall be generally not less than 1.2 metres. The switchgear shall be considered in the fully drawn out condition for this purpose.

Incomer and bus section panels or sections shall be separate and independent and shall not be wired with sections required for feeder. The incomer panel shall be suitable for receiving bus trunking or MV cable of size specified. Switchboards shall be made up of requisite vertical sections, which when coupled together, shall form continuous dead front switchboards.

Switchboard shall be readily extensible on both sides by addition of vertical sections after removal of the end covers. The switchboards shall be designed for use in high ambient temperature and humid tropical conditions as specified. Ease of inspections, cleaning and repairs while maintaining continuity of operation shall be provided in the design.

Metal based neoprene gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 54 as stipulated in schedule of quantities. The unused openings within the switchboards shall be closed using suitable grommets. Special care to be taken to ensure effective earthing of the frame and doors of the switchboards.

Each vertical section shall be provided with a rear or side cable chamber housing the cable end connections and power/control cable terminations. There should be generous availability space for ease of installation and maintenance with adequate safety for working in one vertical section without coming into contact with any live parts. The design of the switchboard shall allow standard extension chambers if required to accommodate cables. Some switchboards may be required to be installed against the wall, for such application- documented designs shall be available.

Switchboard panels and cubicles shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be fabricated from CRCA sheet steel of thickness not less than 2 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned. Switchboard shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.

Bus bars shall be made of high conductivity, 99.9% purity, high strength Copper of ETP grade or copper, Oxygen Free, Bus bars shall be of rectangular cross sections, not less than 10mm thickness better suitable for full load current for phase bus bars and full rated current for neutral bus bar or as stipulated in schedule of quantities. Busbar shall be suitable to withstand the stresses of fault level as specified in schedule of quantities.

The LVSBs shall be mounted on a robust base frame made up of steel channels with a minimum height of 100mm. The base frame shall be able to withstand the static and dynamic loads of the LVSBs. The steel channels shall be painted with epoxy polyester paint. Non-magnetic gland plates of not less than 3.2mm thick shall be provided at the top and bottom of the LV main switchboards for the termination of incoming and outgoing power cables or bus-ways.

#### **c) Switchboard Dimensional Limitations**

The overall height of the switchboard shall be limited to 200 mm for all the Busbar ratings and type of switchboards. Panel should have integral base frame of 75mm, hence total panel height should not be more than 2400mm. The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level. Other dimensional limits if any are specified separately.

#### **d) Switchboard Compartmentalization**

For compartmentalized switchboards, separate totally enclosed compartments shall be provided for horizontal busbars, vertical busbars, ACBs, MCCBs, and cable trays. The main board shall be with Form 4b Construction. Earthed metal or insulated shutters shall be provided between draw out and fixed portion of the switchgear such that no live parts are accessible with equipment drawn out. Degree of protection within compartments shall be at least IP 2X.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position. For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.

For Some MCCB feeders for critical loads like UPS it may be required to have operation only after opening the door, all MCCB shall have pad lockable rotary handle. Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only. A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Separate cable compartments running the height of the switchboard in the case of front access boards shall be provided for incoming and outgoing cables. Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary and adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley / cable chamber.

#### **e) Switchboard Bus Bars**

Busbars and busbar connections shall be constructed in accordance with the requirements of IEC 60439-1&2. The short-time withstand current rating shall be at least 50 kA for 1 second at 415 V.

Busbars shall be of rectangular section hard drawn high conductivity copper adequately rated and supported by non-tracking moulded insulators spaced at suitable intervals. The complete assembly shall be capable of withstanding the maximum mechanical stresses to which it may be subjected to under fault conditions.

Connection shall be made with double split cast brass clamps. Drilling of the Main bars will not be permitted. Busbar, busbar connection and conductors forming part of the equipment of the switchboards shall comply with IEC 61439-1&2 on current carrying capacity and limits of temperature rise.

The main busbars shall be so positioned and arranged that all busbar risers and droppers can be brought onto the main busbars without undue bending. Busbars shall be separated and supported with appropriate clearances in air in addition to the requirement of providing full insulation. Separate insulating covers shall be installed over all bus-bars and incoming bus-bars in accordance

with BS EN 60216, IEC 60085 and IEC 60216-1. The insulating covers shall withstand fire or excessive heat caused by internal electrical phenomenon. Busbars shall be coloured black with colour coded for phase identification. The material for phase identification shall be non-colour fading and use of adhesive label shall not be acceptable.

All conductors between the busbars and the switchgear shall be of high conductivity copper bar, having a current rating of not less than that of the frame size of the switchgear to which they are connected. The conductors shall be insulated and colour coded for phase identification.

The busbars shall be extendible from both ends. The maximum temperature of the bus-bars and the bus connections shall not exceed 90 °C. The temperature rise tests shall be carried out at full rating of rated current for all busbars. Type test certificates for temperature rise shall be given for acceptance in the event of order.

Connections: All the incoming / outgoing terminations shall be extended via fully insulated copper connections into a separate termination chamber adjacent to the rear of the switchboard. When busbars are used between switchboards, the internal busbars of the switchboard shall be in fully insulated copper bars of the same size as the switchboard busbars. No linking with cables shall permit in this case.

The bus bar system may comprise of a system of main horizontal bus bars and auxiliary vertical bus bars run in bus bar alloy on either side in which the circuit could be arranged with front access for cable entrances

Auxiliary buses for control power supply, space heater power supply or any other specified service shall be provided. These buses shall be insulated, adequately supported and sized to suit specific requirement. The material for auxiliary supply bus will be insulated electrolytic copper wires.

Clearances between phases should be in line with IEC.

#### **f) Switchboard Interconnection**

All connection and tap offs shall be through adequately sized connectors appropriate for fault level at location. This shall include tap off to feeders and instrument/control transformers.

For unit ratings up to 100 amps, PVC insulated 105 deg C withstand, copper conductor wires of adequate size to carry full load current shall be used. The terminations of such interconnections shall be crimped. Solid connections shall be used for all rating of above 100 amps.

All connections, tapings, clamping, shall be made in an approved manner to ensure minimum contact resistance. All connections shall be firmly bolted and clamp with even tension. Before assembly joint surfaces shall be filed or finished to remove burrs, dents and oxides and silvered to maintain good continuity at all joints. All screws, bolts, washers shall be zinc plated. Only 8.8 grade nuts and bolts shall be used for busbar connections.

#### **g) Draw out Features**

Air Circuit Breakers shall be provided in fully draw-out cubicles, unless otherwise stated. These cubicles shall be such that draw-out is possible without disconnection of the wires and cables. The power and control circuits shall have self-aligning and self-isolating contacts. Mechanical latches shall be integrated in ACB at service, test and isolated position to ensure that Breaker is firmly latched in respective position. It shall not be possible to move the breaker from the position unless latch is manually operated.

#### **h) Instrument Accommodation**

All voltmeter and ammeter and other instruments shall be flush mounted type of size 96 sq. mm conforming to IEC for accuracy. All voltmeter shall be protected with MCB's. Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switchboard.

For MCCBs, instruments and indicating lamps can be provided on the compartment doors. The current transformers for metering and for protection shall be mounted on the solid copper busbars with proper supports. On all the incomers of switch boards ON/OFF indicators lamps shall be provided suitable for operation on AC 230 volts supply. All I I amps shall be protected by MCBs.

For Incomer and important outgoing feeders comprehensive digital power meters with LCD Display shall be provided which shall display A, V, Pf, Hz, Kw, KVA, KVA<sub>r</sub>, Kwh, Kvarh, average and maximum values, demand values, THD on current and Voltages. Also add on modules for communication, programmable contacts, analogue output etc to link to BMS/SCADA system.

#### **i) Wiring**

All wiring for relays and meters shall be with FRLS/ZHFR copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 2.5 sq. mm. Runs of wires shall be neatly bunched and suitably supported and clamped. Means shall be provided for easy identification of wires. Identification ferrules shall be used at both end of wires. All control wires meant for external connections are to be brought out on a terminal board. The cables and control wires shall be suitable for withstanding 105 deg C.

#### **j) Space Heaters**

Anti- condensation heaters shall be fitted in each cubicle together with an ON/OFF isolating switch suitable for electrical operation at 230 volts A.C 50 Hz single phase of sufficient capacity to raise the internal ambient temperature by 45 C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energized while the switchboard is in operation. As a general rule, the heaters shall be placed at the bottom of the cubicle.

#### **k) Ventilation Fans**

The Switchboard shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 4500 amp and above. The fan shall be interlocked with switchgear operation. The degree of enclosure protection to be maintained even with Fans.

#### **l) Earthing**

Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to station earth at two points. Hinged doors / frames to be connected to earth through adequately sized flexible braids.

#### **m) Sheet Steel Treatment and Painting**

Sheet steel used in the fabrication of switchboards shall undergo a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, descaling in dilute sulphuric acid and a recognised phosphating process after which a coat of primer paint comparatively with the final paint shall be applied over the treated surface. Final paint coat of oven baked powder coating, of minimum

50-60 micron thickness, of sheet approved by Engineer-in-Charge shall then be provided.

**n) Name Plates and Labels**

Suitable engraved white on black name plates and identification labels of metal for all Switchboards and Circuits shall be provided. These shall indicate the feeder number and feeder designation. Nameplate shall carry the name of the original switchgear manufacturer and also the manufacturing franchise partner.

**o) Type test reports.**

Total type test assembly (complete type test switchgear as well as enclosure of Switchboard configurations offered shall be CPRI/ERDA/Independent international test house tested for all the tests as per IEC61439-1&2. The material and the spacing of the Bus bar supports should be same as per the type tested assembly. Copies of the test certificates shall be submitted in the event of order.

**p) Testing at Works**

Copies of type test carried out at ACB/MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Engineer-in-Charge reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the followings.

- Physical variation and dimensional check
- Verification of bill of material
- Functional check
- HV test
- IR test

Before fabrication the contractor will submit a detailed dimensional drawing indicating general layout of ACBs/ Switches/ MCCB's bus-bars, Cable alleys etc. for approval by the engineer in charge. At fabrication stage the panel will be got inspected at the factory also.

Earthing System shall be as per CPWD General Specification for electrical Works (Part-I for internal Works) 2013 and as amended upto date. All the incomer ACB / MCCB and ACBs/ MCCBs as coupler should be interlocked mechanically as well as electrically in a manner as mentioned in the BOQ.

**Auto change over for bus shall be required. In case of failure of any incomer, second incomer shall be ON with immediate effect.**

**5.2.3.10. Measuring Instruments for Metering:**

**Multifunction meter**

**a) Applicable Standards**

The meters shall conform in all respects to International standards – IEC 61557-12, IEC 62053-22, IEC 62053-23 or the relevant Indian standards with latest amendments thereof.

**b) General Requirements**

- The meter shall be suitable for operation in 3 - phase networks, balanced as well as unbalanced load.



- CT polarity correction should be possible through Energy Meter for each phase.
- Import/ Export measurement for KWH/ KVARH is required.
- It shall be possible to use the multifunction meter directly in 480V networks
- The current inputs shall be configurable at site for measuring x/5 A current transformers
- The multifunction meters shall be suitable for operation upto 55 Deg C
- The meters shall be suitable for operation with AC auxiliary power and shall have wide tolerance band of 100V to 240 V ( $\pm 10\%$ )
- The multifunction meters shall have high degree of protection (IP65 from the front) against ingress of dust & water
- The multifunction meters shall have backlit LCD display with adjustable contrast
- The meter shall be tamper-proof (password protected) to avoid mishandling by unauthorized person

**c) Measured Values requirement**

All metered values will be in "true RMS" values. The monitor shall include a keypad allowing for the viewing of different selected values. The monitor shall display the following values

Voltages	Phase-phase / phase-neutral
Currents	Per phase / neutral
Apparent, active and reactive power	Per phase and total
Power factor	Total
Frequency	45...65 Hz
Min. / max. values	Voltage - phase-phase, phase-neutral/ Current/ Neutral current/ Power/ Power factor/ Frequency
Active energy	Import/ export/ net
Reactive energy	Import/ export/ net
Energy demand per measuring period	Three phase average rating for active and reactive power: 1 to 60 min.
Min. / max. rating values within the measuring period	Should be possible to be measured

**d) Measurement Accuracy**

The multifunction meters shall be of high accuracy type and shall have the following levels of accuracy. (Accuracy class in accordance with IEC 61557-12:2007-08)

- Voltage            Class 1
  - Current            Class 1
  - Power            Class 1
  - Power factor    Class 2
  - Active energy    Class 1 in accordance with IEC62053-22:2003-01
  - Reactive energy Class 3 in accordance with IEC 62053-23:2003-01
- e) The meter shall have at least 2 Digital Input and 2 Digital Output as standard for the communication of Circuit Breaker's Status.
- f) Communication

The meters shall have inbuilt RS485 MODBUS RTU. It shall be possible to parameterize the device either by the keys on the device or through parameterization software.

#### 5.2.3.11. Miscellaneous

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting. Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

#### 5.2.3.12. Testing and Inspection

Switchgear and all its components should have been type tested and proven type. Type test certificates shall be furnished for Purchaser's review. Switchgear and its components shall be subjected to routine tests as per applicable Indian Standard. In addition, any special test required shall also be performed. Test reports shall be submitted for approval.

#### 5.2.3.13. SPARES LIST

Suitable number of commissioning and successful running for 2 years spares list shall be submitted for approval.

### 5.2.4. 110V DC SYSTEM

#### 5.2.4.1. Introduction

This specification covers the requirements of 110V DC Batteries, Chargers and DC Distribution Board.

#### 5.2.4.2. Design

The function of the 110V DC Power Supply System is to provide the normal source of power to the 110V DC loads, such as Control Supply to Switchgears / Panels.

The 110V DC Power Supply System shall also be capable of constantly supplying emergency loads for a period of 1 hour when AC supply to Charger fails.

The duty cycle imposed on the battery shall include the following.

- Continuous loads (indicating lights, continuously energized coils, Control Panels, Relays)
- Momentary loads (switchgear operation (Trip coil/Closing coil), which exist for a period of less than 1 min period)

The 110 VDC Power Supply System shall be operated as an ungrounded system; that is, the negative terminal or ground reference terminal is not connected to the station ground grid. A DC ground monitoring system on the DC systems shall be provided and any DC ground fault shall be alarmed.

Batteries shall be sized in accordance with IEEE-485. The battery shall be sized with a 10% design margin and an ageing factor of 1.25

110V DC Power Supply System consists of 1X100%, 110V batteries, 1X100% 110V battery chargers and DC Distribution Boards. End Cell Voltage of Lead Acid Plate battery is 1.85 V / Cell and Nickel cadmium battery is 1.14V / Cell

During Normal operating condition, batteries shall be supplied from two (2) 100 percent battery chargers. The chargers are supplied power from PCC/ MCC's. The battery chargers shall supply the 110V DC loads and, at the same time, shall continuously float charge fully charged batteries. Both the chargers shall have dedicated incoming AC supply from MCC/PCC.

During Emergency operation the battery shall supply the DC load when there is a loss of all auxiliary AC power supplies and/or a loss of power from the battery chargers. Batteries shall normally be permanently connected to the load in parallel with a charger and shall supply the load during emergency condition when AC supply is lost.

The Charger shall be float cum boost type Chargers suitable for float charging both the batteries and supply load simultaneously. Chargers shall boost charge fully discharged batteries in 12 hours. Design margin of minimum 20% shall be considered in charger sizing for either mode of operation.

Charger protections such as DC-O/V & U/V, AC U/V, E/F, S/C protection etc. shall be considered.

#### 5.2.4.3. Construction of Battery

Lead Acid (Valve regulated) sealed maintenance free Plate type batteries shall be float charged at 2.15 to 2.20 Volts per cell and chargers shall also be capable of boosting charging the associated DC battery up to 2.7 Volts per cell at the desired rate. Batteries shall be rated for 10 hour discharge rate (C10) as per manufacturer data.

Containers shall be made of suitable glass fibre reinforced plastics or Polypropylene. Containers shall be robust, heat resistance, leak proof, non-absorbent, acid/alkaline resistant, non-bulging type and free from flaws such as wrinkles, cracks, blisters, pin holes etc.

Batteries shall have thick plates designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative terminals shall be clearly marked.

Each cell shall be separately supported on porcelain insulators fixed on to the racks with adequate clearance between adjacent cells. Breathers/Vent plugs etc. shall be provided for each cell. It shall be anti-splash type and having more than one exit hole to allow the gases to escape freely but prevent

the acid spray from the battery.

Lead coated copper inter-cell connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. All the terminals and cells, interconnections shall be fully insulated or have insulation shrouds/covers.

End take off connections from positive and negative poles of batteries shall be made by single core cables having stranded copper conductors and PVC/XLPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied. All connectors and lugs shall be capable of continuously carrying the 60 minute discharge current of the respective batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Anti-corrosive gel shall be applied at the Battery terminals.

Wooden racks shall be provided for batteries for multi-tier installation. These racks shall be made of good quality first class seasoned teak wood. They shall be free standing type mounted on porcelain insulators. Numbering tags, resistant to acid for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor.

The following accessories shall be provided with batteries.

- |  |                      |
|--|----------------------|
| • Syringe type Hydrometer                            | : 2 Nos per Battery  |
| • Thermometer with specific gravity correction scale | : 2 Nos per Battery  |
| • Cell testing voltmeter 3-0-3 volts                 | : 2 Nos per Battery  |
| • Acid resistant funnel                              | : 2 Nos per Battery  |
| • Acid resistant jug.                                | : 2 Nos per Battery  |
| • Rubber apron and gloves                            | : 2 sets per Battery |
| • Spanners   | : 2 sets per Battery |
| • Wall mounted teak wood rack for above items        | : 2 Nos per Battery  |

The following maintenance spares shall be provided as a minimum

- |                            |                  |
|----------------------------|------------------|
| • Inter cell connectors    | : 10 Nos.        |
| • Inter row connectors     | : 2 Nos.         |
| • Battery stand insulators | : 2 Nos          |
| • Cell insulators          | : 2 Nos          |
| • Nuts, bolts & washers    | : 10 pieces each |
| • Vent plugs               | : 10 Nos.        |
| • Spare dry cell           | : 4 Nos.         |

Fuse box for each battery shall be provided in the battery room and shall comprise the following:

- DP Fuse Switch unit
- HRC Fuses with striker pin & aux contact for remote alarm
- FRP enclosure.

Discharge resistor made of punched stainless steel grid enclosed in sheet steel enclosure shall be provided for discharge testing of Battery.

Battery cell voltage in any discharge condition shall not be less than 1.75 V.

#### 5.2.4.4. Construction of Battery Charger

During float charging, each charger shall feed the respective DC Distribution board and as well as float charge its own batteries and shall maintain a DC voltage that shall pass the minimum current through the cells to keep them charged without overcharging. In case of mains failure to charger or charger failure, battery shall supply the full load. While boost charging of respective battery, DCDB shall be isolated from the Charger and shall be fed from other Charger.

Each Battery charger should meet the Trickle requirement of both banks (under emergency) and boost requirement of each bank. During boost charging, the battery charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the boost charging current continuously over a range of 50 to 100 % of the rated output current for boost charging mode. During boost charging the Boost charger shall recharge the completely discharged battery to full capacity in 10 hours.

When on automatic control mode during float charging, the charger output voltage shall remain within  $\pm 1\%$  of the set value for AC input voltage variation of  $\pm 10\%$ , frequency variation of  $\pm 5\%$ , a combined voltage and frequency (absolute sum) variation of 10 % and a continuous DC load variation from zero to full load. Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the charger panel covering the entire float charging output range specified. Battery chargers shall have a selector switch for selecting the battery charging mode i.e. whether float or boost charging.

All battery chargers shall be provided with facilities such as automatic voltage regulator (AVR) for both automatic and manual control of output voltage and current.

The chargers shall be of self-regulating, natural air cooled, static type provided with suitable double wound transformer, full wave thyristor type rectifiers, filter circuits, DC & AC Switchgear. Chargers shall be metal enclosed, fixed type, suitable for indoor mounting on floor. Panel frame shall be fabricated using cold rolled sheet steel of thickness not less than

2.0 mm. The frames shall be enclosed by cold rolled sheet steel of thickness not less than

2.0 mm. Suitable synthetic rubber gaskets shall be provided to achieve a degree of protection of IP54.

Rectifier transformer shall be continuously rated, dry type, class F insulation, epoxy resin impregnated, A.N. cooling and with adequate number of taps. The rating of rectifier transformers shall correspond to the rating of the associated rectifier assembly.

All the charger panels shall be provided with an illuminating CFL lamp, a 5 Amp socket and space heaters with thermostat. Toggle switches and MCB's shall be provided separately for each of the above fittings. Space heaters "ON" indication to be provided. Two separate grounding pads shall be provided. Locking facilities shall be for locking float / boost selector switch in the float position only.

Digital type Window annunciator shall be provided for alarm annunciation with acknowledge, test and reset push buttons and a buzzer for the following conditions.

SCR fuse fail Battery / DC system under voltage

- DC system overvoltage
- DC over load
- Output fuse blown
- AC supply fail
- AC undervoltage
- Battery earthfault
- Filter fuse failure
- Battery on Float / Boost
- Charger fail/Battery on discharge
- Any other annunciation, as required

Remote alarm contacts for hooking up to PLC shall be provided. For each charger, current & voltage transducer shall be provided for remote monitoring of DC voltage and Current at PLC. Protection features, indications, meters and alarms shall be provided for each charger. Protection features shall include the following as minimum.

- Overload Protection
- Phase failure protection
- Voltage unbalance protection
- Fuse failure protections for SCR and filter circuit

Suitable potential free contacts for remote indication of above abnormal conditions shall be provided. However the requirements / design shall be firmed up during the detailed engineering stage.

Vendor shall consider two independent sources of AC supply and change over shall be considered accordingly in panel. Battery charger must have one or two exhaust fan for the air circulations.

#### 5.2.4.5. Testing and Inspection

Battery & Charger and all its components should have been type tested and proven type. Type test certificates shall be furnished for Purchaser's review. Battery & Chargers shall be subjected to routine tests as per applicable Indian Standard. In addition, any special test required shall also be performed. Test reports shall be submitted for approval.

#### 5.2.4.6. Spares List

Suitable number of commissioning and successful running for 2 years spares list shall be submitted for approval.

### 5.2.5. Power, Control and Data Cables

#### 5.2.5.1. Introduction

This specification covers the requirements Power & Control cables.

#### 5.2.5.2. Design

Power cables shall be sized to satisfy the following Criteria:

- Short circuit withstand capacity for applicable fault current and duration.
- Full load current carrying capacity under installation conditions considering Site ambient temperature & site installation (Grouping) conditions based on Manufacturer's recommendation.
- Permissible voltage drop limits under steady state/transient state as applicable.

Power cables shall withstand the fault current of the circuit for the duration not less than the max. time taken by the primary protective system to isolate the fault. Cables shall be sized for the following short circuit rating.

- Outgoing cables from 11kV Switchboards: 31.5 kA for 0.16 sec.
- Incoming cables to 415V PCC (Breaker operated): 50 kA for 1 sec.
- Incoming cables to 415V MCC (Breaker operated): 50 kA for 0.5 sec.
- Incoming cables to 415V MCC/DB (MCB protected): Fuse cut-off current for 10m.sec
- Cables from 415V MCC to Motors: 50 kA for 0.16 sec ACB operated
- Feeders from MCC/DB (MCB protected): Fuse cut-off current for 10 m.sec

To maintain voltage at motor terminals / equipment end within desirable limit, it is proposed to limit the voltage drop in the cables within the following limits:

- Steady state Voltage drop (Continuous running condition) : 2.5%
- Transient state voltage drop (During Motor Starting) : 10 %

All cables shall be suitable for laying on racks, in ducts, trenches with chances of flooding by water and shall also be suitable for directly buried installation. All the cables shall be flame retardant low smoke (FRLS) type designed to withstand mechanical, electrical and thermal stresses developed under steady state and transient operating conditions.

The minimum size of LV power cable shall be of 2.5 Sq.mm for Copper. Power cables shall have copper conductor for sizes up to 10 sq.mm. For higher sizes, Aluminum conductor shall be provided. The minimum size of control cable shall be of 1.5 Sq.mm copper. For CT/VT circuits, minimum 2.5 sq.mm copper cable shall be provided. Conductor of Copper cables shall have plain annealed copper. All the conductors shall be multi-stranded.

Power cables shall be XLPE insulated. Control cables shall be PVC insulated. PVC insulation shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90 °C and short circuit conductor temperature of 250°C.

The cable cores shall be laid up with fillers between the cores wherever necessary. All the cables shall have distinct extruded PVC inner sheath. For single core armoured cables, armouring shall be of copper wire. For multicore armoured cables, armouring shall be of galvanised steel strip/wire as per applicable IS.

Outer sheath shall be of PVC black in colour having following FRLS properties.

- Oxygen index of not less than 29.
- Acid gas emission of max. 20%
- Smoke density of not more than 60%

The cables shall meet flammability test as per IEEE – 383. All the cables shall be protected against rodent and termite attack. Necessary chemicals shall be added in to the PVC compound of the outer sheath.

#### 5.2.5.3. Construction

##### a) HT cables

Cables shall be extruded XLPE (dry cured) insulated, screened, PVC inner sheathed (extruded), armoured (round wire), non-conducting water swellable tape of thickness approx. 0.3 mm. applied over armour, FRLS PVC outer sheathed, compacted Aluminium conductor conforming to IS: 7098 Part-II. 33/11 kV cables shall be suitable for unearthed system. The conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion process. The metallic screen of each core shall consist of copper tape with minimum overlap of 20% copper screen which shall be capable of carrying the system earth fault current for 2 seconds. Outer sheath shall be FRLS PVC.

##### b) LV Power cables

LV Power cables shall be of 1.1 kV grade, XLPE insulated, PVC inner sheathed (extruded), armoured, FRLS PVC outer sheathed, compacted copper conductor conforming to IS: 7098 Part-I.

##### c) Control cables

Control cables shall be of 1.1 kV grade, multicore, PVC insulated, PVC inner sheathed, armoured, FRLS PVC outer sheathed stranded copper conductor conforming to IS:1554 Part-

I. Up to 5 cores it shall be colour coded and above 5 cores shall be numbered.

##### d) Trailing cables

Trailing cables / Flexible cables shall be rubber insulated with copper conductor as per applicable standards. The minimum size of LV power cable shall be 4 Sq.mm for Copper.



#### 5.2.5.4. Cable identification system

Cable Identification tags shall be provided at every 5 meters interval incorporating the following marking shall also be embossed over outer sheath.

- Cable size and voltage grade.
- Feeder Details
- Word 'FRLS' at every 5 metre.
- Sequential marking of length of the cable in meters at every one metre.

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

#### 5.2.5.5. Cable drums

Cables shall be supplied in wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with waterproof layer. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS 10418.

#### 5.2.5.6. Testing and Inspection

Cables offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Routine tests, Acceptance tests and all special tests for FRLS properties shall be carried out for all the cables as per applicable standards. The sample shall be drawn at the rate of one per type and size for every lot offered for inspection.

#### 5.2.5.7. Special Tests

The following tests as applicable to FRLS sheathed cables shall be conducted as type tests on each size of each lot.

- Oxygen index test
- Temperature index test
- Acid gas generation during fire
- Smoke generation test under fire
- Swedish chimney test for class F3 as per SS : 4220 14 : 75
- Under fire conditions for bunched cables as per IEEE std. 383 / 74

#### 5.2.5.8. Spares List

Suitable quantity of commissioning and successful running for 2 years spares list shall be submitted for approval.

### 5.2.6. Lighting System

This specification covers the requirements of Illumination system.

The lighting system includes

- 100% Normal AC lighting for substation building
- High Pressure Sodium Vapour (HPSV) lamps have been considered for all areas, like conveyors, stockpile, transfer towers, stockyards etc. whereas fluorescent fittings are proposed for control room.

Normal AC Lighting shall be energized from 3-phase, 4-wire, 440 V main lighting distribution board. These MLDBs shall feed Lighting Distribution Boards (LDB) for each individual area. Dry type lighting transformers of voltage ratio 1:1 shall be provided for reducing fault level in MLDB. The single phase voltage level considered for lighting system & fixtures shall be optimally arrived to achieve energy efficiency without sacrifice in the illumination level. Lighting transformer tap range & tap step to be designed accordingly.

LED lamps shall be used as light sources in the lighting system.

Fixtures considered shall be energy efficient type with low loss & low harmonics (less than 10%) and with higher lumen / watt.

Enclosure of all fittings shall be of weather & dust-proof construction and consist of cast aluminium body able to withstand direct hosting. AC lighting fixtures and accessories shall be suitable for operation on 240 V AC, 50 Hz supply with supply voltage variation of  $\pm 10\%$ , frequency variation of +3% to -5% and combined voltage and frequency variation of absolute sum of 10%.

Illumination level at various location is given below:

Sl. No.	Area	Illumination Level (Lux)
1	Transfer Towers	100
2	Electrical Room	250
3	Control Room	300
4	Stockpile	25 (Average)
5	Conveyor Gallery	50
6	Jetty / Berth	50

All receptacles shall be of high quality Polyamide P-6 body (shock proof, rust free, corrosion free, acid and chemical resistant, fire retardant, having high impact, made of halogen and silica free recyclable material) & terminals with Solid high-quality turned contacts made of

copper alloy (Brass). All steel components (screws, springs etc) shall be Zinc plated & blue - chromed or nickel plated. For each contact double screws shall be available to give better cable strain relief. It shall be heavy duty type, IP67 suitable for fixing on wall/column and complete with individual switch.

In general the receptacles to be installed shall be of the following type:

Welding Socket - 63A, 440V, 3 Ph, 4 Wire, 5 pin interlocked plug and switch with earthing contact to be used in workshop. Other requirements shall be same as type RA. Welding sockets shall not be connected to lighting distribution board and shall get supply from feeders in the MCC/ACDB/PDB.

Suitable number of 63 ampere, 3 phase, 440 volt AC welding receptacles shall be provided. Welding receptacles shall be placed near all major equipment and minimum 2 numbers on each floor in all the buildings. 15A, 240V, Single phase convenience receptacle with switch shall be provided in all the rooms. The convenience outlets shall be spaced to provide access to any point with a 15 meter extension cord. Receptacles shall be served from an earth leakage circuit breaker (ELCB).

Welding sockets shall be fed from ACDB / PDB. Number of receptacles per circuit shall not be more than 2. Each welding receptacle unit shall have dedicated MCB installed adjacent to the receptacle with IP55 type enclosure. Welding socket outlets at 100 M interval will be installed throughout the conveyor length for welding purposes.

Electric power to light fixtures located outdoors shall be switched with photoelectric controllers and timers. Outdoor lighting shall have auto/manual mode of operation. Provision shall be made to bypass the photoelectric controller and timer.

Switches shall be sized maximum of 80 percent of the light switch ampere rating with enclosures suitable for the location in which they are installed. Load on each lighting circuit and single phase receptacle circuit shall be limited to 2000 W.

For areas illuminated by more than one circuit, the adjacent circuit shall be fed from different phase. Load balance on all the 3 phases to be envisaged for lighting as well as 1-ph power distribution circuit. Wiring for indoor lighting installation shall be carried with PVC insulated wire with following sizes laid in conduit.

- Lighting Panel to lighting Fixtures : 2.5 sq.mm copper
- Switch box to lighting Fixtures : 2.5 sq.mm copper
- Lighting Panel to Sockets : 4 sq.mm copper

For Area lighting, PVC insulated, PVC inner sheathed, armored, FRLS PVC outer sheathed Copper conductor cables shall be provided. Wiring for lighting circuits of Normal AC system and DC system shall run in separate conduits. Wiring for Lighting fixtures and receptacle units shall be fed from different circuits and shall run in separate conduits. Two different phase circuits shall not be laid in the same conduit.

All conduits shall be surface mounted in general. Conduit fill criteria shall be 40%. Conduits should have the minimum number of bends in their run with pull boxes at suitable locations. Conduits shall be sloped & drained to avoid water accumulation & draining into the equipment at its end. Conduits shall be galvanized steel except in corrosive areas, where it shall be epoxy painted.

a) Receptacles

Welding Socket - 63A, 440V, 3 Ph, 4 Wire, 5 pin interlocked plug and switch with earthing contact to be used in Workshop building. Other requirements shall be same as type RA. Welding sockets shall not be connected to lighting distribution board and shall get supply from feeders in the MCC/ACDB/PDB..All receptacles shall be provided with matching plug-tops. All hardware shall be of Stainless steel type only including the mesh of well glass luminaries, nut, bolts, washers, etc.

#### b) Installation of Light Fittings

Mounting height of centre-line of the various lighting equipment from FFL/Working platforms or finished grade level shall be as noted below unless otherwise specified in corresponding lighting layout drawings:

- Lighting panels/control gear boxes : 1500 mm
- Switch boxes : 1500 mm
- Receptacle boxes (Indoor) : 500 mm
- Receptacle boxes (Outdoor) : 1000 mm
- JB on poles : 750 mm

Lighting fixtures to be mounted on ceiling/platforms having considerable vibrations which can cause damage to the fixtures shall be suitably supported with rubber pads to limit vibrations in the fixtures. Where conduit wiring is adopted, an earth continuity conductor of 12 SWG galvanized steel wire shall be provided for earthing the lighting fixtures, switch boxes, etc. The earthing conductors shall be run along the entire length of the conduits and shall be securely connected and terminated at the junction boxes/control gear boxes/lighting panels. The earth connection shall be properly secured with bolts, nuts and washers. For outdoor lighting installations, an earth continuity conductor of atleast 25 x 3 mm galvanized steel flat shall be used for earthing the lighting masts/poles.

While designing the lighting circuit, the cables shall be sized such that the farthest loop from the supply receives no less than 95% of its nominal voltage, in addition it must be assumed that all the light fittings are energized while this design calculation is made. LED lights should be chosen & located carefully where they illuminate rotating shafts, so as to avoid stroboscopic effect. Fittings made from Aluminium and its alloys should be avoided because the oxide that invariably forms after a time is considered as a potential source of sparks caused by mechanical impact. All fittings shall be installed at a safe height for maintenance & effective illumination. All lighting controls shall be from a non-hazardous area, using double pole, switches, the supply neutral should be switchable along with the phase.

#### 5.2.6.1. Main Lighting Distribution Board / AC Distribution Board

Main Lighting distribution board (MLDB) shall be totally enclosed, sheet steel, indoor, dust tight, vermin proof and floor mounting type. The sheet metal thickness shall be 2mm. MLDBs shall be provided with separate chambers for (i) bus bars (ii) outgoing feeders (iii) incoming feeders (iv) cabling chamber. MLDBs shall have degree of protection of IP-54 for indoor and IP-55 for outdoor installation.

AC distribution board (ACDB) shall be totally enclosed, sheet steel, indoor, dust tight, vermin proof and floor mounting type. The sheet metal thickness shall be 2mm. ACDB shall be provided with separate chambers for (i) bus bars (ii) outgoing feeders (iii) incoming feeders

(iv) Dry type transformer (v) cabling chamber. ACDB shall have degree of protection of IP-54 for indoor

and IP-55 for outdoor installation.

ACDB shall be provided with 415/415V, 3 phase dry type transformer of suitable capacity to obtain 3 phase, 4 wire system and to limit the fault level to 3KA. The capacity of the transformer shall be decided such that there is atleast 20% margin over the total lighting load.

MLDB & ACDB shall be provided with one TPN MCCB for incomer feeder and required number of 3phase outgoing feeders with TPN MCB's and two Nos. Spare feeders. CT operated ammeters and Voltmeter and indicating lamps shall be provided for incomers.

All the JB's and panels for outdoor application must be of SS 316 with powder coating thickness of 120 -160 micron minimum.

#### 5.2.6.2. Lighting/Power Distribution Boards

For lighting circuits, Lighting Distribution Boards (LDBs) shall be provided. For welding receptacle circuits, separate Power Distribution Boards (PDBs) shall be provided. LDBs shall be provided with suitable rating TPN MCB/MCCB for incomer and required number of suitable rating SPN outgoing feeders with MCBs and ELCBs with neutral links for each circuit distributed over three phases. Maximum lighting load on any one circuit shall be restricted to 1500 watts.

PDBs shall be provided with suitable rating TPN MCB/MCCB and required number of suitable rating TPN outgoing feeders with MCBs and ELCBs with neutral links for each circuit distributed over three phases. Maximum welding receptacle load on any one circuit shall be restricted to 2000 watts.

All the JB's and panels for outdoor application must be of SS 316 with powder coating thickness of 120 -160 micron minimum.

LDBs shall be provided with 415/415V, 3 phase dry type transformer of suitable capacity to obtain 3 phase, 4 wire system and to limit the fault level to 3KA. The capacity of the transformer shall be decided such that there is atleast 20% margin over the total lighting load.

##### a) Testing and Inspection

Equipment of Illumination system should be type tested and proven type. Type test certificates shall be furnished for Purchaser's review. Equipment shall be subjected to routine tests as per applicable Indian Standard. Test reports shall be submitted for approval.

##### b) Spares List

Suitable quantity of commissioning and successful running for 2 years spares list shall be submitted for approval.

#### 5.2.7. Cabling and Cable Trays

##### 5.2.7.1. Introduction

This specification covers the requirements of cable trays, support structures, cable laying, termination, earthing and lightning protection system.

##### 5.2.7.2. General Requirements

While finalizing Cable routing layouts, consideration shall be given to the requirements of Safety, Reliability and Convenience of cable laying and termination.

Where duplicate drives/auxiliaries are provided for reliability, cable routing shall be segregated to the extent practically possible.

In cable trenches, distance between bottoms most tier and bottom of trench shall be 150 mm and clearance from top most tray to top of trench cover shall be 400 mm. Distance between two tiers shall be minimum 250 mm.

PCC flooring of built-up trenches shall be sloped in longitudinal and also in transverse direction for effective drainage system. Other than cable vault & cable trenches, Cable trays shall be laid in vertical formation to avoid dust accumulation in areas.

In cable spreader room a clear access passage of atleast 800 mm wide shall be provided along the cable ways. Wherever passage is through cable routes, a clear height of not less than 2.0 M shall be provided. Cables should not be laid directly in the trench floor. Cable trenches should be provided with strong & effective covers with water & fire proof sealing arrangement at trench entry & exit points.

Cables of different voltages shall be laid in separate racks. Minimum distance of 250 mm shall be maintained along the routes between various types of cables. In case of horizontal formation, the highest voltage cables shall be laid in the top most position in the tray stack followed by other grades as follows in the descending order.

- 11 kV Power cables (Bottom Tier)
- 3.3kV Power Cables (Above Bottom Tier)
- 1.1kV Power cables (Above 3.3kV HT Tier)
- Electrical Control Cables (Above LT Tier)
- Instrumentation/Signal cables (Top most tier)

Cable laying tier position indicated above is for ready reference; however, same shall be finalized as per site condition during detail engineering and execution.

On cable trays all the multicore power cables can be laid in touching formation. Single core cables shall be laid in trefoil formation with the spacing equal to twice the diameter of the cable. Control cables shall be laid in not more than two layers.

Cables shall be terminated using double compression cable glands suitable for the voltage grade of cables. Cable glands shall be heavy duty brass. Cable lugs for power and control cables shall be tinned copper solderless crimping type conforming to IS 8309.

All joints and terminations, except for separable insulated connectors shall be of the heat-shrink, cold-shrink, or cold-applied polymeric type design, manufactured and tested to meet the requirements of the relevant Standards, and shall be suitable for application to 33 kV, 11kV and 3.3kV cables as described in this section.

Power & Control cables shall be laid on ladder type trays. Instrumentation & Signal cables shall be laid on perforated type trays. Cable trays shall be of galvanized steel. Cable trays shall be supported at an interval of 1500 mm approximately. Vertical runs shall be supported at an interval of 1000 mm approximately. Cable tray support system shall be of site fabricated, welded and painted steel supports.

Cable tray support system shall consist of ISMC channel as vertical support & ISA as horizontal arm. Horizontal arm is welded to the vertical support MS channel.

Fire barriers/ Fire stops shall be provided for all fire rated wall and floor penetrations and for all direct cable entries into electrical Switchgear / Panels from Cable Vault. Fire barriers/ Fire stops shall provide a fire endurance rating of at least 2 hours. The fire sealing materials shall be non-hygroscopic, mechanically steady, non-toxic and physically & chemically stable under fire conditions. Fire barriers/ Fire stops shall be either of the following methods:

- Panel sealing method comprising Encasing Panels, Cavity fill material & Sealant
- Mortar sealing method comprising Mixing Mortar curing with water.

### 5.2.7.3. Design and Construction

#### a) Cable trays, Fittings & Accessories

Cable trays shall be ladder/perforated type as specified prefabricated made out of hot/cold rolled mild steel sheets, complete with matching fittings (like elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, Tray cover etc.) and hardware (like bolts, nuts, washers, GI strap, hook etc.) as required. All the items (including hardware) shall be hot dip galvanized. Thickness of galvanizing shall be not less than 610grams/sq.M. The size of the trays shall be selected on the basis of maximum 40% fill criteria.

Cable trays shall be standard width of 150mm, 300mm & 500mm and standard lengths of 2.5 M or more. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2mm. Rung spacing shall be 250mm maximum. The thickness of side coupler plates shall be minimum 2.5mm and of tray covers shall be minimum 1.6mm. Cable Trough shall be required for branching out few cables from main cable route. These shall be fabricated of mild steel sheets of minimum thickness 2mm and shall be hot dipped galvanized. Troughs shall be of standard width of 50mm & 75mm and 25mm height.

#### b) Conduits/Pipes, Fittings & Accessories:

Conduits/pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.). The size of the conduit/pipe shall be selected on the basis of maximum 40% fill criteria.

Rigid pipes shall be of reinforced concrete conforming to class NP3 for road crossings as per IS: 458. GI pipes shall be of medium duty as per IS: 1239. Rigid steel conduits conforming to IS: 9537 Part-I & II shall be suitable for heavy mechanical stresses, threaded on both sides and threaded length shall be protected by zinc rich paint. Conduits shall be smooth from inside and outside. Fittings and accessories shall also be hot dip galvanized.

Flexible conduits where required, near equipment terminations, shall be made with bright, cold rolled, annealed and electro-galvanized mild steel strips. Flexible conduits shall be supplied with suitable end coupler nipple and check nut. In corrosive areas, epoxy coated conduits shall be provided.

#### c) Clamps

Trefoil clamps for single core cables shall be pressure die cast aluminium or fibre glass or nylon and shall include necessary fixing accessories like GI nuts, bolts, washers etc. Trefoil clamps shall have adequate mechanical withstand capability in case of a fault and shall be tested and proven type. For clamping the multicore cables self-locking, de-interlocking type nylon clamps shall be used.

### 5.2.7.4. Cabling Installation

The work shall be carried out in the best workman like manner in conformity with relevant specifications / code of practices of the Bureau of Indian Standards. In addition, work shall also conform to the requirements of latest editions / amendments of the following:-

- Indian Electricity Act and rules framed thereunder.
- Fire Insurance Regulations
- Regulations laid by the office of the Chief Electrical Inspector to Government.
- Any other regulations laid down by the local authorities.

Support system shall be so designed that it is able to withstand weight of the cable trays, Weight of the cables (75 Kg/metre run of each cable tray), Concentrated load of 75 Kg between every support span without any permanent deflection. Factors of safety of at least 1.5 shall be considered. Cable tray mounting structure shall be welded / bolted to the plate inserts or to steel structure and the type of welding shall be of fillet type of at least 6mm size.

All cable way sections shall have identification, designations as per cable way layout drawings and painted/stencilled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted / stencilled with identification numbers at every floor.

Tray covers shall be provided for overhead cable trays on top most tier. The cable risers or vertical raceways shall also be covered by cable tray covers upto 1.5 metres from respective floor for mechanical protection. The sheet cover shall be of removable type.

#### **5.2.8. Earthing System**

The complete earthing system shall conform to the provision of Indian Electricity Rules, and applicable code of practice for earthing IS: 3043, however for chemical earthing IEEE:80- 2000 shall also be followed. Working layout drawings shall be prepared by the successful Contractor. Value of earth resistivity shall be considered as per the areas indicated in IS:3043 or the actual value as obtained from the site from previous records available with the employer, if any.

##### **5.2.8.1. Earthing Below Ground**

- a) The main earthing grid shall be buried below ground unless required otherwise. For crossing any trench or under-ground pipe minimum earth coverage of 500 mm shall be provided over the earthing conductor.
- b) Where the earthing conductor passes through reinforcement or steel plate it shall be bonded to the same.
- c) All building steels and columns shall be bonded directly to the earthing grid.
- d) The riser/pigtails from earthing grid shall project 600 mm above grade/concrete level unless shown otherwise.
- e) All earthing conductor connections shall be made by electric arc welding or by nuts and bolts using plain washers and spring washers.
- f) All arc welding shall be carried out with low hydrogen content electrode.



- g)** All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. No artificial cooling should be adopted to cool welded joints.
- h)** The welding required for earthing shall serve the following three purposes (i) sufficient mechanical strength between the jointing materials (ii) sufficient electrical area for the flow of system short circuit current and (iii) sufficient electrical area available after commissioning during the life time of the plant.
- i)** Before welding, the earth conductors shall be clamped tightly to ensure good surface contact at welding points.
- j)** Before applying bitumen compound two coats of red oxide primer shall be applied to risers and exposed portion of earth grid, if any. Construction joints shall be given treatment with Barium Chromate before applying red oxide paint and bitumen.
- k)** Earthing shall be mechanically robust and all joints shall be capable of retaining low resistance even after passages of many fault current.
- l)** All the connections are to be made carefully and properly. Improper/poor connections are to be remade at the cost of Contractor.
- m)** Welded areas of risers/pigtail shall be thickly coated with bitumen compound to prevent corrosion.
- n)** Earthing pits/conductors shall be laid in field to avoid fouling with concrete foundations and in consultation with the Employer at site.
- o)** Trenches shall be filled up with 'Free of Stones' earth after laying earth conductor. After filling up of trenches the earth shall be rammed carefully.
- p)** The successful Contractor shall submit detailed working drawings of earthing grid for approval by Employer prior to construction of the grounding system.
- q)** The rate quoted shall be inclusive of cost of all materials, labour required for excavation, backfilling, welding, cutting, bending, placing of GI strips etc. complete as per specification.
- r)** All tests as per relevant standards shall be conducted to certify the effectiveness and other requirements of the earthing grid.
- s)** Depth of laying of earth conductor for earth grid, ring and inter-connections shall generally be min. 500 mm from ground level and 300 mm below all foundations.
- t)** Erection of earth pits shall include making of masonry enclosure and supply of chemical and other materials.

#### **5.2.8.2. Earthing Above Ground**

- a)** The successful Contractor shall lay the above ground earthing conductors inside the buildings and on various structures for connection to various equipment/ drives etc. The earthing conductors may be installed within the cable trays in the form of runway conductors. The connection to equipment shall be tapped from these runway conductors at suitable locations. One runway conductor shall be provided for each side of cable trench/tray.
- b)** The neutral points of all earthed system of different voltages, all equipment frame works ,

other non-current carrying metallic structures and equipment such as motor frame enclosures of MCCs, panel boards, cable armour, cable trays, sheaths etc. shall be earthed by a minimum of two separate and distinct connections.

- c) Armor of all power and control cables shall be earthed at both ends through gland earth ring provided with the cable glands.
- d) All cable trays and supporting structure are to be earthed. All cable tray sections shall be bonded with each other for continuity.
- e) All earth leads and riser connections shall be as short as possible.
- f) Metal pipes and conduits through which cables run shall be effectively bonded and earthed.
- g) Neutral connection shall not be used for equipment earthing.
- h) All connections to earth conductors shall be welded/bolted type. Earthing connections to all equipment shall be bolted type.
- i) Earthing conductor along their run on steel columns, beams etc. shall be tack welded at intervals of 1000 mm.
- j) All joints in earthing conductor shall be welded type. All joints shall be welded with an overlap of 65 mm. Joints shall be thoroughly cleaned before welding. Welding is to be done around joint completely. All joints shall be given two coats of anti-corrosive paint (Red Oxide) to a thickness of 3-5 mils, followed by a coat of bitumen paint. Joints shall be thoroughly cleaned before applying paints.
- k) All nuts, bolts washers etc. shall be cadmium plated or zinc passivated. Generally, earthing studs and terminals shall be provided on all equipment. In such cases, where it is not provided the Contractor shall have to drill and tap the equipment for deriving earth terminals.
- l) Connections of earthing conductors to the main earthing loops or to equipment shall generally be made by means of cable lugs in case of round conductors, solid or stranded and directly in case of strips. Devices like spring washers and lock washers must be used to ensure that the connections are vibration proof.
- m) Laying of earthing conductor shall include fabrication and fixing of clamps, cleats and supply fixing device i.e. nuts, bolts, washers as also civil work such as preparation of floor surface and finishing them to the finished floor level after installation of earthing strips.

#### 5.2.8.3. Earth Electrodes

All GI pipes comprising an earth system shall be connected together with a continuous ring of earth tape. After installation, test shall be made to ascertain that the earthing resistance hereinafter specified is obtained. If the required resistance value cannot be obtained, sufficient number of additional pipes shall be installed, until the resultant resistance not exceeding the specified value can be obtained.

In all cases the pipes shall be driven such that their zones of earthing do not overlap. Earth electrodes for Body Earth pits and Instrument earth pits shall be minimum 65mm diameter, 6mm thick, 3m long GI pipes, whereas for Neutral earth pits of Transformers, DG etc. plate electrodes of Copper 600mm x 600mm x 6mm thick shall be used as per IS:3043.

Each earth electrode / plate shall be connected to its associated earth tape through a linked connection. The link shall be installed as close to the earth electrode as possible. Each earth electrode shall be enclosed together with the link in a reinforced concrete hand-hole with cast iron cover, which shall be set flush with the ground. Electronic earthing shall be completely isolated from the Plant earthing system.

#### 5.2.8.4. Earth Pits for Earthing and Lightning Protection Systems

Earth pits shall be based on High Conductivity Technology. In this technology of chemical earthing, a compound of high electrical conductivity shall be filled up in the space around the ground electrode, so that the earth resistance value would decrease appreciably. The high Conductive Compound shall be able to perform in any weather and soil Conditions and shall have following properties;

- a) It shall have high electrical conductivity, which should remain constant and unaffected by changes in temperature & moisture.
- b) It shall permanently remain embedded and should neither dissolve in and swept away by water.
- c) It shall have an ability to absorb large amount of water and retain the same over a long periods of time.
- d) It shall decrease earth pit resistance with passage of time.
- e) Solubility: Shall be partly miscible; so that it does not dissolve fully like common salt and thus increasing the Earth Pit Life.
- f) The pH value shall be near neutral so that it does not pollute soil or water and also does not corrode earth electrode.
- g) It shall be maintenance free Compound so that there shall be no need of extra water pouring at regular interval as in conventional earthing material, because it should retain the moisture.
- h) Chemical Compound shall be thermally conductive, in order to maintain a constant Earth resistance in temperature range of -50 to +60 degree Celsius.
- i) The Compound shall have relatively High conductivity so that it can create very low resistance even in rocky areas.
- j) It shall have low earth resistance, carries high peak current repeatedly.
- k) It shall have a Long and reliable life.
- l) It shall be easily installed in any soil conditions.
- m) Earth pit identification boards to be provided with the details of Individual Resistance, Combined Resistance, date of testing, due date etc.

Minimum Electrode size shall be as per the latest amendments of IS:3043. Earth electrodes / plates for body earth, DG & transformer neutral, Instrumentation earthing and Lightning earth pits shall be selected as per the latest amendments / requirements of IS:3043.

All earth electrodes comprising an earth system shall be connected together with a continuous ring of earth tape. After installation, test shall be made to ascertain that the earthing resistance hereinafter

specified is obtained. If the required resistance value cannot be obtained, a sufficient number of additional pipes shall be installed, until the resultant resistance not exceeding the specified value can be obtained.

In all cases the pipes shall be driven such that their zones of earthing do not overlap. Each earth electrode shall be connected to its associated earth tape through a linked connection.

The link shall be installed as close to the earth electrode as possible. Each earth electrode shall be enclosed together with the link in a reinforced concrete hand-hole with cast iron cover, which shall be set flush with the ground.

#### 5.2.8.5. Earth System

The Contractor shall furnish and install a 75 x 8 mm GI strip as the main grid. The resistance between any point on each earthing system and the earth electrode shall not exceed 0.1 ohm. The overall resistance between the earthing installation and the general mass of earth shall be less than 1 ohm.

The main earthing bars shall be so placed that earthing terminals of major equipment and where required cable sheaths to be earthed, can be readily connected to them. Branch connections from the main earth bars shall be provided to all switchboards, power transformers, capacitors, Control Consoles, distribution boards, etc. The bonds shall be made to the cable glands on which the lead sheath shall be plumed and the armour clamped. All steelwork supporting electrical equipment shall be bounded to the main earthing bars.

The Sizes of GI earth bus and earth wires shall be as follows:

Table 8-1 Earthing Size

Main earthing grid	75 x 8 mm GI strips
Riser upto ground level	75x8 mm GI Strip
HT & LT boards, PCC/MCC panels, Cable trays(HT & LT)	40 x 6 mm GI strip
High Masts Earthing	40 x 6 mm GI strip
Transformers and DG Neutral Earthing	50 X 6 mm Cu Strip
LDB, Weld socket, Cable tray	25 x 6 mm GI strips
Control & Instrumentation	25 X 6 mm Cu Strip
Lighting panels, Distribution Boards etc.	25 x 6 mm GI strips
Junction boxes, field instruments, gland earthing Lighting fixtures, 15A switch sockets	8 SWG GI Wire

**Note:** Above listed size of Earthing stripe / cable are indicative, successful bidder shall submit the detail calculation with drawing to employer for final sizing and MOC of earthing material.

Joints, termination, fixing of the earth bars and their protection from corrosion shall be in accordance with the recommendation given in the aforementioned code of practice subject to the additional

requirements specified herein. GI tapes shall be secured at intervals not exceeding 1m by means of single-screw fixing purpose made gunmetal saddle of a pattern approved by the Employer. The tapes shall run in square and symmetrical lines. Links shall be provided in the system adjacent to all junctions to enable tests to be carried out from time to time. All links shall have high tensile steel bolts and the nuts shall be tightened by means of a torsion spanner. All joints in exposed sections shall be protected against moisture and corrosion by the application of two coats of an anti corrosive paint and shall be taped with self-adhesive PVC tape.

#### 5.2.8.6. Earthing of Equipment

- a) All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. rule.
- b) Ground connections of sub-station and meter room shall be made from nearest available 75 x 8 mm ground grid. All connections to ground grid shall be done by arc welding.
- c) Lighting panels shall be directly connected to ground system grid by two nos. 25 x 6 mm GI strip at two different locations.
- d) A continuous ground conductor of 8 SWG G.I. wire shall be run all along each conduit run and bended at every 600mm by not less than two turns of the same size of wires. This conductor shall be connected to panel ground bus.
- e) All junction boxes, receptacles, lighting fixtures, etc. shall be connected to this 8 SWG ground bus.
- f) Earthing of High Mast light towers shall be done by connecting 2 nos. of 40x6 GI strip at two different places.

#### 5.2.9. Advance Lightning Protection System

##### 5.2.9.1. Scope of Work

The lightning protection system should comply in accordance with NFC 17-102 standard and shall be installed strictly to the manufacturer's instructions.

The advance lightning protection system shall include components as follows:

- ESE Air Terminal (For Non-building application) / Conventional Air Terminal (Building application)
- Mechanical Supports
- Down Conductors
- Lightning Strike Recorder
- Maintenance free chemical gel earthing system

The LPS shall be designed by a company engaged in the manufacturing and development of advanced lightning system components, of types, sizes and ratings as shown, who can show evidence or support that their products have been in satisfactory service for not less than 10 years. The advanced lightning protection system shall be installed strictly to the manufacturer's instructions.

##### 5.2.9.2. Standards

Complete installation shall be engineered and constructed in accordance with the latest revision of

the following:

- NFC 17 102
- IEC 61024
- IEC 60-1:1989

#### 5.2.9.3. Test Certificates & Approvals:

- a) **Country of Origin Certificate:** Country of Origin issued by the respective country's "Chamber of Commerce & Industry" duly acknowledging the serial number of the lightning arrester exported from their country.
- b) **CPRI:** The ESE air terminal should be tested & certified by CPRI (Central Power Research Institute, Govt of India) for a minimum impulse current of 45 KA (8/20 micro sec) with 5 positive & 5 negative impulse.
- c) **IEC certificate:** As per IEC 60-1:1989, the ESE air terminal should successfully withstand a current impulse equivalent to 200 KA (8/20 micro sec waveform).
- d) **NF C 17 102 certificate:** As per NF C 17 – 102, the ESE air terminal should be tested with the "Switching Impulse Voltage" of -700 KV & "Direct Voltage" of -70 KV. The test report shall have reference wave in accordance with 650 microsecond standardized wave according to clause 4.2 of NF C 17 102.

The details of the lightning protection system shall also confirm to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this specification and drawings, whichever is more stringent and acceptable to the engineer.

#### 5.2.9.4. ESE Air Terminal

The stormmaster ESE air terminal shall be of the type that responds dynamically to the appearance of a lightning downleader by creating free electrons between outer floating four panels and an earthed central finial rod. The lightning air terminal shall be configured as a spheroid which is comprised of separate electrically isolated panels surrounding an earthed central finial. The central finial shall be elevated above the spheroid to a length of 90 mm. The insulation material used to electrically isolate the panels shall be comprised of a base polymer which provides high Ozone & UV resistance with a dielectric strength of 24-38 KV/mm tested as per NFC 17-102 & IEC 60-1:1989

The unit shall detect the lightning when it approaches and emit the streamer within few microseconds. ESE air Terminals shall be manufactured as per NFC 17 -102 standard. A dedicated wired ESE tester should be available for maintenance purpose after a certain period of time as advised by the manufacturer. The ESE manufacturer shall be ISO 9001 certified. Performances of the air-termination should have been tested in the international laboratories as per IEC 60-1:1989.

The air terminal should work under Early Streamer Emission (ESE) Technology and the attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics. The ESE air terminal should have no moving parts, no electronic circuits and will have no dependence on external power supply or batteries. The ESE air terminal shall not have any solar panels, no inbuilt batteries, no usage of any degradable ceramics like transducers, etc.

The stormmaster ESE air terminal should deliver a unique gain time in efficiency, anticipating the natural formation of an upward leader. The ESE air terminal generates a leader that propagates rapidly to capture the Lightning stroke and conduct it towards the ground. Arcing is not to be continuous and shall only occur during the progress of the lightning leader. The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The protective zone provided by the air termination shall be such that it becomes the preferred strike point for all discharges exceeding a peak amplitude return strike current of "X" kA according to the statistical level "Y" per IEC61024. The design shall take account of upward leader competing projections on the structure.

Strike Current (X)	Level of Protection (Y)	Exceedance Probability
2.9 KA	Protection Level I - Very High	99%
5.4 KA	Protection Level II - High	97%
10.1 KA	Protection Level III - Medium	91%
15.7 KA	Protection Level IV - Standard	84%

The stormmaster ESE air terminal shall be tested & certified by CPRI (Central Power Research Institute, Govt of India) for a minimum impulse current of 45 KA (8/20 micro sec) with 5 positive & 5 negative impulse.

The stormmaster ESE air terminal serial number which is displayed on the lightning arrester shall be mentioned on the "Country of Origin" certificate issued by the respective country's (where the lightning arrester is manufactured) "Chamber of Commerce & Industry".

The materials of the air termination shall be non-corroding in normal atmosphere. The height of the air terminal support mast should be minimum 2 meters and the height will be increase as per the coverage design. The support shall be securely installed and guy wires shall be used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

#### 5.2.9.5. Air Termination Support (Mast)

The air termination shall be fixed at the top of a GI rod pole so as to be at least 2 meters above the top of the structure to be protected. The elevation pole should have a minimum diameter of 35 mm to 50 mm with a thread at the top to fix the unit. Grid shall be constructed.

The support shall be securely bolted to other mast materials with guy wires used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

##### a) Down Conductor:

The down conductor for the lightning arrester shall be of 70 sq.mm PVC insulated flexible copper cable or 25 x 3 mm (copper/G.I) strip along with the fixing accessories. The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to bends of less than 0.5 metres radius.

The down conductor after routing must be kept in constant physical contact with the structure via conductive clamps. The top 10% of the installed length from the terminal must be anchored at least every 1 metre. The lower must be anchored at least every 2 metres.

b) Lightning Strike Recorder:

Each protection system shall be supplied with Lightning strike recorder. The lightning strike recorder shall be of mechanical type and non-resettable with 7 digits. LCD screen is not permitted; because the display depends upon the battery and battery life is not reliable.

The lightning strike recorder shall be tested & certified by CPRI (Central Power Research Institute, Govt of India) for a minimum impulse current of 45 KA (8/20 micro second) with 5 positive & 5 negative impulse. The lightning strike recorder shall be tested & certified in series with the lightning arrester by CPRI.

The recorder shall have a register that activates one count for every discharge where the peak current exceeds 1500A at the 8/20 micro second waveform and a maximum of 220 KA. The lightning strike recorder shall be robust and easy to install. The counter shall operate from the energy of the lightning discharge and should not work on external or battery power to operate.

The lightning strike recorder shall be tested and certified as per IEC 60-1:1989 standard in line with the lightning arrester for a impulse current of more than 450 KA (8/20 micro second). The lightning strike recorder shall be installed to the manufacturer's instructions in a readily accessible manner (always 2 mtrs above the ground) so that reading can be taken at regular intervals.

c) Earthing:

The lightning arrester grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the lightning protection system. The backfill compound should be tested & certified from any international laboratory for the resistivity of the material parameter of less than 0.2 ohm-mtr.

As per the international standards, radial shallow earthing system is a preferred design for lightning protection. The earth electrode shall be of UL listed 10 feet long 17 mm dia 250 microns copper bonded steel rod. The UL listing shall be marked on the rod for the physical verification at site.

The electrode shall be surrounded by Reslow grounding minerals. The grounding minerals shall contain a compound with a base electrolyte when mixed with other compounds produces an earth gel which provides good earthing gel.

Reslow grounding minerals provide high conductivity in the electrode – ground contact area and improves the absorbing power and humidity retention capability. A gelatinous mass within the surrounding ground soil which will not wash away. A high conductive mass allowing for the effective dissipation of electrical surges and faults.



A high conductive mass that is hygroscopic in nature and does not reduce, contract or separate from the accompanying ground electrode. A high conductive mass which does not contaminate ground water. When the products employed react, they shall produce compounds with high conductive power and decrease the resistance of the earth, mainly in those with salts deficiency. Higher doses may be necessary for optimum results in high resistance soil or rocky areas.

As per IEEE 80-2000 (Clause 14.5 d), the resistivity of the grounding minerals is less than 0.12 ohm-mtr. The compound is tested & certified from an international laboratory to confirm the ohmic value (high conductivity) of not less than 0.12 ohm-mtr.

The earth pit shall be suitable covered with the man hole chamber for the testing purpose with the heavy duty weather proof environment friendly polyplastic earth pit chamber with cover of auto-locking facility with the following dimensions - 254 mm dia (top), 330 mm dia (bottom) and 260 mm height. 4 knock-out openings are provided for the easy interconnection of earth strips between the earth pits to form a grid.

The contents of the chemical compound used for back filling around the earth electrode shall be duly tested and certified by any International accredited and BIS (Bureau of Indian Standards), Govt of India accredited laboratory. The testing laboratory should be an ISO 9001 & ISO 14001 certified.

#### 5.2.9.6. Testing and Inspection

Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards.

Test link box shall be provided on two end of the structure. Further insulator shall be added for the separation of the circuit to the strip.

#### 5.2.9.7. Spares List

Suitable quantity of commissioning and successful running for 2 years spares list shall be submitted for approval.

### 5.2.10. 415 V Capacitor Bank with Automatic Power Factor (PF) Correction Control Panels

415 V Automatic Power Factor Control Panels shall comprise of 415V circuit breaker, PF Meter, Automatic PF Correction Relay with Capacitor Banks of suitable rating as indicated in the attached Single Line Diagram. Ratings shown in the SLDs are indicative. Contractor shall perform their own calculations to verify the size and submit the same to Employer for verification. Number of steps shall be based on 10kVAR power step minimum. The capacitor banks ratings shall be finally selected to provide a power factor of 0.95 lag on the bus. Zero step shall also be provided.

Harmonic Filters for Automatic Power Factor correction shall be provided. The Harmonic Filters shall be designed in such a way that the THD shall be less than 8%. Capacitor duty contactors to be installed for capacitor banks. Capacitor bank shall be of phase cap type construction gas filled capacitors.

### 5.2.11. Public Address System

#### 5.2.11.1. General

- a) The system shall be distributed amplifier type for indoor/outdoor usages
- b) The nominal voltage of the system shall be 240V, single phase 50 Hz except that power

supply of reduced voltage is specified for certain purposes. All the equipments and materials shall be suitable for the system voltage unless otherwise specified.

- c) The design of the Communication System shall be in accordance with the requirements of this specification and the best current engineering practice, together with the following general requirements:
- d) The minimum enclosure protection degree of the system components shall be in accordance with IEC 529 as follows:
  - Outdoor IP 55.
  - Indoor IP 41

#### 5.2.11.2. Operational Feature

The basic system shall incorporate the following operational features:

- a) It shall be possible to make announcements by lifting any of the microphone hand sets and speaking into the mouth piece. The announcement shall be heard over all the speakers within the area.
- b) It shall be possible for the called party to reply by moving to the nearest microphone hand set station and lifting the microphone hand set off the hook switch. The conversation now shall proceed between the caller and called party over the channel. This shall be heard over all the loud speakers. The system shall be of common talking type allowing any handset station to take part in the conversation.
- c) Lifting of a handset off the hook shall automatically mute the adjacent loudspeaker. This is required to prevent the acoustic coupling and feed back to the local handset mouthpiece transmitter.
- d) Facilities shall be provided to generate a 400 Cycles signal which will be used as siren during emergency. This tone signal shall also be used to test all amplifiers and loudspeakers circuits. A tone/test switch shall be provided on the amplifiers rack to initiate the siren. Provision shall be made for testing all microphones and associated circuits.
- e) The Contractor shall propose a suitable scheme to overcome the problems generally associated with long distance propagation of voice signal and paging and shall submit the details of offered scheme showing schematic diagram, system write-up and other necessary details.

#### 5.2.11.3. Component Specification

##### a) Amplifier

The rated output power of the inbuilt amplifiers in any handset station shall be adequate to cater to microphone handset and specified number of loudspeakers. If the amplifier has sensitivity sufficient to operate only from the highest input voltage likely to be met with, the same has to be supplemented with pre-amplifier for use with source at lower voltage. The frequency response, harmonic distortion and the signal to noise ratio shall be as per the relevant standards. Amplifiers shall incorporate safeguards against excessive voltage or current rise in case of open circuit conditions or short circuit conditions respectively, in the output circuit. Volume and tone control shall be provided.

##### b) Loudspeakers

The loudspeakers shall be of high efficiency, high peak power drive units in weather-proof design of rugged metal construction designed for non-ringing and shall deliver clear, faithful voice reproduction through any degree of noise level.

Facilities shall be provided for easy orientation of the speaker units over wide horizontal and vertical plane after the assembly has been mounted. Suitable means for locking in any position shall be provided on each speaker. Electrical filter at the line matching transformer shall be incorporated to cut off low frequencies to avoid damage to the voice coil at lower frequencies. The power handling capacity of the transformer shall be not less than the power to be absorbed by the speaker. The transformer primary and secondary shall have suitable taps to match the voltage tap at the amplifier output transformer and loudspeaker impedance respectively. Volume control shall be provided in horn type and cone type loudspeakers; no provision shall be kept in bidirectional horn type loudspeakers.

Loudspeakers shall preferably be rated for 15 W and shall be suitable for outdoor operation in areas with high ambient noise level. These speakers shall have good directional properties and high acoustical efficiency. The driver impedance matching transformer and all other accessories shall be housed in steel enclosure designed for wall or steel structure mounting. All necessary accessories shall be dust, vermin and weather-proof provided with neoprene gasket covers. Necessary provision shall be made for terminating incoming cable. Loudspeakers suitable for indoor use shall be rated for 6 watts. These shall be cone type and suitable for wall mounting. These shall be provided with buffer of thick plywood. Enclosure interior shall be padded with suitable lining for damping.

**c) Hand Set Station**

Each hand set station shall comprise of a microphone hand set unit. Handset station shall be wall mounting type.

Handset microphones shall be of low impedance, dynamic type, with highly directional characteristic designed for close talking and minimum acoustic coupling and feedback. The handset shall pick up only the operator's voice and shall shield out extraneous noise.

Handset shall be provided with special neoprene covered shielded, retroactive coiled core type cable of length not less than 3 metres to provide freedom of movement.

Handset mouth pieces shall be protected from dirt and other foreign particles by means of filters.

The handset shall be equipped with locking type plug and socket to permit easy removal and replacement of handset when desired, without disturbing the soldered connection.

Handset stations and all associated equipment shall be completely assembled and wired at factory on a conduit core ready for mounting on conduit box and attached directly to field conduit. In case of handset stations for outdoor locations robust, weather-proof enclosures designed for direct connection to field conduit shall be provided.

**d) Signal Cable**

The signal cable shall be annealed, high conductivity bunched copper conductor, twisted, PVC insulated, colour coded, PVC sheathed and armoured cables.

**5.2.12. Indicative Technical Data Sheet**

**5.2.12.1. General:**

- a) Tenderer shall provide all information requested in this schedule and in the specification.

The items requiring description shall not be limited by the list that follows. The Tenderer shall ensure that the variation in data furnished now and after detail design stage shall be within +10 % in respect of cases such as weight, loads in different conditions, etc.

- b)** Any deviation from the technical specifications shall be clearly indicated under a separate heading "DEVIATION FROM TECHNICAL SPECIFICATIONS" otherwise it will be construed that there is no deviation from the technical specifications.

#### 5.2.12.2. HT Switchgear (All ratings)

<b>A.</b>	<b>Switchgear Panel</b>	
1.	Make and type designation	
2.	System :	
	a) Rated voltage	kV
	b) Highest system voltage	kV
	c) Number of phases and rated frequency	
3.	Service	Indoor/Outdoor
4.	Enclosure :	
	a) Thickness of sheet steel	
	b) Degree of protection offered by enclosure	
5.	Number of circuits	
6.	Busbars :	
	a) Busbar material and grade	
	b) Cross-section of busbars and rated busbar current	sq.mm. & ...Amp.
	c) Minimum phase to phase clearance	mm
	d) Minimum phase to earth clearance	mm
	e) Temperature rise over 40 deg.C ambient	deg.C
	f) Disposition of busbars	
	g) Earth Bus :	

	<ul style="list-style-type: none"> <li>Size</li> </ul>	
	<ul style="list-style-type: none"> <li>Material</li> </ul>	
7.	Rated power frequency withstand voltage	kA
8.	Rate short circuit breaking current	
9.	Rated short time current & duration	kA
10.	Total VA burden (for all panels) to be considered for battery AH calculations	
11.	Tests :	
	a) Routine tests : (Confirm whether the following are covered)	
	i) Power frequency voltage withstand on main and auxiliary circuits	
	ii) Operation check for proper functioning of control switches, meters, relays, indicating lamps and safety interlocks	
	iii) Insulation resistance measurement before and after power frequency voltage withstand	
	b) Type tests: (Type test certificates to be furnished for tests conducted on switchgear having busbar and connections of the same cross-section)	
	i) Power frequency withstand voltage	
	ii) Short-time current and dynamic withstand	
	iii) Temperature-rise	
	iv) Test to establish degree of protection offered by enclosure	
12.	Dimensions (WxDxH)	
	a) 33 KV Circuit Breaker Panel	
	b) 11 KV Circuit Breaker Panel	
13.	Approximate weight :	
	a) 33 KV Circuit Breaker Panel	

	b) 11 KV Circuit Breaker Panel	
14.	Painting :	
	a) Type	
	b) Outer Finish	
	c) Inner Finish	
	33 KV/11 KV Circuit Breakers (Data to be provided for each rating)	
1.	Make and Type designation	
2.	Type of circuit breaker	
3.	a) Rated voltage and frequency	kV/Hz
	b) Maximum continuous service voltage	kV
	c) Rated Current :	
	i) Under normal condition	A
	ii) Under site condition	A
	d) Short-time current rating 1 sec.	kA
	e) Breaking symmetrical current	kA
	f) Making capacity	kA peak
4.	Operating time :	
	a) Closing time	ms
	b) Opening time	ms
	c) Arc duration at 100% rated breaking current	
5.	a) Type of operating mechanism :	
	i) Closing	
	ii) Tripping	

	b) Power required at rated supply :	
	i) Closing coil	
	ii) Tripping coil	
6.	Rated operating sequence	
7.	a) Dry one minute power frequency withstand voltage	kV rms
	b) Full wave 1.2/50 micro sec. impulse withstand voltage	kV peak
8.	Minimum clearance in air :	
	a) between phases	
	b) live parts to earth	
	c) centre to centre distance between phases	
9.	Weight of circuit breaker	
10.	Dimensions (WxDxH)	
11.	Tests :	
	a) Routine test : (Confirm whether the following are covered)	
	i) Measurement of resistance of main circuit	
	ii) Operation test	
	iii) One minute power frequency voltage withstand test on main circuit	
	iv) One minute power frequency withstand test on auxiliary circuit	
	v) Measurement of insulation resistance before and after power frequency voltage withstand test	
	b) Type tests : (Type test certificates for tests conducted on identical circuit breakers shall be furnished)	
	i) Temperature rise measurement of main circuit	
	ii) Temperature rise measurement of auxiliary circuit	
	iii) Measurement of resistance of main contacts	

	iv) Operating test	
	v) Mechanical endurance	
	vi) Impulse voltage withstand	
	vii) One minute power frequency withstand	
	viii) Test for short circuit conditions	

#### 5.2.12.3. HT Cables (All voltage grades):

<b>A.</b>	<b>General</b>	
1.	Name of Manufacturer	
2.	Address of Manufacturer	
3.	Locations of major works	
4.	Service facilities	
<b>B.</b>	<b>General Cable Data</b>	
1.	Standards to which the cables are quoted	
2.	Voltage Grade	
3.	Type of cable	
4.	Conductor :	
	a) Material of conductor	
	b) Special treatment on conductor, if any	
	c) Nominal number of strands per conductor	
	d) Nominal diameter of each strand in mm.	
	e) Nominal cross section area of conductor in mm.	
	f) Reactance per phase at 50 C/S-ohm/km	
	g) Shape of conductor	
	h) Maximum resistance of conductor at 20 deg.C ohm/km. (DC resistance)	



5.	Insulation :	
	a) Composition of insulation and type	
	b) Minimum thickness of insulation-in mm and method of drawing viz. by extrusion	
	c) Specific insulation resistance of the insulating material at 60°C -in ohm-cm.	
	d) Minimum insulation resistance of the finished cable per km. at 20°C in megohm	
	e) Maximum conductor operating temperature under normal (continuous) operation- deg.C and min. tensile strength - kg/cm.sq.	
	f) Minimum elongation (Normal)	
	g) Maximum conductor temperature under short circuit - deg.C	
6.	Inner Sheath :	
	a) Composition of inner sheath and type	
	b) Thickness of inner sheath and method of drawing, viz. by extrusion	
	c) Diameter of cable over inner sheath but below armour wire in mm.	
7.	Armouring and Bedding :	
	a) Material of the armour	
	b) Type of armouring (round wire required)	
	c) Dimensions of armour wire	
	d) Whether single layer or double layer armour	
	e) Minimum tensile strength of armour wire kg./sq. cm.	
	f) Diameter of cable over armouring - mm	
	g) Bedding particulars viz. material, thickness, method of drawing etc.	
8.	Non-conducting water swellable tape	
	a) Material of the tape	
	b) Thickness of the tape	
9.	Outer Sheath :	

	a) Composition of outer sheath material and type	
	b) Thickness of outer sheath and method of drawing viz. by extrusion	
	c) Diameter over outer sheath in mm.	
10.	Current Ratings : Continuous current carrying capacity for conditions of installations stand below shall be stated clearly:	
	a) Maximum conductor temp	
	b) Ambient air temp	deg.C
	c) Depth of laying	cm
	d) Thermal resistivity of soil	cm/W
	e) Method of installation For conditions of installations different from that of basic assumptions sufficient and suitable rating factors shall be furnished and shall be according to relevant standard, if any.	
11.	Weights and Dimensions	
	a) Approx. net weight of cable - kg/km.	
	b) Maximum overall diameter of cable - mm	
	c) Normal delivery length of cable - meter	
	d) Approx. gross weight per drum - kg.	
	e) Size of drum Approx. flange diameter - mm.	
	f) Minimum bending radius of finished cable	

#### 5.2.12.4. 3.0 L.V. Panels:

<b>A.</b>	<b>Construction</b>	
1.	Make	
2.	Type	
3.	Whether single/double front construction	
4.	Type of mounting	
5.	Degree of protection of enclosure	

6.	Sheet steel thickness (mm)	
7.	Dimensions of each vertical section panel (mm)	
8.	Whether suitable for busduct termination at top	YES/NO
9.	Dimensions of cable alley (mm)	
10.	Whether space heaters provided in each vertical section complete with switch fuse and terminal blocks	YES/NO
11.	Whether extension facility is provided on both ends of the SWITCHGEAR	YES/NO
12.	Whether locking facility for each module provided	YES/NO
13.	Overall dimensions (L x W x H)	
14.	Weight	
<b>B)</b>	<b>Operating Conditions</b>	
1.	Short circuit rating (in kA)	
2.	Time of duration for short circuit current (sec.)	
3.	Temp. rise allowed based on site ambient temperature (50deg.C)	
	- Busbar chamber	
	- Cable alley and wire way	
	- Individual feeder module	
	- Busbar	
<b>C)</b>	<b>Busbars</b>	
1.	Material	
2.	Grade and composition	
3.	No. of busbars	
	- Main horizontal busbars	
	- Vertical dropper busbars	

4.	Continuous current rating of busbar and temp. rise over 50 deg.C ambient	
5.	Phase to phase and phase to earth clearances	
6.	Whether sleeving or shrouding provided for busbar	YES/NO
7.	Whether separte earth bus provided	Yes/No
8.	Earth bus size	
<b>D)</b>	<b>Power cable connection :</b>	
1.	Type, make and material of power cable terminals	
2.	Whether power cable terminating arrangement suitable for termination of cables specified	Yes/No
<b>E)</b>	<b>Control Cable Connection :</b>	
1.	Type, make material for control terminals	
2.	Type of control connection from the withdrawable unit to the fixed portion	
3.	Cable size of control wiring	
<b>F)</b>	<b>Switchgear Equipment</b>	
1.	<b>Air Circuit Breaker/MCCB</b>	
	a) Rated operational voltage	
	b) Rated insulation voltage	
	- Main circuit	
	- Auxiliary circuit	
	c) Rated current	
	d) Rated making capacity (peak)	
	e) Rated breaking capacity (r.m.s.)	
	f) Rated peak withstand current	
	g) Rated Short time current and its duration	

	h) Voltage rating of motor drive	
	i) Overload/short circuit/earth fault releases	
	j) Auxiliary contacts	
	k) Make	
2.	<b>Overload Relay</b>	
	a) Type and make	
	b) Whether ambient temperature compensated	
	c) Whether handreset type	Yes/No
	d) Whether single phasing protection provided	YES/NO
3.	<b>Push Button</b>	
	a) Type & make	
	b) Contact rating at 110V, 50 Hz A.C.	
	c) Whether 'stop' (red) push button is provided 'unshrouded' type	Yes/No
	d) i. Whether separate "Yellow" push button provided for overload reset.	Yes/No
	ii. Whether separate white push button is provided for single phase protection reset	Yes/No
	e) No. of 'NO' & 'NC' contact in a standard stack.	
4.	<b>Meters</b>	
	a) Type & make	
	b) Range of meters	
	c) Instrument accuracy class as per relevant IS	
	d) Whether suppressed scale ammeters are provided for motor starting current in motor feeders.	
5.	<b>Current Transformers</b>	
	a) Type & Make	
	b) Voltage class	

	c) Accuracy class of C.T.	
	d) V.A. Burden	
6.	<b>Potential Transformers</b>	
	a) Type & make	
	b) Voltage class	
	c) VA burden	
	- Whether leaflets and catalogues for the following showing the technical particulars, characteristic curves, contact numbers and rating etc. enclosed herewith	YES/NO
	▪ Combined over current and earth fault relay	
	▪ Under voltage relay	
	▪ Over voltage relay	
	▪ Motor protection relay	

#### 5.2.12.5. L.V. Cables (Power and Control):

1.	<b>General</b>	
	a) Name of Manufacturer	
	b) Address of Manufacturer	
	c) Locations of major works	
	d) Service facilities	
2.	<b>General Cable Data</b>	
	a) Standards to which the cables are quoted	
	b) Voltage Grade	
	c) Type of cable	
	d) Conductor :	
	i) Material of conductor	
	ii) Special treatment on conductor, if any	

	iii) Nominal number of strands per conductor	
	iv) Nominal diameter of each strand in mm.	
	v) Nominal cross section area of conductor in mm.	
	vi) Reactance per phase at 50 C/S-ohm/km	
	vii) Shape of conductor	
	viii) Maximum resistance of conductor at 20 deg.C ohm/km. (DC resistance)	
	<b>e) Insulation :</b>	
	i) Composition of insulation and type	
	ii) Minimum thickness of insulation-in mm and method of drawing viz. by extrusion	
	iii) Specific insulation resistance of the insulating material at 60 deg C-in ohm-cm.	
	iv) Minimum insulation resistance of the finished cable per km. at 20deg. C in megohm	
	v) Maximum conductor operating temperature under normal (continuous) operation- deg.C and min. tensile strength - kg/cm.sq.	
	vi) Minimum elongation (Normal)	
	vii) Maximum conductor temperature under short circuit - deg.C	
	<b>f) Inner Sheath</b>	
	i) Composition of inner sheath and type	
	ii) Thickness of inner sheath and method of drawing, viz. by extrusion	
	iii) Diameter of cable over inner sheath but below armour wire in mm.	
	<b>g) Armouring and Bedding</b>	
	i) Material of the armour	
	ii) Type of armouring (Whether round wire or flat wire)	
	iii) Dimensions of armour wire	
	iv) Whether single layer or double layer armour	
	v) Minimum tensile strength of armour wire kg./sq. cm.	

	vi) Diameter of cable over armouring - mm	
	vii) Bedding particulars viz. material, thickness, method of drawing etc.	
	<b>h) Outer Sheath :</b>	
	i) Composition of outer sheath material and type	
	ii) Thickness of outer sheath and method of drawing viz. by extrusion	
	iii) Diameter over outer sheath in mm.	
	<b>i) Current Ratings :</b> Continuous current carrying capacity for conditions of installations stand below shall be stated clearly:	
	i) Maximum conductor temp	
	ii) Ambient air temp	deg.C
	iii) Depth of laying	Cm
	iv) Method of installation For conditions of installations different from that of basic assumptions sufficient and suitable rating factors shall be furnished and shall be according to relevant standard, if any.	
	<b>j) Weights and Dimensions</b>	
	i) Approx. net weight of cable - kg/km.	
	ii) Maximum overall diameter of cable - mm	
	iii) Normal delivery length of cable - meter	
	iv) Approx. gross weight per drum - kg.	
	v) Size of drum Approx. flange diameter - mm.	
	vi) Minimum bending radius of finished cable	

#### 5.2.12.6. Transformers (All Ratings):

1.	a) Manufacturer's Name	
	b) Whether all type test conducted on an identical transformers	YES/NO
	c) Whether Technical leaflets/ catalogues enclosed	YES/NO



2.	<b>Technical Data (All Ratings)</b>	
	a) Service	Indoor/Outdoor
	b) kVA rating	
	c) Rated Voltage :	
	i) HV winding	Kv
	ii) LV winding	kV
	d) Rated frequency	Hz
	e) Number of phases	
	f) Connections :	
	i) HV winding	
	ii) LV winding	
	g) Connection symbol/vector group and reference temperature	
	h) Tapping :	
	i) Range	
	ii) Number of steps	
	i) Type of cooling	ON AN
	j) Temperature rise over 45 deg.C ambient	
	i) Winding (Temperature rise measured by resistance method)	deg.C.
	k) Total loss at rated voltage at principal tapping and frequency	kW
	l) Component losses	
	i) No load loss at rated voltage on principal tapping and rated frequency	kW
	ii) Load loss at rated current at principal tapping at 75 deg.C	kW
	m) Impedance voltage at rated current for principal tapping	%
	n) Reactance at rated current and frequency	%
	o) No load current at rated voltage and frequency	%

	p) Insulation level :	
	i) Separate source power frequency voltage withstand	
	▪ HV winding	kV rms
	▪ LV winding	kV rms
	ii) Induced over voltage withstand	
	▪ HV winding	kV rms
	▪ LV winding	kV rms
	iii) Full wave lightning impulse(1.2/50 micro second) withstand voltage on HV winding	kV peak
	q) Efficiency at 75 deg.C at unity power factor :	
	i) At full load	%
	ii) At 3/4 full load	%
	iii) At 1/2 full load	%
	r) Regulation at full load at 75 deg.C :	
	i) At unity power factor	%
	ii) At 0.8 power factor lagging	%
	s) Terminal arrangement :	
	i) HV side	
	ii) LV side	
	iii) Neutral	
	iv) Creepage distance	mm
	t) Insulation	
	u) Approximate weight :	
	i) Core and winding	kg
	ii) Tank, fittings and accessories	kg

	iii) Total weight	kg
	v) Approximate overall dimensions	
	iv) Length	mm
	v) Breadth	mm
	vi) Height	mm
	w) Untanking Height	mm
	x) Whether outline dimensional drawing of transformer enclosed	YES/NO
	y) - Conductor material HV/LV	
	Max. current density	
	Core Material	
	Max. flux density	
<b>3.</b>	<b>Fittings :</b> (Out of following, list out fittings covered in offer)	
	a) Sampling valve	
	b) Air release plug	
	c) Double flanged valve in feed pipe to gas and oil actuated relay	
	d) Explosion vent	
	e) Dehydrating breather	
	f) Dial type thermometer	
	g) Winding temperature indicator	
	h) Separate neutral bushing	
	i) Neutral current transformer	
	j) Jacking pads	
	k) Lifting lugs for active parts	
	l) Marshalling box	
	m) Disconnecting chamber on HV side	

	n) Cable box with cable glands & lugs	
	o) HV bushings with arcing horns	
	p) HV & LV bushings	
	q) Earthing pads with clamps	
	r) Bidirectional wheels	
	s) Diagram and rating plate	

#### 5.2.12.7. Battery, Battery Charger and DC Distribution Board:

<b>1.</b>	<b>Battery :</b>	
	a) Make and type designation	
	b) Type of Battery	
	c) Rating :	
	i) Battery voltage	VDC
	ii) Number of cells	
	iii) Nominal cell voltage	VDC
	iv) Ampere hour rating at one hour discharge	A
	v) Reference ambient temperature	deg.C
	d) Reference standards	
	e) General arrangement drawing	
<b>2.</b>	<b>Battery Charger :</b>	
	a) Make and type designation	
	b) Rating :	
	i) Output voltage and nominal DC current rating V/A DC	
	ii) Float voltage variation as a percentage of output voltage setting for:	
	▪ a load current	%
	▪ a variation in AC supply	+%

	▪ range of ambient temperature	deg.C
	c) AC rms ripple current as a percentage of nominal DC current rating	%
	d) Charging modes, float/boost	
	e) Charging input voltage ranges of:	
	▪ float	V to V
	▪ boost	V to V
	f) Diagram of charger	
	g) Reference standards	
<b>3.</b>	<b>DC Distribution Board</b>	
	a) Make and type designation	
	b) System :	
	i) Nominal system voltage	V
	ii) Highest system voltage	V
	c) Circuits :	
	i) Number of circuits	A
	ii) Circuit rating	A
	iii) Circuit breaker rating	A
	d) - Busbar rating	sq.mm.
	- Cross section of busbar	
	- Material of busbar	
	- Temperature rise over reference ambient of 45 deg.C	deg.C
	e) Enclosure :	
	i) Thickness of sheet steel	
	ii) Degree of protection offered by enclosure	
	f) General arrangement drawing	

	g) Reference standards	
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#### 5.2.12.8. Capacitor Bank:

<b>1.</b>	<b>Capacitor</b>	
	a) Rated voltage	
	b) Rated output	
	c) Rated current	
	d) Rated frequency	
	e) Type	Indoor/Outdoor
	f) Bank arrangement	
	g) Connection type	
	h) Number of units per bank	
	i) Bank protection (internal fuse/ external fuse)	
	j) Loss	W KVAR
	k) Bank mounting arrangement	
	l) Power frequency withstand voltage	kV rms
	m) Impulse withstand voltage	kV peak
<b>2.</b>	<b>Series Reactor</b>	
	a) Rated voltage	
	b) Rated kVAR	
	c) Rated current	
	d) Type	
	e) Reactance per phase	

#### 5.2.12.9. NGR:

1.	Rated Voltage	
2.	Rated Duty	

3.	Rated Current	
4.	Rated Resistance	
5.	Temp. rise over ambient	

#### 5.2.12.10. List of Approved Makes

Make of the equipment under supply items shall be selected as per the following list. Employer, however, reserves, the right to select the particular make during detailed engineering for uniform design and inventory. Approval of makes for items not mentioned in this list shall be obtained from Employer/Employer's Representative Engineer before initiating procurement action.

S. No.	Equipment / Component	Preferred Makes
1.	Power Transformer	ABB/VoltAmp/Bharat Bijlee/Schneider
2.	Dry Type Transformer	Pete Transformer/ VoltAmp / T&R /Schnieder
3.	HT Switchgear Panel	ABB/Schneider/Siemens
4.	LT Switchgear Panel (Indoor)	ABB/Schneider/Siemens/L&T/ SS Control / Akshar Pyrotech/ Horizon / Authorized partners for OEMs (Neptune/Enerlec/Ambit)
5.	LT Switchgear Panel for CSS (Outdoor)	ABB/Schneider/Siemens/L&T/ SS Control / Akshar Pyrotech/ Horizon / Authorized partners for OEMs (Neptune/Enerlec/Ambit)
6.	Distribution Boards	Legrand / Havells/Adlec
7.	Compact Substation (CSS)	ABB/Schneider/Siemens
8.	HT cables	Ravin/ CCI/ Finolex/Torrent/KEC International-RPG/ Universal
9.	LT Power cables	Havells/Ravin/CCI/KEI/Finolex/Torrent/KEC International-RPG/Universal / Avocab
10.	Control Cables, Wires & Flexible cables	Havells/Ravin/Finolex/Torrent/KEC International-RPG/Universal/Apar / Avocab/Thermo cab/ Lapp
11.	Cable Glands/Lugs	Jainsons / Dowells
12.	Cable Trays	Ercon / Indiana / Industrial Perforation / Sintex / MM Engineering /OBO /EPP/Sumip/Ercon
13.	Capacitor Panel with Banks and other related accessories	L&T / EPCOS / Schneider / ABB
14.	Battery	Exide / Amco / HBL
15.	LED Lighting fixture (Indoor)	Bajaj / Philips / Syska / Havells / Surya
16.	Light Poles	Bajaj /Philips/CGL/Lighting Technologies
17.	Plate-Switches & Sockets, Boxes	MK / Crabtree (Havells) / Anchor/Roma/Legrand
18.	VCB	ABB / Schneider/Siemens

19.	ACB	ABB / Schneider/Siemens
20.	MCCB	ABB / Schneider/Siemens / L&T
21.	MCB / ELCB / RCB / MPCB	Schneider/Siemens / L&T/Legrand/ABB
22.	Fuse/Link	Siemens / L&T / Schneider
23.	Indicating Lamps / Push buttons	Siemens / Schneider / Teknic / Kaycee / L&T
24.	Meters (digital) MFM	Schneider(Conzerv)/ Secure/ABB/Siemens
25.	Voltmeter / Ammeter / PF Meter / Frequency Meter/ KWH Meter	AEI / Rishabh
26.	Selector Switch	L&T / Siemens / Schneider
<b>S. No.</b>	<b>Equipment / Component</b>	<b>Preferred Makes</b>
27.	Auxiliary Contactors/ Relays	L&T / Siemens
28.	Protective/ Auxiliary Relays	Siemens / ABB
29.	Terminal Blocks	Elmex / Connect Well
30.	Current Transformer/ Potential Transformer	AE / Kappa / Precise/ Neptune
31.	Power & Welding Sockets	Hensel/Mennekes/Neptune-Bals
32.	PVC Conduit and accessories	BEC / Polypack / Precision /AKG
33.	Cable Termination Kits & Straight Through Joints	Raychem / M-Seal (3M) (For 33kV & above : Only Raychem)
34.	Chemical Earthing	Indelec / JMV/OBO/Uniearth/Any CPRI approved
35.	Lightning Protection (ESE Terminal)	Indelec/ Protek / Uniearth / APS
36.	Fibre Optic Cable	D-Link / Finolex / RPG Cables Ltd.



## 6. INSTRUMENTATION AND CONTROL

### 6.1. PLCs

The programmable controllers shall be of rugged design and quality to meet the functional requirements, capable of withstanding/bypassing high electric noise, electromagnetic interferences, vibrations etc.

The microprocessor based systems shall be of modular design and suitable for mounting in standard racks. Each module including rack/mount base shall be individually meta l e n clo se d dust and vermin proof for withstanding worst environmental and ambient conditions etc. Remote input/output cabinets shall be suitable for mounting on walls/columns in transfer towers or conveyor galleries and shall be in IP-65 degree of protection enclosures.

RTD (0-20mA) signals shall be processed in the PLC through an analog input card which wil l b e programmed for alarm and tripping the relevant drives in case of abnormal temperature of a n y RTD. Winding temperatures shall also be available on colour monitor VDU (in the fault w i n d o w ) when required by the operator. The scan rate for all RTD channels shall not be more than 2 ms.

The analogue module system shall also have provision to accept signals from the belt scales and other subsystems generating 4-20mA analogue signals. Proper conversion to standard units shall be done by control software.

The memory shall be EEPROM type and sufficient battery backup must be provided. The execution cycle of the PLC shall meet the functional requirement of plant.

In event of power failure during battery replacement the memory contents shall not be lost for at least 30 minutes. Battery down alarm/indication shall be available at least 20 days in advance both at the CCO and at the Maintenance Workshop.

The memory capacity of the PLC shall be adequate to perform the required functions satisfactorily and with 100% spare capacity for use in the future.

Dual redundancy (100% hot standby) shall be provided in the PLC's such that in case of failure of any of the processors, the hot stand by processor shall take over automatically. The changeover shall be smooth. Redundancy shall be provided for complete the processor subsystem including CPU, memory, power supply.

Each CPU shall be complete with required number of modules, main power supply unit, marshalling box, interconnection cables etc. and shall have screw type terminals for I/O connections.

A processor failure condition shall be indicated in the CCR and the Maintenance Workshop and change over to redundant systems shall be smooth. Extensive diagnostics shall be available for all intelligent modules of the system. The processor shall execute the programme for the plant operation at very high speed.

Input/output units shall be capable of accepting discrete, analog and digital i n p u t a n d o u t p u t devices. If the number of slots for input and output modules in the controller rack is not sufficient expansion units shall be connectable to the CPU by means of interface modules.

Signals to each remote interface unit shall be transmitted by means of the network.

I/O modules shall have status indications to indicate the proper functions of the modules and scanning of signals by the processor.

Each Input and Output module shall be electrically isolated from the controllers through opto-couplers or isolation transformers and shall withstand severe voltage transients without damage or adverse effect on the controller. Output modules shall incorporate self-contained damping networks and voltage limiting devices to prevent false triggering of outputs and to suppress line voltage spikes.

Each output card shall have fuses to protect its circuitry from over current and overloads.

PLC power supply units must have self-test facilities for detecting under voltage and also must be able to give alarm and switch over to UPS mode in case the output voltage is + 20% above the normal value.

The status indications for power 'ON', control supply healthy, overloads, by means of LED's should be available on the power supply unit. The equipment must be capable of accepting wide voltage fluctuations + 10% voltage + 3% frequency.

The Contractor shall furnish the power load details of his system and shall keep 30% spare capacity in the power supply excluding allowances for transformers, cable losses etc.

The Contractor shall provide separate grounding system for the PLC based control system equipment supplied with independent earth pits and earth grid of 8 SWG G.I. wire with PVC sleeve.

## 6.2. Remote Interface Units:-

It shall have mini processor, shall also perform the logical operation. It shall accept the command from main PLC; also it shall send and receive the data from CCO-PLC. It shall have RS-485 port interface to communicate with bought out panel/controllers (by others).

### a) Digital Input Module

#### Indicative Technical Specifications

Supply Voltages	DC 24 Volt Reverse Polarity Protection
Current Consumption	10mA
Isolation	Isolation should be checked with 500V DC (isolation by opto-couplers)
Dimensions(Max)	As per standards
Operating Condition	Temperature : 8°C-65°C Humidity : 8% -80%

Input Voltage For signal "0" For signal "1"	-6 to 6 V DC -15 to -57.6 V DC  Or other approved to meet the operational requirements
Input Current	7mA at 24 V DC

**b) Digital Output Module**

**Indicative Technical Specifications**

Supply Voltages	DC 24 Volt Reverse Polarity Protection
Short circuit protection of the output	As recommended per channel
Isolation	Isolation should be checked with 500V DC (isolation by opto-couplers)
Dimensions(Max)	As per standards
Operating Condition	Temperature : 8°C-65°C Humidity : 8% -80%
Output Voltage For signal "1"	24 +(-1.0 )V DC or any approved to meet the operational requirement
No. of Channels	8 per Group
No. of Groups	4

**c) Analog Input Modules**

**Indicative Technical Specifications**

Supply Voltages	DC 24Volt Reverse Polarity Protection
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Current Consumption	225 mA
Isolation	Isolation should be checked with 500V DC
Address space per module	4 byte
Dimensions(Max)	As per standards
Operating Condition	Temperature : 8°C - 65°C Humidity : 8% - 80%
Measurement Type/range	Deactivated/ 4 to 20 mA
Overflow / underflow	Disable/enable
Errors/accuracies Temperature errors	+ 0 to 2% K
No. of Channels	2/4 input channels
Conversion time (per channel)	55/65 ms
Cable length	With 1.5 sq.mm CU maximum up to 400 meters
Status information/alarms/diagnostics	Process alarm (yes)
Cycle time (all channels)	0.25 ms

**d) RTD Modules:-**

To read the temperature values from 6 RTDs from motor winding and 2 RTDs from motor bearing temperature

**Indicative Technical Specification**

Supply Voltages	DC 24Volt Reverse Polarity Protection
Current Consumption	225 mA
Isolation	Isolation should be checked with 500V DC
Address space per module	4 byte
Dimensions(Max)	As per standards
Operating Condition	Temperature : 8°C - 65°C Humidity : 8% - 80%
Overflow / underflow	Disable/enable
Errors/accuracies Temperature errors	+ 0 to 2% K
No. of Channels	2/3/4 wire RTDs(PT 100 tyoe)
Conversion time (per channel)	20/30 ms
Cable length	With 2.5 sq.mm CU maximum up to 400 meters
Status information/alarms/diagnostics	Process alarm (yes)
Cycle time (all channels)	0.25 ms

### 6.3. Uninterrupted Power Supplies (UPS)

These shall be provided for components/locations as indicated on HIPL 1-432 EC-01 R1, with rated output powers to suit the load in each case.

#### Indicative Technical Specifications

Rated output power	To serve the loads for 30 minutes
Input	230 Volts, AC + 10% at 50 Hz + 5%

Output	230 Volts, AC, 50 Hz
Output Tolerance	+ 1 % (Steady state)
Switch over Time	Less than 10 milliseconds
Design      Reference      Ambient Temperature	45 deg C

Stationary type Ni-Cd storage battery units(SMF) with closed top cells of capacity to meet the 60 minutes UPS backup requirements shall be complete with all accessories and devices. While sizing each battery the following factors shall be taken into consideration:

- Aging factor as 0.8
- Temperature correction factor
- Backup period - 30 minutes
- Power Factor - Unity

(Non-bypass mode)

## 6.4. Software

### 9.4.1 In General

Software provided shall be based to the maximum extent on standard packages to minimize complex programming tasks and facilitate support, maintenance and upgrading. Software shall be "user friendly".

The development of the application software shall be done in consultation with the Engineer in a number of stages (requirements definition, functional specifications, design, implementation and testing, maintenance and training) with each stage to the Engineer's approval. The final version of the software will be subject to the approval of the Owner.

The software shall meet the requirements of this specification for all of the management and control system functions and operations, and it shall be possible to develop it in further detail on site to meet the management and operating needs of the Owner.

Programs shall be rationally structured, well readable, easily revisable, and with man-machine interfaces displayed in English.

The software shall be suitable for use with multiple methods of English character input.

Manuals will be provided for all software in English

Proprietary software packages forming part of the software provided will include permanent run-time licences. If any part of the software requires annual licence fees, the cost of such fees will be indicated in the bid.

In any case the Owner shall have the right to freely develop, modify, maintain the application

software, and shall provide the source code and all relevant manuals and information needed for this purpose.

Utility programmes shall be included in the software supply, including network management, multi-level password protection, on-line help, virus protection, and back-up and archiving, word processing, statistics, simulation and data communication.

Whenever an operator input data, a text window will be prompted on the display.

#### **6.4.1. Control Software**

The control software shall be used mainly to:

- Control the process flow operations
- Process operating instructions
- Control operating cycles and interlocking sequence logic
- Collect data automatically on equipment status and fault indication
- Collect and process data in real-time
- Transmit data and communicate with RIOs/subsystems/associated control devices/VFDs
- Receive input data on trains, trucks and ships
- Automatically diagnose faults in the complete system
- To provide a human interface for the operators
- Update the software programmes

The PLC programming language shall be of ladder type, functional block description, or other approved standard type. It shall be possible to program the system on-line. Facilities shall be provided to monitor the system on-line in addition to programming, using either mounted on PLC hardware or separately through a programming workstation so that forcing of I/Os, changing of timer/counter values, contact monitoring, error analysis etc are possible. The PLC/PCs shall read or write data from/to the RIO, workstations, VFD drives, associated control devices indicated on the Control Architecture Drawing and elsewhere in this specification.

A human interface/graphics package shall be part of the control software and shall communicate with the large VDUs and the operator's colour graphics workstations/PC's required. The databases shall be updated continuously in real time in not more than 1 second. All displays shall be dynamic and updated continuously, irrespective whether they are actual or shown on the screens or not at the time. All page/graphic displays shall be programmable so they can be changed at any time to add additional information needed by a software engineer at the site off-line.

The software shall display the fault and alarm status of the plant components and shall be available in the data base at all times. The fault and alarm status shall be transferred to maintenance operator

automatically.

The data base and data formats in the control system shall be identical to the management system databases.

## 6.5. Central Control Room and Related Rooms

The CCR will be housed on the second floor of the Substation 1 (SS1), which will house the CCR, a control equipment room, a computer room, UPS room, and offices.

In CCR the following equipment will be installed:

- Control desk for operation and monitoring;
- PC workstations;
- Printers;
- Public address system station;
- Central control console;

The consoles will be low profile, laid out ergonomically in an arc shaped pattern, to accommodate the equipment and the operators to permit efficient operations with a minimum of fatigue. The layout will be subject to the approval of the Engineer. Appropriate non-glare lighting shall be provided in the CCR, which shall be fully air conditioned and shall have sound absorbing paneling ceilings and walls.

The control equipment room will house equipment such as PLC panels, relay panels, distribution panels, control power panels, PA system amplifiers. The computer room will accommodate the network file servers, network devices; system engineers work station and printer. The UPS and associated batteries will be in a separate room. False floors shall be used in the CCR and the computer room to accommodate cabling and connections. The Contractor shall supply six revolving, ergonomic office chairs, media storage, bookcases for manuals, and filing cabinets.

## 6.6. Associated Control Devices/Sub-Systems

### 9.6.1 Introduction

Associated control devices are mainly individual equipment level control devices. One group of such devices shall be supplied and installed by the Contractor under this Contract. Another group of such devices or sub-systems shall be supplied and installed by others. The Contractor shall be responsible for the interconnection of **all** such devices/sub-systems with the control system under this specification and their integration with the software supplied by the Contractor. Please note that the interconnections shall be such that the **status** of all devices/sub-systems shall be transmitted to the control network irrespective of whether a motor drive is in the "local" or "auto" mode.

#### 6.6.1. Control Devices by the Contractor

The following items shall be furnished, installed, connected, and integrated into the system by the



Contractor in accordance with these specifications.

#### 6.6.1.1. Local Control stations

All local control stations shall be of SS 316 with powder coating up to 120 - 160 micron.

##### a) Conveyor Motor

Each electrical drive motor shall have two modes of operation; 'Local' and 'Auto', manually selectable by a three position selector switch "Local-Off-Auto". Each heavy duty selector switch shall be located close to and within view of each drive motor.

In the cases of conveyors with multiple motor drives, a *single* L-O-A switch shall be provided per conveyor near only one of the drive motors. However:

A maintained contact emergency stop switch shall be provided near the other drive motor(s).

The emergency stop switch shall have at least three sets of NC/NO potential free contacts rated at 10 amp at 110V DC in an IP-65 protected enclosure. A red mushroom type of actuator shall be used. There shall be two cable entries suitable for double compression glands (or better) for up to 10 x 2.5 sq mm copper conductor armored control cable. Earthing terminals shall be provided on the enclosure.

##### b) Scoop coupling

Each electrical actuator shall have three modes of operation; 'Local' and Remote and mechanically selectable by a three position selector switch with IN and OUT Push button for actuator. Each Local control station shall have Two indication lamps, to be provided for position of actuator 0 % or 100 %.

##### c) Movable Head pulley and Flap gate

Each Gate motor shall have two modes of operation; 'Local' and Remote selector switch with Forward and Reverse Push button. Each Local control station shall have indication lamps provided for position of gate.

##### d) Winch Motor

Each Winch motor shall have two modes of operation; 'Local' and Remote selector switch with Forward and Reverse Push button.

##### e) Pull Cord Emergency Switches

Heavy duty enclosed epoxy painted dust and vermin proof Pull Cord Switches with IP-65 degree of protection shall be provided on both sides of conveyor at intervals of about 50 meters. The switches shall have a vertical lever with a suitable rope clamping device. It shall be feasible to actuate the switch in a maintained mode by pulling on the rope from either side of its normal vertical axis. A manual resetting lever shall be provided to reset the switch to its normal position. The switch shall have 2 NO + 2 NC potential free contacts suitable for 10 Amp at 110 V DC and a built in terminal box complete. Two numbers of earthing terminals suitable for 8 SW G GI wire shall be provided on the body of the switch.

The Contractor shall ensure that the voltage drop at the receiving end of the control cable connections is within acceptable limits to ensure reliable operation and that delay in delivery of a stop signal to the drives is the minimum. (30 milliseconds or less)

**f) Belt Side Travel Switches (BSTS):-**

Heavy duty long vertical roller lever type belt side travel switches in epoxy painted IP 65 protected enclosure, shall be provided on both sides of Belt Conveyors at both ends. Sufficient over travel shall be provided to avoid damage during impact of the belt. This switch shall be a momentary contact/self-reset type. Each switch shall have 2 NO + 2 NC potential free contacts suitable for 10 Amp at 110V DC and shall be wired to an internal terminal block. Two numbers of earthing terminals suitable for 8 SWG GI wire shall be provided on the body of the switch. These switches shall operate only in the Auto mode and shall stop the drive only after an adjustable time delay.

**g) Zero Speed Switch**

A non-contact electronic type Zero Speed Switch shall be provided on a tail end pulley of each Belt Conveyor. The switch shall have a sensing device and a monitoring unit. The switch shall serve to interlock the feeding conveyor and stop it or prevent it from starting if the pulley is not rotating at a preset speed (only in the auto mode). Suitable control cable shall be provided for connection between the sensor and the monitoring unit. 240 Volt AC power supply shall be provided for the monitoring unit. The actuator shall also be in the scope of supply and shall be mounted on the tail pulley. Each switch shall have 2 NO + 2 NC potential free contacts suitable for 10 Amp at 110VDC and shall be wired to internal terminal blocks. Three nos. cable entries suitable for double compression cable glands shall be provided in the monitoring unit. Two numbers earthing terminals suitable for 8SWG GI wire shall be provided on the enclosure of monitoring unit. The component enclosures shall meet IP: 65 protection standards.

**h) Belt Take Up Switches**

These switches shall be provided and installed so as to be actuated by an extreme movement of the conveyor belt take up should the belt tension not be adequate for any reason. Each switch shall be dust and vermin proof and shall have a degree of protection IP65. Each switch shall have 2 NO + 2 NC potential free contacts suitable for 10 Amp at 110V DC and shall be wired to an internal terminal block.

**i) Transfer Chute Blockage Switches**

These switches shall be provided in the transfer chutes at the head end of each conveyor and shall operate in both the local and auto modes. They shall be pressure plate type level indicators or rotary "Bin Indicator" types, or other approved types, which shall be actuated and maintain the switch contact on a "chute blocked" condition until the level of the material is reduced. It shall be an important requirement to ensure that these switches will not be affected by dusty conditions, will not be damaged by the material flow, and will survive being buried temporarily in the material. These switches shall be dust and vermin proof and shall have IP: 65 degree of protection. Each switch shall have 2 NO + 2 NC potential free contacts suitable for 10 Amp at 110V DC and shall be wired to an internal terminal block. One or two number of cable entries suitable for double

compression cable gland for 5\*2.5sq.mm/ copper conductor armoured cable shall be provided together with grounding lugs.

**j) Field Hooters**

These shall give an audible alarm before a conveyor, or movable head pulley commences to move; both in the auto and local mode. The hooters shall be capable of sounding continuously for a pre-settable interval. The alarm/ siren shall be motor driven. It shall work on 220 V AC, 1 phase.

More than one will be needed for long conveyors. Adequate numbers/conveyors shall be provided to ensure their audibility along-side the full conveyor length. The Contractor shall indicate the numbers required, the db ratings and the spacing to suit the db ratings proposed in his bid.

The housing of the hooters shall be IP-65 protected and shall have the appropriate terminals, cable connectors and grounding lugs.

**k) Heavy Duty Limit Switches**

Heavy duty Limit Switches shall be provided at every travel end of moveable head pulleys/winch drives. The enclosure shall be IP-65 degree of protection. It shall work in dusty and humid environment. The Contractor shall supply, install and terminate to respective MCC and nearby RIO.

## **6.7. Standards**

### **9.7.1 In General**

The design, manufacture and testing of equipment shall be carried out as per the latest Indian Standards, Indian Electricity Rules, Tariff Advisory Committee Regulations for Electrical Equipment, Statutory acts and rules as made by the Government of India or Government of Gujarat.

Where Indian Standards do not exist, the relevant applicable standards from the following codes shall apply:

- IEC : International Electro Technical Commission;
- ANSI : American National Standard Institute
- DIN : Deutsche Institute for Norms
- JIS : Japanese Industrial Standards
- ISO : International Organisation for Standardization
- IEEE : Institution of Electrical and Electronics Engineers

All electrical equipment and components shall be provided with dust proof, sealed and salt spray proof enclosures.

In places with dust hazard danger classified as Zone 21 and Zone 22 as per IEC standards, the electrical components shall be dust hazard proof.

For Zone 21 a minimum of IP6X, for Zone 22 a minimum of IP5X to IEC standards shall be required. Equipment and components supplied for use in dust explosion hazard areas will be marked in accordance with the standards and "Codes of Practice" of IEC or equivalent/approved standards of

the country of origin.

For non-dust hazard areas the protection class for enclosures of electrical components will be at least IP4X for indoor installation and IP55 for outdoor installation, subject to the location and the working environment, or as called for in the specifications.

#### 6.7.1. Applicable Standards

Some of the relevant Standards for equipment covered under this specification are given below:

IS: 5	Colour Codes of Paint
IS: 375	Marking of Busbars
IS: 694	PVC insulated cables for working voltages upto and including 1100 Volts, AC
IS: 1248	Indicating Instruments
IS: 2147	Degree of Protection for enclosures
IS: 2208	HRC cartridge fuse link upto 500 Volts
IS: 2419	Panel mounted indicating and recording electrical instruments
IS: 2959	Contactors
IS: 3202	Climate proofing of electrical equipment
IS: 4064	Air Break Switches
IS: 4237	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V AC
IS: 6005	Code of practice of phosphating iron and steel
IS: 6875	Control Switches
IS: 8623	Factory Built Assembly of Switchgear and Control gear
IS: 8828	Miniature Circuit Breaker
IS: 9224	Low Voltage Fuses

IS: 325	Three Phase Induction Motor
IS: 900	Code of Practice for installation and Maintenance of Induction Motor
IS: 1231	Dimensions of three phase foot mounted Induction Motor
IS: 4029	Guide for testing three phase Induction Motor
IS: 4691	Degree of Protection provided by enclosures for rotating Electrical machinery
IS: 4722	Rotating Electrical Machines
IS: 4728	Terminal Marking and direction of rotating electrical machinery
IS: 4889	Methods of determination of efficiency of rotating electrical machines
IS: 6362	Designation of method of cooling for rotating electrical machines
IS: 7816	Guide for testing Insulation resistance for rotating machines
IS: 12065 & BS: 4999	Permissible Noise levels
IEC: 72	Dimension of Induction Motor
IEC: 34	Three Phase induction Motor
IS: 8789	Values of performance characteristics for three phase induction motor
IS: 12075	Limits of Vibration severity
IS : 2026	Power Transformers
IS : 2099	Bushing for Alternating Voltage above 1000 Volts

IS : 3639	Fittings and Accessories for Power Transformers
IS : 2147	Degree of Protection for enclosures.
IS : 2705	Current Transformers
IS: 3156	Potential Transformers
IS: 6236	Ammeters.
IEEE C57.18.10	IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers.
IEC 61378	Converter Transformers
IEC 60204	Safety of Machinery
IEC-60056	Switchgear
IEEE-519	Recommended Practices for Harmonic Control in Electrical Power Systems.
IEC 6034	Guidance for the Design & Testing of AC Motors for Converter Supply
IEC 61800	Adjustable Speed Electrical Power Drive Systems

### 6.7.2. System Voltage Standards

The primary distribution at the port will be at 11 kV to the power distribution substations and to the primary of the VFD transformers. The system voltages particulars at the receiving side shall be as follows:

Motor Control Centre and Distribution Boards	690/415 V, AC, 3 Ph, 50 Hz, 4 Wire grounded
Small Power and Miscellaneous Supplies	415/240V, AC, 4/2 Wire grounded
Control Circuits:	

Sequence Interlocking Control System	24V DC/48V DC,110VDC AC 220V(direct wiring) 110 V, AC, 2 Wire grounded
Circuit Breaker Protection & Tripping Control System	110 V DC, 2 Wire grounded
Motor Control Centre	110 V AC, 2 Wire grounded DC 24/48/110/220 V
MCU, LDP, F.I (Remote) I/O	240 V, AC, 1-Phase, 50 Hz All equipment shall have internal close loop regulation & spike arrestors
VDU, Keyboard, Printer	240 V, AC, 1-Phase, 50 Hz All equipment shall have internal close loop regulation & spike arrestors
UPS System	Primary 240 V + 10%, AC, 50 HZ +/- 5%, 1 Ph, 2 Wire
Field Hooters Power Supply	240 V, 1 Ph, 50 Hz, AC

In case any other special voltages are required for his equipment it will be the responsibility of the contractor to generate the same in his own power distribution board.

## **7. CIVIL AND STRUCTURAL WORKS:**

### **7.1. Introduction**

The Kandla phase expansion of port is planned within the existing port limits. This note covers the Indicative basis of civil design for conveying system. Design basis for mechanical equipment or structural systems of the conveying system are not included in this document.

### **7.2. General**

The Scope of this document is intended to cover the design of all civil engineering work for various structure included under the bulk cargo MHS.

This document covers the General Description of:

- Structural framing system.
- Applicable latest Standards, Codes & Recommendations of the Bureau of Indian Standards Specifications / Indian Road Congress and Specifications published by Ministry of Road Transport and Highways (MORTH).
- All structures shall be designed for the most critical combinations of dead loads, live (imposed) loads, equipment loads, crane loads, wind loads, seismic loads, Design Parameters.
- Design methodology.
- Characteristics of construction materials to be adopted for the project.
- This DBR has been developed on the basis of relevant parts of the Technical specifications. In the absence of any particular aspects of structural Design of the element, suitable IS Specification and Codes of Practice, other recognized International Standards, Codes and Practices will be followed.

### **7.3. Site Information:**

#### **7.3.1. Site Location:**

The Major Port of Kandla is situated in the Gulf of Kutch on the West Coast of India, at latitude 23° 01' North longitude 70° 13' East. The Port serves a vast hinterland covering north and north-western parts of India. The Port is situated in the Kandla Creek and is 90 kms. from the mouth of Gulf of Kachchh.

#### **7.3.2. Seismic condition:**

The project site lies in the Seismic Zone–V as defined in IS 1893 (Part I): 2002

#### **7.3.3. Wind Condition:**

Kandla has a tropical humid climate with hot summers and the region is characterized by one seasonal monsoons:



- The South-West Monsoon extends from June to September is characterised by occurrence of rain, with predominantly south westerly winds.
- Basic Wind speed: 50 m/sec as defined in IS 875 (part III) -1998 (Cyclonic Condition).
- Operating Wind speed: 22 m/sec.

#### **7.3.4. Rainfall**

Rainfall at Kandla is low. Annual average rainfall is about 322 mm per annum with the total number of rainy days of 17 per year, about 90% of which is received during the south-west monsoon season, i.e., between June and September with a maximum of 153 mm in July. April and May are dry months with average rainfall below 0.6 mm per month.

#### **7.3.5. Temperature**

The mean daily maximum temperature is 34°C and with 45°C the highest occurring in May. Mean daily minimum temperature is 20°C and with 12°C the lowest occurring in January.

#### **7.3.6. Visibility**

Throughout the year visibility is good as the region has zero fog days. However, during rains and squalls, the visibility deteriorates.

#### **7.3.7. Relative Humidity**

Relative humidity is generally high and rises to about 80% during the monsoons in the month of August.

#### **7.3.8. Cyclone**

In general the west coast of India is less prone to cyclonic storms compared to the east coast. It is observed from the cyclonic tracks in the Arabian Sea that only 6 storms endangering the Kandla coast have occurred till date with maximum speed recorded was 100 kmph. However, in 1998 a severe cyclone hit the Kandla Port with a wind speed of 150 kmph resulting in high tidal waves of 10.5m causing extensive damage to port installations.

#### **7.3.9. Reference level:**

- a) Jetty for Berth-8 and 9 is under construction and proposed Jetty Top Level is - +9.14.
- b) Back up area filling and development has been done. Ground level is in slope, GL at Berth-8 and 9 end of the plot is +9.14 m. Bidder shall visit site and collect desired information as per requirement.

### **7.4. References, Codes and Standards:**

The design and drawings will be developed on the basis of the standard codes and documents as:

Reference Code	Description
<b>IS:456 : 2000</b>	Code of Practice for Plain and Reinforced Concrete
<b>IS:875 : 1987</b>	Code of Practice for Design Loads for Building and Structures Part 1 – Dead Loads Part 2 – Imposed Loads Part 3 – Wind Loads Part 5 – Special Loads and Combinations
<b>IS:1080</b>	Code of Practice for Design and Construction of Shallow Foundation on Soils (other than raft, ring and shell)
<b>IS: 1786</b>	High Strength Deformed Steel Bars & Wires for Concrete Reinforcement.
<b>IS: 800 : 1984</b>	Code of practice for general construction in steel
<b>IS: 801: 1975</b>	Code of practice for use of cold formed light gauge steel Structural member in general building construction.
<b>IS 1893: Part 1: 2002</b>	Criteria for Earthquake Resistant Design of Structures Part I – General Provision and Buildings.
<b>IS 4326: 1993</b>	Code of Practice for Earth Quake Resistant design and construction of buildings.
<b>IS:2950</b>	Code of Practice for Design and Construction of Raft Foundations
<b>IS:2911:2010</b>	Part1 / Sec2 - Code of Practice for Design and Construction of Pile Foundations - Bored Cast in situ piles
<b>IS: 13920</b>	Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces.
<b>IS:3370</b>	Code of Practice for Design and Construction for the liquid storage structures. Part I to IV.
<b>IS:1904</b>	Code of Practice for Design and Construction of Foundations in Soils – General Requirements

<b>SP16</b>	Design Aids to IS: 456
<b>SP24</b>	Explanatory Handbook on Indian Standard Code for Plain and Reinforced concrete.
<b>SP34</b>	Handbook on Concrete Reinforcement and Detailing

Whenever Deemed necessary, the stipulations of ISO, ACI, AISC or BS codes shall be used in design as supplement to IS code.

## 7.5. Loads and Load Combinations:

Port will be used to handle the following materials with its Characteristics to be considered as:

<b>Material</b>	<b>Average Bulk Density (T/cum)</b>	<b>Angle of Repose (degrees)</b>	<b>Size (mm)</b>
Coal	0.7 to 1.3	34	0.25-100 mm
Other cargo	As per actual data sheet	As per actual data sheet	0.25-100 mm

### 7.5.1. Design Life of the Structures

As a general guideline design life of minimum 50 years shall be considered for the permanent structure unless mentioned otherwise.

Following table indicates specific design life corresponding to the type of structure:

**Table 10-1 Design Life of the Structure**

<b>Type of structure</b>	<b>Design life of the structure (years)</b>
All the pavements	30
All the pits	30
All civil structures to support electrical and IT	30
All buildings	30
Workshop	30
Toilet Block and Shed for rest	30
Water tanks	30
Gate Complex and barriers	30

Compound wall	30
Fencing	10

## 7.5.2. Types of loads

### 7.5.2.1. Dead Loads (DL):

Dead loadson the structure shall include self-weight of the complete structure with:

- a) Flooring, finishingand fixtures
- b) Partitions, wall panels
- c) All equipment weights and its supportingstructures
- d) Roofing material
- e) Piping
- f) Cable trays

The following unit weightsof the material shall be considered for computation ofloads. IS 8 75 (Part I): 1987 will be used for the materialweight as:

Material	Unit weight
Plain Cement concrete	: 24.0 kN / cu.m.
Reinforced Cement Concrete	: 25.0 kN / cu.m.
Cargo for Load calculations	: 11.5 kN / cu.m.
For Volume calculations	: 8.0 kN / cu.m.
Floor finishes	: 24.0 kN /cu.m.
Brick /block work	: 20.0 kN / cu.m.
Structural Steel	: 78.50 kN / cu.m.
Roof treatment (at RCC roofs for buildings)	: 21 kN /cu.m.

All likely dead loads to be experienced by the structure during its life time. Vendor specific d at a shall be used for unit weight of the material for which data is not available in IS: 875 (Part-1 ) o r relevant Indian Standards.

### 7.5.2.2. Imposed Loads ( IL):

The Imposed loadsare those loads produced by:

- a) Live loads,
- b) Dust / spillage loads,
- c) Minor equipment loads

- d) Cable trays
- e) Small pipe racks /hangers,
- f) Erection loads,
- g) Operation/ maintenance loads, etc.

Floors and supporting members of different areas which may be subjected to heavy equipment live loads shall be designed on the basis of weight of equipment OR specifically defined live loads, whichever is greater. The loads considered shall not be less than that specified in IS: 875 (Part II).

#### 7.5.2.3. Indicative Live Loads (LL)

- Sloped Roof: 75 KG/m<sup>2</sup> with reduction for slope as per IS 875.
- Live load on Flat roof shall be 0.75 kN / m<sup>2</sup> for Non-accessible roofs
- Live load on Flat roof shall be 1.5 kN / m<sup>2</sup> for accessible roofs plus dust Load as 0.75 kN / m<sup>2</sup>.
- Building floors :
 

Control room / MCC floor	: 10 kN/ m <sup>2</sup>
Pump House / operating floor	: 5 kN /m <sup>2</sup>
Toilet areas	: 2 kN /m <sup>2</sup>
- Floors where equipment is not located : 3 kN/m<sup>2</sup>
- Stair area : 5 kN /m<sup>2</sup>
- Gallery /open truss walkways : 4 kN/m<sup>2</sup>
- Chequered plate flooring : 5 kN/m<sup>2</sup>
- Cargo spillage load on gallery walkway: 0.5 kN/m<sup>2</sup>
- For open truss gallery walk ways : 0.25 kN/ m<sup>2</sup> is considered ( min)

In addition to above live loads, cable trays shall be considered as 0.50 kN/m as min. On each of the walkway members and Handrail load shall be applied at Walk way sides.

#### **Note:**

For special use areas, live loads shall be revised upward as necessary as per the technical requirement.

Reduction of L.L shall be made in accordance with the provisions of IS: 875 and IS: 1893 in case of seismic analysis.

#### 7.5.2.4. Consideration of Material, Equipment, Monorail and erection Loads:

- Load per unit length of each conveyor due to material on belt as: (design capacity / maximum speed) in kN / m.

- Static and dynamic loads of major equipment shall be based on manufacturer's data. Equipment load e.g. Pulley weight, motor and assembly weight, electrical hoist including belt and idler weight etc. shall be considered as applicable.
- Hoist / monorail load shall be as per Mechanical Load data and needs.
- Floor beams directly supporting drive machinery like head - tail end / drive pulleys, motor and gear boxes etc. impact factor shall be to mechanical load data.
- In case the erection load on any particular area is higher than the specified live load of that area then the structure design shall be based on erection loads.

**Impact Factors: -**

- For belt tension at start = 1.5
- Electrically operated crane = 1.25
- Manually operated crane/Hoist = 1.1

#### 7.5.2.5. Indicative Wind Loads:

The design wind load shall be calculated as per provisions of IS: 875 (Part-III).

The Basic Wind Speed for the project site:

- Basic wind speed under cyclonic condition ( $V_b$ ) : 50 m/sec
- Basic wind speed under operating condition : 22.4 m/sec
- The Design wind speed to be obtained from the formula given below:

Design Wind Speed,  $V_z = k_1 \times k_2 \times k_3 \times k_4 \times V_b$

Where,

$k_1$  = Risk Coefficient = 1.0 (Table 1)

(Unless mentioned specific value for the structure)

$k_2$  = Terrain, Height and Structure size factor

(Category 2, Class A, B or C, based on dimension of the structure (Table 2))

$k_3$  = Topography factor = 1.0 (Clause: 5.3.3.1)

$k_4$  = Importance Factor for Cyclonic Region  $k_4 = 1.0$

#### 7.5.2.6. Load combination for footing design & frame elements (For Wind Load Governing Case)

- DL + LL
- DL + or - WLX
- DL + or - WLY

- DL + LL + or - WLX
- DL + LL + or - WLY

The wind analysis shall consider the wind direction relative to structure and both external and internal pressure applied to the windward and leeward sides of the structure.

#### 7.5.2.7. Seismic Loads:

Seismic Loads (SL): Design for seismic loads shall be done in accordance with IS: 1893 – 2002.

The Seismic Zone for the project site is zone-V

- Type of frame : Special Moment Resisting Frame (SMRF)
- Zone factor (Z) : 0.36 (Zone V for Kandla)
- Importance factor (I) : 1.0
- Response reduction factor : 5
- Seismic co-efficient :  $A_h = Z I S_a / 2 R g$

$$= \frac{0.36 \times 1.0 \times S_a}{2 \times 5 \times g}$$

$$= 0.036 S_a / g$$

Reduction in LL shall be considered IS: 1893 -2002 (part I)

#### 7.5.2.8. Load combination for footing design (For Seismic Load Governing Case)

- DL + LL
- DL + EQX
- DL + EQY
- DL + LL + EQX
- DL + LL + EQY

#### 7.5.2.9. For frame elements (beams and columns) the following combinations are considered.

(As per IS: 1893:2002, Part – I, Cl. 6.3.1.2)

- 1.5DL+ 1.5LL
- 1.2DL+1.2 LL+1.2EQX
- 1.2DL+1.2LL+1.2EQY
- 1.5DL+1.5EQX
- 1.5DL+1.5EQY

- $0.9DL+1.5EQX$
- $0.9DL+1.5EQY$

Wind and Earthquake load shall be assumed not to act simultaneously. The total shear at base due to wind and seismic shall be compared and the governing shear load only shall be used for the design of structural members.

#### 7.5.2.10. Earth Pressure Loads

Earth pressure for all underground structures shall be calculated using coefficients of earth pressure (active/passive). In addition to earth pressure and ground water pressure, a minimum surcharge load of 1000 kg/sqm at ground level shall also be considered for the design of all underground structures to take into account the vehicular traffic in the vicinity of the structure, if applicable.

#### 7.5.2.11. Load cases and Combinations

Basic load cases to be considered for the analysis

- Dead Load : DL
- Live load on floor/walk ways : LL
- Equipment Loads : EL
- Conveyor Belt tension : BT
- Wind Load : WL
- Seismic Load : EQ

#### 7.5.2.12. The load Combinations:

Critical load combinations from various loads as stated above shall be considered.

- $DL + LL + BT + \text{Equipment Load and monorail}$
- $DL + LL + WL + BT + \text{Equipment Load and monorail}$
- $DL + 0.5LL + EQ + BT + \text{Equipment Load and monorail}$
- $DL + WL/EQ + BT + (\text{Without Material})$
- $0.9DL + EQ + BT + \text{Equipment Loads and monorail}$
- $-0.8DL + WL$
- $DL + EQ$

Basic structure shall be designed for worst combinations of loadings as per IS: 875 Cl. 8 of (Part – V) / IS: 1893.

The individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial forces, shear force and/or torsion to condition.

Separate load combinations shall be taken for Operating and Non-Operating conveyor condition for wind load case combination along with Belt Tension.



Dynamic Belt Tension is considered while operating condition and for Non-Operating Condition Belt tension shall be considered as per mechanical load data.

#### 7.5.2.13. Permissible Stresses and Increase in Permissible Stresses for design:

Permissible stresses for different load combinations shall be taken as per IS 875 (part V) and other relevant IS codes. The increase in permissible stress for member shall be as per Latest Version of IS code.

### 7.6. Indicative Design Criteria

#### 7.6.1. Civil Structure to support Electrical works and components

##### Lighting foundation

The structure shall be made of minimum M40 grade of reinforced cement concrete. Foundation shall be designed in accordance with the loading supplied by electrical contractor during detailed design and operation/functional requirements. Design and procurement of foundation bolt and templates shall be in the scope of high mast supplier.

Detail design to be carried out based on input from lighting pole system vendor.

##### Pits and cable trenches for electrical/IT cable pulling and Foundation for Compact Substation

Structure shall be made of minimum M40 grade of reinforced cement concrete. The top of pits shall be made flush with the FGL. A heavy duty removable RCC cover shall be provided on the pit. Refer IRC loading for the design loads of the pits. The foundation for compact substation shall be designed as per loading specified by the electrical contractor/vendor.

##### a) Conduits for Electrical/IT Cable Laying

HDPE DWC pipes shall be used for electrical and IT cable laying. Class and strength of the conduit shall be proposed by contractor for approval of Employer considering loading mentioned in the design basis.

##### b) Earthing Pits

Two types of earth pits shall be provided to meet earthing requirement in yard components.

- Reinforced concrete earth pits in traffic areas of yard
- Masonry type earth pits in non-traffic areas of yard

Yard lighting for loading and passing lanes (if applicable – it may happen during detail design that may compensate the lighting requirement through yard highmast)

The structure shall be made of minimum M40 grade of reinforced cement concrete. Foundation shall be designed in accordance with the loading supplied by yard lighting vendor during detailed design and operation/functional requirements.

#### 7.6.2. All Buildings & Other Civil Infrastructure

Design loads will comply with the requirements of IS: 875 (Parts 1 to 5) & IS: 1893 as a minimum unless more stringent requirements are specified herein.

The following loads will be considered in general for the analysis and design of structures and foundation:

##### c) Loading and Load Combinations

- Live Load

Terrace floor (roof accessible)	1.5 KN/m <sup>2</sup>
Terrace floor (roof Non-accessible)	0.75 KN/m <sup>2</sup>
Live Loads due to further floor loading for office space usage and other purpose, if any shall be consider as per IS: 875	

- Seismic Load

Type of frame : Special Moment Resisting Frame(SMRF) Response

reduction factor, R 5

Importance factor, I : 1.5 Or 1.0 (Same may vary based on type of building and suggestion from Independent engineer, if any)

- Soil Parameters

The soil parameters will be considered as per soil investigation report. The groundwater table shall be considered as per soil investigation report.

- Load Combinations

In general, below listed basic loads and load combinations will be considered in design of structures:

Basic load cases:

- Dead Load DL
- Live Load LL
- Seismic Load EQ
- Wind Load WL

Load combination for footing design (As per IS 1893- 2002, Part – I Cl. 6.3.1.2)

- DL + LL
- DL + EQ<sub>x</sub>
- DL + EQ<sub>z</sub>
- DL + WL<sub>x</sub>
- DL + WL<sub>z</sub>
- DL + LL + EQ<sub>x</sub>
- DL + LL + EQ<sub>z</sub>
- DL + LL + WL<sub>x</sub>
- DL + LL + WL<sub>z</sub>

For RC frame elements (beams and columns) the following combinations are considered. (As per IS: 1893:2002, Part – I, Cl. 6.3.1.2)

- 1.5DL + 1.5LL
- 1.2DL + 1.2LL + 1.2EQ<sub>x</sub>

- 1.2DL+1.2LL+1.2EQY
- 1.5DL+1.5EQX
- 1.5DL+1.5EQY
- 0.9DL+1.5EQX
- 0.9DL+1.5EQY

Required all governing Load combinations shall be considered for footing & design frame elements as per latest versions of Indian standards.

**d) Design Philosophy**

Design of all RCC structures, shall be carried out by Limit State of Collapse as per IS: 456-2000. Design strength of material and design loads will be calculated using appropriate partial safety factors over characteristic strength and characteristic loads as per IS: 456:2000.

Foundation design will be as per Limit State of Serviceability with forces as per load combinations mentioned and then multiplied by appropriate factor.

**e) Design Parameters**

- Concrete

Following grades of concrete shall be used in RCC structures:

Usage	Concrete Grade
<b>R.C.C. Substructure</b>	
Piles, Pile Caps, Isolated footing/ strip footing, columns & beam up to plinth level.	M30
Grade Slab	M25
<b>R.C.C. Super structure</b>	
Columns	M30
Beams and slabs	M30

- Clear Cover

Minimum clear concrete cover (From face to main steel) shall be as follows:

Structural Element	Min cover (mm)
<b>Sub structure of bldgs.</b>	
Pile	60
Pile Cap	75
Isolated footing/ strip footing	50
<b>Super structure</b>	
Slab	30
Columns	45
Beams, wall faces exposed to soil	40
Beams, Wall faces not exposed to soil	30

- Foundations

Final dimensions and founding level of shallow or strip footing or Bored cast-in-site or pre cast pile foundation shall be determined during the detailed design based on the actual super- structural loading. The piles are

supposed to be socketed into the stiff silty clay layer available at an available depth below the natural ground level. Final dimensions and founding level of piles shall be determined during the detailed design based on the actual superstructure loading. The piles shall be designed as per the Cole and Stroud method as specified in IS 2911 (Part-1/Sec-2): 2010.

## **7.7. Foundations:**

### **7.7.1. Geotech Investigation and sub structure design:**

The subsoil investigation has been carried out for the proposed site location. The Geotechnical investigation report is available for various areas as investigated by Geotech soil testing laboratory. The Sub structures shall be designed to have adequate design strength to withstand safely all loads likely to act on it throughout its life in accordance with Working stress Design method as defined in IS: 800 -2007 good engineering practice. Consideration would be undertaken for moving heavy items of equipment into place and consider loading when mounting or replacing heavy items of equipment.

### **7.7.2. Founding structures:**

Foundations for structures and equipment shall be proportioned to resist the critical load combinations obtained from the analysis of super structure. All foundations will be designed in accordance with relevant parts of IS 2974, and IS 456-2000. Provisions given in IS: 1904 will be considered to soil condition.

It is envisaged to have deep foundation in the form of RCC Pre cast / bored cast in situ piles which support the pile cap and columns. It is expected that pile foundations for structures like Transfer Towers, Overhead conveyor gallery, other utility structures, will be provided. The pile capacities will be considered to Geotech investigations.

If suggested in the soil investigation report, isolated or strip foundations shall be considered only for light structures like Open ground conveyor gallery, Cable supporting structures and minor structures like single storied buildings.

The foundation depth shall be determined based on loadings on foundation, safe bearing capacity at the founding level, constructional and technological requirements.

However, any other type of foundations which may be economical, without compromising the safety aspects, will be designed and suggested.

### **7.7.3. Pile foundations:**

Based on the sub soil strata pre-cast driven piles / bored cast in place may be recommended for onshore plant structures, if applicable. The piles are in general supposed to be rested on stiff silty clay layer available at an available depth below the natural ground level. The pile capacity will be to Geotech report design recommendation.

### **7.7.4. Bearing stress and increase in stress:**

The maximum allowable bearing pressure for design of foundation shall correspond to values confirmed by result of detailed soil investigation taking into account limits of allowable settlement considered for design of structures and equipment.

Safe bearing capacity of soil / pile capacity will be increased by 50% under seismic and 25% under wind load conditions. In working stress design, the allowable stress in concrete and reinforcements steel under wind (or seismic) in combination with other loads shall be increased by 33%. In case of limit state of design, load factors to IS 456-2000 shall be considered.

In case the structure permits higher lateral deflection at pile level based on the serviceability criteria, the pile capacity can be increased.

Capacity of single pile bearing stress and increase:

Both side tied single pile with pile head as fixed will be considered as to standards and to design loads.

#### **7.7.5. Stability:**

The stability checks of foundations shall be done as per IS 456:2000, cl. 20. Only vertical weight of soil within the plan of structure shall be considered for the stability calculation.

#### **7.7.6. Foundation settlement:**

For Open foundation, the permissible settlement and differential settlement shall be governed by IS: 1904 and based on geo technical report. However, the settlement shall be restricted to lower value, if necessary as per system requirement.

In case of pile foundation, this type of settlement issue is not anticipated in design as the pile capacity is defined in view of bearing and/or friction capacity to cut off level of pile and the pile diameter as considered.

#### **7.7.7. Site Grading**

In this project site the existing ground levels varies. Ground level is in slope, GL at Berth-14 end of the plot is +9.14 m and GL at entry side fencing gate is +8.6 m. Existing GL and Proposed Railway RL mentioned are indicative for reference. Bidder shall visit site and collect desired information as per requirement.

The grade filling material shall be granular, non-cohesive nature and shall be free from organic and deleterious matter and shall have the following properties;

- Maximum particle size of : 200mm
- % maximum particle size : 10%
- % passing 60 micron sieves : 10% Max.
- Liquid limit : 35% Max.
- Plasticity index : 6% max.

The material shall properly spread in the reclamation area in layers and compacted to 95% maximum dry density.

#### **7.7.8. Ground Improvement Works**

Based on the port requirement there are two kind of stockpile embankment i.e., Dry Bulk Cargo stockpile, Operation buildings and settling pond. The layout indicates that the stock height is of 10 m.

Considering the soil properties, slope stability analysis may be carried out for the stockpile with grade filling. In case the analysis reports indicate the slip occurs in the soft clay layer, to avoid the shear failure and excessive settlement and to safety factor needs, ground treatment by geo tech analysis will be suggested and implemented.

#### **7.7.9. Machine Foundations:**

The design of machine / equipment foundation will be as per IS: 456 and IS: 2974. Frequency and amplitude criteria shall meet the requirement as laid down by the relevant codes or machine manufacturers. Foundations of equipment subjected to dynamic loading shall be isolated from adjoining floors / foundations to prevent propagation of vibration to adjoining structures.

##### **7.7.9.1. Vibration:**

Vibration check shall be done to ensure the separation of the fundamental mode structural frequency from the machine frequency such as conveyor supporting trusses or beams, structures supporting vibrating equipment,

etc. The recommended values are as follows:

- Structural frequency  $[0.66 \times \text{machine frequency}]$
- Structural frequency  $< 1.5 \times \text{machine frequency}$

## **7.8. Material and basic environmental condition consideration:**

### **7.8.1. Cement and RCC Material:**

- All RCC structures except structures storing water etc. shall be designed based on cracked section as per IS: 456:2000 (Limit state method).
- All water storing structures shall be designed as per IS 3370.
- Cement shall be of grade 43/53.
- All reinforcements shall be of grade Fe 500/ 500D of IS-1786. All bars shall be of tested quality.
- No special type of Cement like SRC, Pozzolanic, etc. has been envisaged.
- AGGREGATE: Aggregates shall be natural or crushed gravel or crushed rock and free from deleterious material. It shall comply with the requirements of IS-383. All fine and coarse aggregate shall be tested for susceptibility to Alkali Silicate reaction in a laboratory approved by the Engineer.

### **7.8.2. Coarse Aggregate**

Aggregate of sizes ranging between 4.75 mm and 100 mm will be termed as Coarse Aggregate. Only Coarse Aggregate from approved quarries and conforming to IS:383 will be allowed to be used on the works. Aggregates shall be washed to make it free from deleterious materials, if necessary. The grading of coarse aggregates by sieve analysis shall be as per IS: 383. If by the analysis the deficiency of a particular grain size is found, which could affect the density of the concrete, the Engineer may ask the contractor to avoid such quantities of aggregate of the particular size or and such quantity of aggregate of any particular size to achieve the required grading as per IS:383.

### **7.8.3. Fine Aggregate**

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS:383 is termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used on works.

### **7.8.4. Water**

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. Generally, IS:3550 will be followed for routine tests. Acceptance test for water shall be as per IS:3025, and Table-I of IS:456.

In case of doubt regarding development of strength, the suitability of water for making concrete shall be ascertained by compressive strength and initial setting time tests as per method of tests in accordance with the requirements of IS-516 & IS- 4031 respectively. The pH value of water shall generally be not less than 6.

### **7.8.5. Concrete Mix:**

The following grades of concrete shall be used in RC structures:

Concrete Grade and cube Strength

Usage	Concrete Grade	Cube strength at 28 days
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Raft – Pile foundation	M30 -M35	30-35 N/mm <sup>2</sup>
Columns	M30- M35	30-35 N/mm <sup>2</sup>
Beams, slabs	M25- M30	25-30 N/mm <sup>2</sup>

Grade for PCC will be M15. Min. thickness of PCC will be 75 mm. This will be for below foundation, trenches, Underground structures and mass filling.

Grade for of M20 will be for any plinth protection, base plate encasement, D.P.C. screed of concrete and minor R.C. structures.

In most case, minimum grade of concrete for all reinforced concrete work will be as per above table. M 30 and M 35 as higher grade of concrete, if required in design, specific condition as per code provision will be specified otherwise. Environmental and design needs will be reviewed to requirements.

#### 7.8.6. Minimum Cover:

Minimum clear concrete cover to Reinforcement shall be:

As per IS: 456 – 2000. Environmental condition will be considered for the provision.

Structure	Top (mm)	Bottom (mm)	Sides (mm)
Foundation	50	50	50
Pile / Pile cap	-	-	60 / 75
Column	-	-	40
Pedestal	-	-	40
Beams	30	30	25
Slab	20	20	20
RC Wall	Not exposed to soil		30
RC Wall	Face in contact with soil		40

Fire rating as 1 hr will be considered for the concrete cover to fire protection.

##### 7.8.6.1. Minimum cover to foundation Bolts:

Min. Distance from centreline of foundation bolts / anchor bolts to the pedestal edge shall be maximum of followings:

- Clear distance from edge of base plate / base frame to the outer edge of pedestal shall be min. 50 mm.
- Clear distance from face of pocket to outer edge of pedestal shall be 100 mm.

#### 7.8.7. Reinforcement

For all RCC works, the reinforcement steel to be adopted shall be as: HYSD – TMT Bars (Fe-415) as per IS: 1786

– 1985 and / Or HYSD bars conforming to IS: 432 grade Fe 500 on availability to design.

#### **7.8.8. Brick / block Masonry:**

All masonry works will be designed in accordance with relevant IS Code as applicable. Generally all brick walls shall be non-load bearing walls of 1 brick / block thick. Partitions as non-load bearing walls shall be of half thickness.

We have assumed that only brick surfaces will be plastered with internal plastering of 12 mm thick CM 1:5 and external plastering 18mm thick CM 1:6.

#### **7.9. Conveyor Structures and Supporting Trestles:**

The effect of inclination of conveyors shall be taken into account for design of structures. The inclination shall be as per conveyor layout. End portal of structure shall be designed to transfer all vertical and lateral loads to supporting trestles / junction tower.

Loads due to temperature effect, if any, wind loads and effect of gravity take-up along with other loads combinations shall be considered for the design.

Cross-over, in case required, shall be provided only at the location of fixed trestles, or as suggested in the mechanical design criteria.

All ground trestles shall be out of rolled ISMB / plate section, RHS, SHS, CHS or spiral welded pipes.

The lattice girders supporting the conveyor shall be suitably braced at top and bottom chord levels to transfer the wind load to the end portals connected to trestles.

In between transfer house / buildings four legged trestles shall be placed at maximum interval of 90m. The arrangement shall be such as to ensure that force in longitudinal direction of conveyor gallery of length not more than 90m will be transferred to four legged trestle. Two legged trestles at regular interval may be placed between four legged trestles. The end supporting resting on the four legged trestles can have either ends hinged or one end hinged and the other on slide type as per system requirement. Slide type support shall be with PTFE or other equivalent bearing to allow both rotation and movement. End of conveyor gallery which will be supported over transfer points, shall be so detailed that only vertical reaction is transferred from gallery and no horizontal force in longitudinal direction is transferred from gallery to transfer points and vice-versa.

In conveyor structure design the load due to cables, light fitting and water pipes shall satisfy to approved load list as per Mechanical & electrical.

Base plate for trestles shall be designed as gusseted base considering all axial loads and moments, if any. Shear lugs shall be provided below the base plate to take up all horizontal loads. Anchor bolts shall be designed for maximum uplift for the worst combination of loads.

Walkway of conveyor structure shall be of Hot dip galvanized (with coating min 910 GSM and painted with etch primer -15-25 micron, Epoxy polyamide / HBMIO-200 Micron Total DFT Plus zinc- 305 Micron) steel grating or chequered plate. However, where the conveyors cross the railway line a seal plate of adequate thickness to the design requirement will be provided below the conveyor to cater for a spillage load.

Toe guard shall be provided on sides of walkway as a safety measure.

Hand railing shall be provided on one side of walkways or as indicated in the mechanical design criteria.

##### **7.9.1. Transfer Towers**

Transfer Towers shall be designed with structural steel framing satisfying technological requirements. Design shall be done as per worst load combination considering cyclonic wind + non-operating belt tension and operating wind + maximum belt tension.



Design shall also be carried out for the case of one belt at starting condition and the other belt in running condition along with operating wind/ seismic load in combination with other load cases.

Chute loads on floors shall be evaluated duly considering the chutes are fully plugged with material for its entire height.

Toe guards and hand railings shall be provided around all clear openings.

All floors shall be of chequered plate construction resting over steel beams. Maintenance platforms for gates and flow divider shall be of structural steel and chequered plate construction. Except where head / tail pulley / drives are provided, the entire floor will be of RCC Construction.

Drive units shall be mounted on concrete pedestals for dampening the vibration with local RCC flooring in that area. Necessary Deck sheets to design load can be planned to act as a shuttering for the construction and better finishing.

### **7.9.2. General considerations for Conveyor Structure and Transfer Towers**

Angle sections shall not be used as flexural members except for roof trusses, purlins, side girts and walkway runners.

Where floor beams form part of the vertical bracing system, additional loads from floor beams transferred to bracing shall be considered in the design.

As far as possible, it is advisable to use Star pattern sections instead of back to back in order to achieve the painting to all surface for maintenance and better performance.

For Column Design, moments due to eccentricity of floor beam connections shall be duly considered.

Box section should be covered with end plates.

### **7.9.3. Stair Case:**

Minimum width of main staircase shall be 1000 mm. Staircases shall be provided with hand railing. Staircase will be made out of gratings. Stair case shall be of galvanized steel gratings or as specified in mechanical design criteria.

### **7.9.4. Hand railing:**

Conveyor galleries shall have only top handrail out of MS pipes of medium class conforming to grade Y<sub>st</sub> 210 of IS:1161-1979 with threaded ends and necessary bends, tees, elbows, sockets etc. Top Rail & Vertical posts shall be of 32(M) NB MS pipe and mid rail shall be of 25(M) NB MS pipe. It shall be located 1000 mm above the walkway with supports on the verticals and diagonals of the gallery girder.

Hand railing in junction houses shall have two horizontal rails, one at 500 mm and another at 1000 mm above the base level along with vertical posts spaced at not more than 1200 mm centres. Top rail and mid rail shall be out of NB pipes of medium class respectively conforming to grade Y<sub>st</sub> 210 of IS: 1161-1979 with threaded ends and necessary bends, tees elbows, socket etc. Vertical posts shall be made of suitable IS angles or NB medium class pipe. Necessary toe plate shall be provided to specification and standard regulations.

### **7.9.5. Grating:**

Electro-forged galvanised M.S. Grating with main bars will be 25X5 thick spaced at approx. 41 mm & secondary members 6 mm square bar spaced at 100 mm will be provided for spans not more than and including 1500mm.

Hot dip Galvanizing shall be in accordance with IS 4759. For the Galvanizing thickness refer QA/QC specification.

### **7.9.6. Cladding & Roofing:**

- a) Cladding & Roofing sheet: Permanently colour coated hi-rib metal sheet of 0.55mm TCT (Total coated

thickness), coating class Az150 (min. 150gm/sqm Zinc Aluminium alloy coating mass, total both side, 550 MPa Yield strength) conforming to AS 1397 / IS15961.

- Coating of exposed side : 20micron finish coat over 5 micron primer coat
- Coating of inner side: 10micron finish coat over 5 micron primer coat.

- b) Cladding shall be considered up to last working floor and equipment mounting location. Cladding shall be projected 1000mm beyond floor level. However where ever there is drive or any other equipment on ground floor cladding shall be provided up to ground level.

### 7.9.7. Loads and Load Combinations:

#### 7.9.7.1. Types of loads:

##### Dead Loads (DL):

Dead load on the structures shall include self-weight, weight of floor/roof materials including all other likely dead loads to be experienced by the structures during its lifetime.

The unit weights of the material shall be considered for computation of loads. IS 875 (Part I): 1987 will be used for the material weight.

##### Imposed Loads (IL):

The Imposed loads are those loads produced by:

- Live loads,
- Dust / spillage loads,
- Minor equipment loads
- Cable trays
- Small pipe racks / hangers,
- Operation/ maintenance loads, etc.

Floors and supporting members of different areas which may be subjected to heavy equipment live loads shall be designed on the basis of weight of equipment OR specifically defined live loads, whichever is greater. The loads considered shall not be less than that specified in IS: 875 (Part II).

##### Live Loads (LL):

The following minimum live loads shall be adopted for design of structures.

Live load on Flat roof shall be 0.75 kN / m<sup>2</sup> for Non-accessible roofs

Live load on Flat roof shall be 1.5 kN / m<sup>2</sup> for accessible roofs

Floors of Junction	: 5 kN / m <sup>2</sup>
Chequered plate flooring	: 5 kN / m <sup>2</sup>
Gallery / open truss walkways	: 4 kN / m <sup>2</sup>
Walkways of Conveyor structure	: 4 kN / m <sup>2</sup> (Inclusive of spillage load)
For open truss conveyor walk ways	: 0.25 kN / m <sup>2</sup> is considered (min) , On

Conveyor belt Shall be based on Mechanical load data

Building floors:

- Control room / MCC floor : 10 kN/ m<sup>2</sup>
- Pump House/ operating floor : 5 kN / m<sup>2</sup>
- Toilet areas : 2 kN / m<sup>2</sup>
- Stair area : 5 kN / m<sup>2</sup>
- Cable rack and Waterpipe lines : As per load list in approved drawing.
- Equipment loads : As per load list in approved drawing.

Reduction of L.L shall be made in accordance with the provisions of IS: 875 and IS: 1893 in case of seismic analysis.

For special use areas, live loads shall be revised upward as necessary as per the technological requirement.

Dust load:

- Sloping roof of Conveyor structure: 0.50 kN/ m<sup>2</sup>
- Flat roof of Junction Houses : 0.75 kN/m<sup>2</sup>
- Floors at Junction house and gallery: 1.0 kN/m<sup>2</sup>

For conveyor galleries, either spillage load or dust load will be considered.

#### Consideration of Material, Equipment and Monorail Loads

- Load per unit length of each conveyor due to material on belt as:
- (Design capacity / maximum speed) in kN/ m.
- Hoist / monorail load shall be as per Mechanical Load data and needs.
- Static and dynamic loads of major equipment shall be as per approved vendor data. Equipment load e.g. Pulley weight, motor and assembly weight, electrical hoist including belt and idler weight etc. shall be considered as applicable.
- Floor beams directly supporting drive machinery like head - tail end / drive pulleys, motor, and gear boxes etc. impact factor shall be to mechanical load data.
- Impact factor
  - Design of Monorails, Hoists etc.
    - An impact factor of 1.1 for manually operated hoist.
    - An impact factor of 1.25 for electrically operated hoist.
  - Design of Floor beams supporting drive machinery like head end/ tail end drive pulley, motors, gearboxes etc.: Load along with Impact factor shall be considered as per Mechanical Load Data Drawings. No additional factor shall be applied while actual design.
  - Else 1.50 multiplying factor shall be considered if not considered in Mechanical Load Data.

#### Wind Loads:

The design wind load shall be calculated as per provisions of IS: 875 (Part-III). The Basic Wind Speed for the

project site:

- $V_b = 50$  m/sec for non-operating Cyclonic condition
- $V_b = 22$  m/sec for operating conditions, load combinations.
- Category of terrain as = Category 2
- Probability factor "K1" as = 1.08 to Table 1 of the code.
- Coefficient "K2" as = Ref. Table 2 of the IS code to structure height.
- Coefficient "K3" as = 1.0 as per IS code as Topography factor

The wind analysis shall consider the wind direction relative to structure and both external and internal pressure applied to the windward and leeward sides of the structure as per code.

### Seismic Loads (SL):

Design for seismic loads shall be done in accordance with IS: 1893– 2002. The Seismic Zone for the project site is zone-V.

- Zone factor (Z) : 0.36 (table 2 cl.6.4.2)
- Importance factor (I) : 1.5 (table 6. Cl. 6.4.2)
- Response Reduction factor (R) : 5.0

(Considering steel moment frames resisting frames-Braced System) Reduction in LL shall be considered IS 1893 -2002 (part I)

## 7.9.8. Loadcases and Combinations

### 7.9.8.1. Basic load cases to be considered for the analysis

- Dead Load : DL
- Imposed load ( Including MLL ) : IL
- Equipment Loads : EL
- Conveyor Belt tension : BT
- Wind Load : WL
- Seismic Load : EQ

### 7.9.8.2. The load Combinations:

Critical load combinations from various loads as stated above shall be considered.

- $DL + IL + BT + \text{Equipment Load and monorail}$
- $DL + IL + WL + BT + \text{Equipment Load and monorail}$
- $DL + 0.5IL + EQ + BT + \text{Equipment Load and monorail}$
- $DL + WL/EQ + BT + (\text{Without Material})$
- $0.9DL + EQ + BT + \text{Equipment Loads and monorail}$
- $-0.8DL + WL$

- DL+EQ

Basic structure shall be designed for worst combinations of loadings as per IS: 875 Cl. 8 of (Part V) / IS: 1893. The individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial forces, shear force and/or torsion to condition.

Separate load combinations shall be taken for Operating and Non-Operating conveyor condition for wind load case combination along with Belt Tension.

Dynamic Belt Tension is considered while operating condition and for Non-Operating Condition Belt tension shall be considered as per mechanical load data.

#### 7.9.8.3. Stresses and Increase in Permissible Stresses for structure design:

Permissible stresses for different load combinations shall be taken as Latest Version of IS codes. IS 800: 2007, Clause 11.1.4 and or IS 1893: 2002.

#### 7.9.9. Analysis -Design and Deflection:

##### 7.9.9.1. Analysis and Design:

All the structures shall be designed as per the stipulations indicated here and relevant I.S. codes. The design of steel structures shall be done as per IS: 800:2007, section 11 to working state Design and using appropriate design tables. Where there is no Indian Standard in existence then only the relevant BS or other recognized standards shall be used with prior approval of the Purchaser. The same will be analysed as frame structure using STAAD software for the loads and its combinations as specified. Element design may be carried out either manually or by standardized in-house excel sheets or to the STAAD software design module. Appropriate partial safety factor over characteristic strength and loads to IS 800: 2007 will be considered for design material strength and design loads.

Dynamic analysis shall be carried out for beam supporting vibratory equipment and conveyor supporting beams in gallery for maximum motor rpm and belt speed. The ratio of operating frequency of idlers to the natural frequency of the beam shall be outside the range of 0.8 to 1.2 so as to avoid the resonance.

For designing of junction towers possibility of conveyor operating and not operating is to be considered in STAAD by hiding belt tension etc. for one conveyor.

##### 7.9.9.2. Slenderness Ratios (IS 800 : 2007 Clause 3.8)

The slenderness ratios for axially loaded members shall not exceed following:-

Main compression members

(columns, frames, principal diagonals and struts for trusses) : 180

Tension members : 180

Secondary compression members (diagonals and braces) : 350

Built-up compression members: The ratio for members consisting of individual shapes or bars connected together with intermittent plates or bars shall be calculated for the member at the minimum cross section and the unconnected free length of the individual component. The ratio in this case shall not exceed 50 for the individual member. The ratio for the member as a whole shall be as stated previously.

##### 7.9.9.3. Minimum Thickness:

The minimum thickness of material for main structural elements shall be as follows unless otherwise specified:

- For steel fully accessible for cleaning and repainting – not less than 8 mm.

- For steel not accessible for cleaning and repainting – not less than 10 mm.
- Minimum thickness of chequered plate – 6 mm
- For axially loaded members in framework, minimum angle section to be used shall be ISA 50 x 50 x 6.
- Gusset plate to be provided with minimum thickness for connections to be 8 mm.

#### 7.9.9.4. Deflections:

The deflection of various structural members shall not impair the smooth working of conveyor system, junction houses and top housing of rapid loading structure and shall not exceed the following limits. (AS per IS 11592: 2000, Clause 8.1.4.5)

- Conveyor structure : Span/500
- Conveyor crosses beams directly supporting : Span/500
- Conveyor short posts.
- Trestle supporting conveyor in transverse direction : Height/1000
- Floor/roof beams of Junction House
- and walkway beams of conveyor structure : Span/325
- Floor beams directly supporting drive machinery, motor
- and gear boxes : Span/500
- Monorail track beams : Span/500
- End portal of conveyor structure girder : Height /325
- Frames of Junction towers and crusher house : Height /1000\*\*

\*\* This is applicable only at the conveyor entry point and that too in the direction perpendicular to the centre line of conveyor in the same plane. In all other cases and other heights, this shall be restricted to H/325.

All trusses shall be fabricated with a camber equal to the sum of the dead load and 50% of Imposed load deflections.

#### 7.9.9.5. Connections:

- In general, connections would be shop welded and site bolted.
- Bolted connections shall be of bearing type only.
- Bracings may be adopted as bolted in view of erection philosophy.
- End connections for rolled beams will be designed for a minimum of 60% of their shear capacity and built-up beams for 80% of their shear capacity or actual forces whichever is more.
- Column splices will be designed for 80% strength of the flange and web plates of the column.
- All bracing and truss members connections will be designed for 75% of the tension/member capacity or 1.1 times actual force whichever is greater.
- Beam moment connection if any will be designed for 80% moment capacity of weakest connected member.
- Shop connections shall be welded, unless otherwise approved.

- In case erection bolts are used, the contact surfaces will be welded at site to design strength after final alignment and before hand over with proper paint application.
- Major Field connections shall be bolted, with mating bearing surfaces milled or machined with adequate tolerances to ensure contact is maintained. Joints shall be designed as pre-tensioned by means of high strength bolts
- Splice joints or splits in individual components made due to transportation purpose shall be welded at site as per specific work instruction and with 100 % UT keeping all control dimensions within tolerance.
- Field weld connections shall not be used, where there is any likelihood of distortion induced by welding causing misalignment of bearings and machined surfaces.
- A secondary field connection is defined as connections for conveyor deck platforms, walkways, stairs, purlins and girts. They shall be designed as bolted.
- Bolted connections shall incorporate a minimum of two bolts for angles and four bolts for structural tees, universal columns, beams & channel over 150 mm deep.
- Where pinned connections are employed in main joints, internal lubrication points shall be provided. Where bushings are used in pinned connections, bushings shall have internal lubrication patterns and shall be provided with the necessary wall thickness to prevent elastic and thermal distortion under load. Thin walled bushings are not acceptable.
- For pin connections, minimum standard structural bushings shall be manganese bronze, press fitted into suitable housings.
- Shear keys shall be provided to all base plates subject to shear load from the effects of belt tension or where shear load on the base plate including wind effects exceeds 100 kN working load.

#### 7.9.9.6. Considerations for Detailing:

- All steel work welding shall be as per approved QAP.
- Structural design and detailing shall be such as to produce a structure of modern appearance without any pockets that will hold dust or water. The design shall minimize welded or other connections that can produce stress concentrations.
- For individual member designs, rolled shapes or heavy-duty tubular sections will be preferred, and a lattice type fabrication will not be acceptable.
- Any built-up sections of beams, angles or channels shall be spaced to enable easy inspection and maintenance of all surfaces. Sections shall not be connected to form battened or starred struts.
- Irrespective of load carrying requirements, all welds shall be continuous and fully sealed joints. The ends of tubular or other hollow sections shall be completely sealed.
- The structure shall be designed so as to easily facilitate maintenance and painting.
- Access holes shall be minimized. Any detail deemed to require holes for assembly shall be shown on the shop drawings for approval prior to fabrication. In general access holes, where permitted, shall be left open and the holes shall be at least 50 mm diameter.
- For fillet welded details the fillet weld shall be returned through the hole to meet the fillet weld on the other side of the plate.
- For complete penetration weld details, care must be taken to ensure acceptable weld profiles inside the hole (UT & MPI shall be carried out for Full penetration weld, MPI & DP shall be carried out for

fillet weld).

- The hole shall be dressed to the same finish as for plate edges.

#### **7.9.10. Material And Basic Construction Specifications:**

Weldable steels with the yield strength in the range 250 –350 mpa shall be used for structural components.

##### **7.9.10.1. Type of Construction:**

All steelwork shall be of welded shop and site construction as far as practicable except that site connections for secondary members like purlins, side girts, staircase, stringers, walkway runners of conveyor structure etc. shall generally be bolted construction. For any structural steel member, a minimum of 2 nos. 16 mm dia bolts of grade 4.6 shall be used for permanent bolted connection and site welded connection.

##### **7.9.10.2. Materials Specifications assumed for Design and Construction:**

Where a brittle fracture may cause a failure and influence the safety of the machine as a whole or the safety of personnel, brittle materials shall not be used. Materials shall be deemed to be brittle if the following properties are not achieved, with the orientation of test specimens selected so as to result in the least favourable results:

- The average of three Charpy Impact test specimens for the lesser T design values of – 10°C and 0°C shall be greater than  $1.4 \times$  (ultimate tensile strength, in mpa) 0.5, in joules.
- The minimum of three Charpy Impact test specimens for the lesser T design values of – 10°C and 0°C shall be greater than (ultimate tensile strength, in mpa) 0.5, in joules.
- The minimum ductile fracture area on any Charpy test specimen for the lesser T design values of – 10°C and 0°C shall be more than 75%.
- The minimum elongation at 20°C is more than 10% and the minimum reduction in area is greater than 40%.
- Special attention shall be given to through-thickness properties and material ductility where members may be loaded as a result of a collision.
- Structural steel plates shall conform to IS: 2062-2006, Fe 410W, Grade-B (killed) with minimum  $Y_{st}$  250 mpa for all thickness and shall be free from lamination.
- Structural steel rolled sections shall conform to IS: 2062-2006, Fe 410W, Grade-A.
- In case of for Hollow Sections, the minimum thickness shall be 4mm and weld size shall be 4mm
- Electrodes for mild steel shall conform to IS: 814-1991 & ASME Sec II C (Latest). The electrodes shall be chosen according to the welding procedure to be adopted and quality of metal to be welded. The strength of weld metal and of the parent metal in the heat affected zone shall not be less than that of parent metal.
- Purlins, girts, stair treads, handrails shall be fastened by M12 bolts of 4.6 grade.
- Minimum size of fillet weld shall be as per recommendation of IS: 9595-1980. Structural welding shall not be lower than 6 mm as continuous welding. However, for nominal fillet weld as required, for example, between chequered plates and their stiffeners or supporting members, hand railing junction etc. the leg size shall not less than 4 mm.
- All structural Bolting shall be of Grade 8.8 as per IS: 1367 with minimum two bolts of 16 mm dia. unless noted otherwise. Bolts shall be Hot dip galvanized with min 80 Micron and painted after erection with etch primer -15-25 micron, Epoxy polyamide /H BMIO- 200 Micron Total DFT Plus zinc-



305 Micron.

- Hexagonal head bolts & units shall generally conform to the property class as specified in IS: 1379 (part-3)–1991 as per design requirement otherwise noted.
- Hand rail Pipes shall be to IS: 1161/ IS: 1239 with minimum 240 mpa yield strength.
- Foundation bolts and minor connections (like hand railings) shall be of Grade 4.6 as per IS: 1367. Foundation bolts shall be Hot Dip Galvanized with min coating 80 Micron After erection Foundation bolts shall be painted with etch primer -15-25 micron, Epoxy polyamide /HBMIO-200 Micron Total DFT Plus zinc- 305 Micron.
- All grating and chequered plates shall be of mild steel quality.
- Hook bolts for corrugated sheet coverings shall be of aluminium.

#### **7.9.11. Paints:**

For structural steel paints, provision shall be made for three coats of paints as applicable as per manufacturer's specifications considering exposure condition to weather and seafront areas are as follows:

##### **7.9.11.1. Prime Coat**

The prime coat shall be 75 micron dry coat of zinc paint, applied in accordance with the manufacturer's recommendation and specifications.

##### **7.9.11.2. Intermediate Coat**

Intermediate paint (MIO) high build two component epoxy of 150 micron DFT.

##### **7.9.11.3. Top Coat**

- The top coat shall be 70 micron of aliphatic polyurethane paint. Due to low volume solid, two coats of 35 micron DFT may apply in accordance with manufacturer's recommendations and specification.
- Before application of paint surface shall be shot blasted (Swedish standard specification Sa 2 ½) or Use of scraper wire brush and pig hammer is acceptable wherever shot blasting is not possible due to lack of access. And as per NIT specification all precautions shall be done for preparation of surface for paints. For corrosive protection provision shall be applicable as per NIT specifications.

#### **7.9.12. Inspection and Erection**

- All structures shall be offered for inspection at the fabrication shop before painting. Material certificate for the fabricated structures shall be provided.
- Erection shall be carried out as per applicable standards, drawings, specifications, and regulations. The erection tolerance shall be within the standard specified limits.

### **8. DUST EXTRACTION SYSTEM:**

Vender shall consider requirement for appropriate firefighting system and dust Extraction system suitable for bulk material handling system.

#### **8.1. Dust Extraction System:**

Provide and maintain adequate Dust Extraction system including all accessories required. All the statutory requirements of IS Code/ NFPA / local authority shall be followed.

Dust Extraction System shall be suitable for the cargo i.e. bulk cargo via MHC, Mobile Hopper and Conveyor system. The dust extraction system to be designed based on input data like quantum of cargo, MHS conveyor technical details etc.

Dust extraction system with bag filter arrangement shall be provided for all the discharge and receiving point of conveyors and mobile hoppers i.e. Mobile Hopper, Transfer Tower, Travelling Tripper etc. The dust extraction system shall be designed by EPC contractor based on input data of MHS system mentioned elsewhere in the tender specifications. The dust extraction system shall be suitable for bulk cargo. EPC contractor shall provide calculation and detailed specification of dust extraction system for Employer's review and approval in detailed engineering.

#### **8.1.1. List of Makes for Dust Extraction System**

Bidder shall submit the proposed vendor / manufacturer list for Dust Extraction System for Employer approval.

## **9. GENERAL REQUIREMENTS:**

### **9.1. Site Acceptance and Mobilization:**

The scope shall include Design, Manufacturing/Fabrication/Construction, delivery to site, storage, erection, installation, testing, commissioning, performance testing of the system including all civil, mechanical and electrical/control works. General requirements are described.

#### **9.1.1. Acceptance of Site:**

In accordance with these specifications, the Contractor shall have examined the site and familiarized himself with all existing conditions. He shall accept the site in its existing condition at the time of award of contract and also during whole contract period.

#### **9.1.2. Mobilization:**

Upon award of the Contract and within a reasonable time. Contractor shall mobilise all such labour, equipment and materials that are necessary to complete the project in due time.

#### **9.1.3. Access:**

The Contractor shall provide and maintain adequate access to the project site and all are as related to the works at his expense. If existing roads are to be used for access to the site, the Contractor shall maintain such roads for the duration of their use.

#### **9.1.4. Permits and Licenses:**

Except as expressly stated in the Employer's Responsibilities, the Contractor shall obtain all permits and licenses necessary for the execution and completion of the Works. The Contractor shall pay all associated fees including royalty. He shall also give the Employer a copy of all relevant correspondence and other documents relating to the Contractor's permits and licenses.

### **9.2. Temporary Works:**

The Contractor shall design, install and maintain all temporary facilities required for the construction of facilities under this contract Package, which he requires on or at the site throughout the execution of the work, and remove the same on completion of the works.

The Contractor shall submit his plan for temporary works to the Employer, for approval, within 30 days of award of contract.

Temporary construction shall be adequate for intended uses and for all loads imposed without excessive settlement, deflection or deformation. All parts and members shall be properly strengthened to prevent displacement or failure.

Before or upon completion of work, unless otherwise required or directed, preparatory structures, installations and utility services shall be disconnected and removed from the site.

The excavated road/ plots/ areas to be refurbished /to make good and to be restored as per the requirement of DPA.

### **9.2.1. Utilities:**

Temporary utilities used for construction shall have to be adequate for the intended uses and not to be overloaded or otherwise used or arranged in any manner endangering persons, premises or works. Connections shall be properly made, lines and wiring securely anchored in place and protected against accidents.

#### **a) Water:**

The Contractor shall provide his own arrangements for sourcing and for distribution adequate supply water for the Project including:

- Drinking water: providing and maintaining canisters, coolers or connected drinking fountains of sufficient number to reasonably serve the Project.
- Construction water: providing and maintaining temporary water service and distribution of adequate capacity for construction

#### **b) Electricity:**

The Contractor shall make his own arrangement for power supply.

If found necessary, the Contractor shall provide and maintain generators including a stand - by generator of adequate capacity to meet his additional Project requirements.

The Contractor shall make his own arrangements as outlined hereunder:

- Distribution of adequate capacity for power, lighting and other construction needs.
- As necessary to properly and safely perform work at enclosed spaces or under hazardous conditions. Likewise, providing lights for night work/protection as necessary.

Temporary electrical systems shall comply with the local codes and regulations.

### **9.2.2. Waste and Rubbish:**

The Contractor shall provide regular daily clean-up and removal of trash, waste, scraps, construction debris, etc. from site and temporary work yard and shall arrange for disposal of waste and rubbish to disposal areas approved by the Employer.

### **9.2.3. First Aid and Fire Protection:**

#### **a) Emergencies:**

The Contractor shall maintain the lists of nearest available police, hospital or medical services at the Contractor's Site Office and the same are to be displayed at a number of locations & work places.

#### **b) Fire Protection:**

The Contractor shall establish and submit the following measures to the Employer.

- Establish appropriate emergency escape routes and procedures;
- Maintain fire extinguishers, connected hoses and other facilities necessary for reasonable fire-fighting action at the site and temporary work yard;

- Provide and maintain a first aid kit containing bandages, medicines and sterilized materials for first aid treatment of minor injuries at the Contractor's Site Office.

#### **9.2.4. Construction Safeguards**

##### **a) Excavations**

Trenches intersecting roads shall have to be provided with crossings suitable to carry the type of traffic involved. Vehicular curbs and pedestrian railings shall be provided as necessary. Open pits and in openings in floors and other accessible surfaces shall be protected by barricades or railings.

##### **b) Access**

Access to structures such as scaffolds, ladders, ramps, hoists etc. shall be provided, maintained and operated as necessary.

##### **c) Storage Areas**

Storage and shop areas shall be provided, arranged and maintained at approved locations as necessary to properly store, handle and fabricate the various materials and equipment required.

#### **9.2.5. Protection of the Public**

The Contractor shall provide barricades and enclosures as necessary for public protection.

#### **9.3. Environmental Protection**

The Contractor shall comply with all the conditions stipulated by the relevant statutory and regulatory organisation of Govt. of Gujarat/Govt. of India.

##### **a) Fires:**

Fires and burning of rubbish on the Site are not permitted except when authorised by Employer.

Where fires or burning is permitted, the Contractor shall prevent the structures which are to be preserved from staining and smoke damage. The Contractor shall restore, clean and make good stained or damaged work to new condition.

##### **b) Disposal of Waste and Cleanliness**

The Contractor shall not bury rubbish and solid waste materials on the Site and he shall not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into the waterways, storm water drainage or sanitary sewers.

The Contractor shall keep all pavements and areas leading to and from the site, clean and free of mud, dirt, and debris at all times for movement of vehicles and pedestrians.

##### **c) Drainage:**

The Contractor shall provide temporary drainage and pumping facilities as necessary to keep the adjoining areas of work site free from water logging and flooding.

##### **d) Pollution Control:**

The Contractor shall cover or wet down dry materials and rubbish to prevent blowing dust and debris, and provide dust control for temporary roads and yards.

The Contractor shall take all measures necessary to ensure that no pollution of the waterways or any land areas occurs as a result of his activities. He shall undertake at his own expense all measures necessary to clean up or otherwise rectify any pollution arising from his activities under this Contract to the satisfaction of the Employer.

e) Environment:

The Contractor prior to the commencement of works, shall prepare and implement an Environment Management Programme. The Contractor shall deploy most suitable construction equipment to minimise the suspension of fine sediments at the work site.

#### **9.4. Submission of Documents during Project Execution:**

##### **9.4.1. Program of Works:**

The Contractor shall prepare and submit (both hard copy and soft copy) to the Employer within 30 days of receipt of Letter of Award the following:

- HSE Plan
- Quality Management Plan
- Organization Chart for Head office and Site team for this project.
- Detailed CPM Schedule showing the various activities of the Work using MS Project in soft copy (editable).
- List of designs/drawings/documents along with their schedule of submission.
- List of Vendors/ Suppliers of Bought-out items

The above shall be updated every month and submitted to the Employer.

##### **9.4.2. Operation & Maintenance Plan**

###### **9.4.1.1. General**

The Contractor shall prepare operation & maintenance plan covering all aspects of the works for the review of the Employer. This plan shall be prepared to ensure that the design life periods stated are met in full and where no design life periods are stated, the maintenance plan shall be prepared to maximize the serviceable life. Operation plan show operation methodology which contractor adopt while operating.

###### **9.4.1.2. Maintenance Document**

The Contractor shall provide three copies of the maintenance plan and manuals to the employer to retain by the Employer upon the request of the Employer or following receipt of attention to the Employer's comments.

##### **9.4.3. Daily, Weekly and Monthly Progress Reports**

The Contractor shall maintain a daily log describing the important events pertaining to the Works, (*the working hours, the number of labourers employed, effective operation time of*

*equipment, overtime hours*), progress made in the Works. This daily log shall be submitted to the Employer by 1:00 PM of the following day. Compilation of these logs and their summary shall be submitted to the Employer as Weekly Progress Report in three (3) copies by middle of the next week.

The monthly progress reports shall include progress photographs taken at a fixed point and angle. The photographs shall be sufficient in numbers and locations to record the exact progress of works. The colour photographs shall be in size 200 mm x 250 mm and the CD containing the digital version of the same shall be provided.

The Contractor shall furnish the Employer with five (5) copies of the monthly progress reports within seven (7) days after the end of every month.

#### **9.4.4. Design & Drawing Submissions:**

##### **9.4.4.1. Design Submissions – General:**

The scope drawings listed in this Volume is issued for information and guidance to the extent mentioned in the Tender document. Contractor shall make all arrangement and design drawings to suit his equipment and submit the same for approval to the Employer. Detailed Engineering shall be done by the Contractor. It shall be the responsibility of the contractor to take approval on his design and drawing submissions. The contractor shall not be entitled to any extension of time for completing commissioning or any other relief on account of delay caused due to providing any clarifications or in resubmitting any designs and drawings.

It should be noted by the bidders that the information, size, specifications, design & dimensions mentioned in this Volume and drawings, are indicative. As in EPC Contracts, the successful bidder shall workout detail design & drawings during detail engineering stage meeting the functional, operational & performance requirements & as per relevant IS standards, well within the sanctioned estimate, and submit the fresh design & drawings for approval to employer.

The Contractor shall submit for the approval of Employer, progressively from the date of receipt of the Letter of Award, Five (5) copies of the following:

- Layout and flow diagram of Mechanization of handling of bulk cargo at Berth 8 & 9 with capacity.
- General arrangement of the berth and back up area showing entire facilities.i.e. Cranes, Mobilehoper, Conveying System/ Sub-system/ Equipment involved, , open storage yard, Buildings, etc.
- Cross sections and other details showing important particulars such as overall dimensions, clearances,etc.
- Specification/catalogues of all standard bought-out items.
- All drawings other than shop fabrication/manufacturing drawings. These will include, but not be limited to assembly, sub-assembly, key components, etc. However, one week prior to fabrication, fabrication and part drawings shall be made available to the Employer.
- Power Requirement (installed and peak demand loads)
- Wiring drawings and equipment inter-connection diagrams of local control panels &

Single Line Diagram of facility power distribution.

- Other interface details in a progressive manner
- All design calculations pertaining to conveyor system, equipments, and other subsystems/components.

A further digital copy (in AutoCAD format) of the submission shall be given on compact disc. This digital copy shall include the full submission with scanned copies of any documents prepared by hand.

#### 9.4.4.2. Submission of Calculations:

All calculations submitted for the Employer's approval shall comply with the following:

- a) Each calculation page shall be uniquely numbered.
- b) Each section of calculations shall have a cover sheet, listing the subject of the calculations, document number and date of submission, name and qualifications of the Designer(s), the name and qualifications of the Design Verification engineer(s), and the relevant Indian/other Standards, books and drawings which are the basis of the calculations.
- c) Each section of calculations shall have a Table of Contents, including page numbers.
- d) Calculations shall be accompanied by all necessary sketches or extracts from drawings.
- e) Calculations shall include introductions explaining the purpose of the calculations and the methods and design philosophies adopted. This shall clearly state the Standards on which the calculations are based.
- f) Equations and values from Standards and Codes of Practice are to be clearly referenced. Extracts from publications other than Indian Standards or International Standards which are used in the design shall be attached to the submission. The relevant Indian/other Standards forming the basis of the design shall be quoted.
- g) Where values used in the calculations are brought forward from previous calculation pages, the page reference shall be included.
- h) At the end of each section there shall be a summary, listing the conclusions of the calculations, and referring to construction drawings.
- i) If calculations are revised due to design changes or corrections or comments of the Employer, the calculations sheets shall be clearly marked with a revision letter.
- j) All calculations shall be signed / approved by the designer and design verification engineer.
- k) The design calculations shall be written in English. In case any software is utilized to perform the calculations a sample set of manual calculations with references of various formulae used shall also be submitted for proper verification.

#### 9.4.4.3. Submission of Drawings:

All drawings submitted for the Employer's approval shall comply with the following:

- a) All drawings shall be in metric millimeter dimensions, and be finally prepared in ink with legible lettering on either A0 1189mm x 841mm using AutoCAD format compatible with AutoCAD 2016 or lower version. The submitted prints shall be clearly legible throughout and there shall be no ambiguity.



- b) All drawings shall be submitted in digital format on compact disc, as well as three paper prints.
- c) Drafting Standards employed in the preparation of all drawings shall be sufficient to produce legible 297mm x 420mm (A3) reduced drawings.
- d) Drawings from various sub-contracting services, specialist suppliers etc. shall also be presented in a similar manner (identical title blocks/format etc.) to provide a matched set of drawings.
- e) All drawings shall clearly show the status and revision of the drawings. Revised drawings shall clearly indicate the nature and details of the revision work and also revision cloud & revision mark shall be marked wherever revised.
- f) All drawings shall clearly identify the drafts-person responsible together with the identity of the drawings checker.
- g) Each drawing shall show the scale(s) of the components illustrated by the drawing related to the original drawing size, A0, A1, A3 etc.

#### 9.4.4.4. Inspection of Drawings at Site:

The Employer shall have the right at all reasonable times to inspect all drawings at the premises of the Contractor or call for any drawing to be given to Employer's office.

#### 9.4.4.5. Manuals and Technical Data:

##### a) Manuals:

The Contractor shall supply Five (5) hard copies along with One (1) soft copy (in editable format) of Erection & Installation Manuals, Operation Manuals, Spare Parts Manuals and Inspection and Maintenance Manuals prior to the starting of erection. Recommendations of the manufacturer in respect of preventive maintenance, trouble shooting, and breakdown maintenance and overhaul shall be brought out in the inspection and maintenance manuals. Soft copies of all drawings shall be supplied.

##### b) Technical Data:

On completion of the works and before handing over possession to Employer, the Contractor shall supply Five (5) hard copies together with One (1) soft copy of the following:

- Shop drawings of all wearing parts and also major assemblies and minor assemblies which require unit replacement;
- All "As Built Drawings of equipments, conveyors, civil / structural, electrical items etc.
- On completion of the work and before handing over the system to DPA, Contractor has to supply five (05) sets of completion drawings, assembled drawings of various components, technical literature, maintenance manuals, spare parts catalogue etc., along with soft copy of the same. PLC software of Automation, Auto-cad drawings (with licensed version) in form of DVD with Two (2) new latest version Laptops.

Complete technical data and dimensional drawings of all bought out product/ items such as bearings,

seals, couplings, gear reducers, brakes, valves and such other items etc. in the system, shall be furnished - Six (6) hard copies together with One (1) soft copy of the following:

- List of recommended spare parts.
- Parts catalogues in the case of all equipment /assemblies illustrated with part numbers in drawings both for electrical and mechanical items.

#### 9.4.4.6. Tools and Maintenance Equipment:

A list of complete set of tools/tackles and instruments required to be provided for satisfactory maintenance of the Works shall be furnished.

#### 9.4.4.7. As Built Drawings, Design and Final Report:

Before submitting a request for commissioning Certificate, the Contractor shall ensure that it has furnished to the Employer all required documents including but not limited to two (2) sets of as-built drawings, final design in the supporting of as-built drawings and a final construction report as draft. And within thirty (30) calendar days after receipt of comments from the Employer, the Contractor shall submit five (5) sets of the Final Construction Report and five (5) sets of Final As-built drawings & Design documents. As-built drawings of the works consists of two (2) sets of original size copies (white print) and six (6) sets of bound copies reduced to A3 size. All documents and drawings will be also delivered on CDs (drawings in Auto-CAD format, documents in other required formats and soft copy of the file used in software on which design was carried out).

On completion of the work and before handing over the system to DPA, Contractor has to supply five (05) sets of completion drawings, assembled drawings of various components, technical literature, maintenance manuals, spare parts catalogue etc., along with soft copy of the same. PLC software of Automation, Auto-cad drawings (with licensed version) in form of DVD with Two (2) new latest version Laptops.

Before submitting a request for commissioning Certificate, the Contractor shall ensure that it has furnished to the Employer all required documents including but not limited to five copies of manuals for installation, commissioning, operation and maintenance and the drawings/ documents etc., covering all aspects of the Works for the review of the Employer. This plan shall be prepared to ensure that the design life periods stated are met in full and where no design life periods are stated, the maintenance plan shall be prepared to maximize the serviceable life. In the event the Contractor makes any changes effecting such submission the Contractor shall submit afresh such document duly revising to that extent.

### 9.5. Quality Control and Assurance:

#### 9.5.1. General:

The Contractor will be required to adopt a system of self-certification in accordance with his general quality plan and the appropriate detailed quality procedures. The quality system shall comply with Standards of ISO 9001.

The Contractor shall monitor his performance of executing his Works against two levels of certification:

- The completion of individual work items and
- The completion of activities listed in the Programme.

In addition to the certification of the completion of work items and activities, the Contractor shall be required to issue the Quality Assurance (QA) certificates concerning the Quality Plan, Quality Procedures and Construction Documents.

The Employer may monitor the Contractor's work against the Contractor's Quality Plan and Quality procedures. The Employer may do this by spot checks, and/or by continuous monitoring of the work. The Employer may also do this by carrying out compliance audits periodically against the Contractor's Quality Procedures. The frequency and intensity of such checks will depend on the proven reliability of the Contractor as work progresses. Each non-compliance with the Quality Plan shall be notified promptly to the Employer by the Contractor, together with proposals for remedy of the non-compliance. The absence of monitoring of or commenting on quality aspects as above by the Employer shall not absolve the Contractor from any of its contractual obligations and/or shall not entitle the Contractor for any claim.

#### **9.5.2. Improper Certification of Unsatisfactory Work:**

If the Contractor or its personnel repeatedly confirms/declares a work as being satisfactory when such work is not satisfactory, the Employer may reject such work any time during the currency of the Contract and instruct the Contractor to re-execute such work in full or a part thereof without any implication of time or cost to the Employer. In case of improper certification and/or Contractor's failure to rectify, the Employer may proceed as per the Contract including terminating the Contract.

#### **9.5.3. Quality Plan and Quality Procedures:**

The Contractor will be required to submit his complete General Quality Plan to the Employer within four weeks of the Commencement Date. A designer's quality plan will be accepted as an interim measure to permit design work to be started in advance of the preparation of the General Quality Plan.

Detailed Quality Procedures for each element or item of work must be submitted to the Employer for review at least four weeks before that work is due to commence. Detailed Quality Procedures are required for all items manufactured prior to delivery to site.

#### **9.5.4. Submission and Certification of Construction Documents:**

The Contractor shall submit a Design Certificate (in duplicate) and Design Check Certificate whenever he is submitting Construction Documents to the Employer for review. Construction Documents submitted without the relevant Design Certificate will not be reviewed.

The Contractor is to ensure that all Construction Documents submissions are in a form that enables the Employer to review the Construction Documents as required by the Contract without delaying completion of the Works.

#### **9.5.5. Certificates for Work Item Completion:**

Readily identifiable Work Items must be certified as checked and found satisfactory by

- Contractor's surveyor responsible for checking.
- Contractor's supervisor responsible for checking temporary works, material cleanliness, dimensions (not checked in (a) above), workmanship and all other matters to enable him to certify that the item of work complies in every respect to the contract.

The Work Item Completion Certificate shall be checked and approved by the Contractor's Quality Manager.

Each Work Item Completion Certificate must be identified by a unique and appropriate reference number.

If the Employer is not satisfied that the works have been carried out satisfactorily as certified, the Employer shall raise a non-conformance report to which the Contractor shall respond stating his proposals for rectifying the non-conforming item and what action will be taken to prevent recurrence. The Employer may reject such work any time during the currency of the Contract and instruct the Contractor to re-execute such work in full or a part thereof without any implication to the Employer. In case of recurrence/failure of the Contractor to rectify, the Employer may adjust the Contract price by deducting the value of such work.

Any consequences in respect of any revisions arising out of Work Item Completion Certificates being returned with comments shall not be treated as a compensation event.

#### **9.5.6. Certificates for Activity Completion:**

When a section of work has been completed satisfactorily, the Contractor shall certify that the activity has been completed in accordance with the Contract.

The Activity Completion Certificate shall be checked by the Contractor's Quality Manager and confirmed by the Contractor. The Designer's Representative shall also certify that the activity has been completed in conformance with the relevant Documents and the Employer's Requirements.

The Activity Completion Certificate shall list the reference numbers and dates of Work Item Completion certificates that have been relied upon by the signatories to the Activity Completion Certificate.

Each Activity Completion Certificate shall have attached to it, copies of any material test certificates which were received after signing the relevant Work Item Completion Certificates and which have not been submitted to the Employer under separate cover during the period between the signing of the Work Item Completion Certificate and the preparation of the Activity Completion Certificate.

### **9.6. Operating Safety**

#### **9.6.1. General**

In the design and fabrication of the equipment all normal safety provisions shall be observed. It shall be the responsibility of the Contractor to ensure that the equipment satisfies in every respect the statutory requirements of the following:

- Indian Factories Act
- Indian Electricity Rules
- Indian Electricity Act
- Indian Dock Labourer's Act
- Tariff Advisory Committee as required
- Other relevant safety standards as per IS Codes

All materials shall be installed in accordance with the requirements of above and/or any other statutory body having jurisdiction over the site. The Contractor shall be responsible for getting all type of approvals for his installation from the concerned authorities / regulatory bodies.

#### **9.6.2. Safety and Identification Signs**

Necessary Safety and Identification signs shall be placed on equipment, piping and other work areas. All signs shall be painted on 2.5mm minimum thickness brass/ stainless steel sheet.

Identification signs shall be black lettering (minimum of 50mm high) on a white background. Each item of equipment shall be clearly identified with a minimum of two signs.

All equipment and work areas shall have signs for:

- Hearing protection
- Warning the “equipment may start without noise”;
- High voltage
- Direction of rotation wherever applicable
- Eye protection
- Other safety signs as required by local codes.

#### **9.6.3. Noise and Protection of Workman**

All equipment used for the construction activity shall be properly maintained to ensure least generation of noise, and also workers shall be protected with ear muffs. The moving parts of the machines shall be properly oiled and greased to reduce noise generation. The workmen with loose fitting garments shall not be permitted and all workmen shall be provided with protective clothing, helmets, protective goggles and appropriate shoes and gloves etc., wherever required.

#### **9.6.4. Fuel Oil Storages**

The construction equipment vessels and vehicles used in construction work and for transport of material require fuel oils. There shall be a storage facility for such fuel oils, well designed, and protected against fire hazards and provided with a compound wall, to prevent access to unauthorized elements. All surfaces run off from such storage areas shall pass through oil water separator, before it finds access to any storm water drainage course or sea.

## **10. QUALITY ASSURANCE AND CONTROL REQUIREMENT:**

The Successful Bidder shall establish the Project Quality Plan (PQP) in line with the Deendayal Port Authority Quality Policy and requirements.

The Bidder shall prepare the draft Project Quality Plan and submit the same to the employer's Quality team for validation & approval.

Review /approval of the Project Quality Plan (for his scope of work) by the employer shall not dilute the responsibility of the bidder for adherence to the Quality requirements during execution and or the DPA Quality policy requirements from time to time.

### **10.1. General**

Objective of this document is to provide a guideline & framework to help the bidder to achieve construction quality, across the life cycle of the project in line with the employer's requirements.

This document outlines the activities & requirements to be adopted and adhered by the Bidder during the execution phase to ensure compliance to approved drawings, technical specifications and quality management systems.

The Bidder will be responsible for ensuring quality of construction carried out by them/their approved sub-contractors in accordance with the following

- a) Technical specifications
- b) Applicable Codes & Standards.
- c) Contract conditions
- d) Approved drawings &
- e) QA/QC procedures

Bidder shall also be responsible to set-up material testing facility / laboratory at site as required by employer.

**Note: Review/approval of the Bidder's activities by Employer shall not dilute the responsibility of the Bidder for maintaining quality.**

### **10.2. Basic Requirements**

The Scope for Construction Quality Control activities for an EPC contract involves the role of bidder's engineering quality and is broadly envisaged as executor in inspection of critical activities as identified and communicated including enabling & coordinating planned & unplanned auditing/assessment & surveillance by employers Quality Manager & its team from time to time.

#### **10.2.1. Quality in Engineering**

The bidder shall ensure that all Technical specifications submitted to employer's engineering are validated by the employers quality team and inputs sought before actual approval.

The bidder's design function shall be subjected to audit /assessment for the following by the employer's assessment team for all engineering deliverables

- Assessment as per engineering quality plan
- Assessment for Safety in Design

**Note1:** The bidder shall ensure that the engineering quality plan is approved by the employer's quality team before the kick off meeting.

### **10.2.2. Quality in Procurement & Construction**

All work/services to be performed by the Bidder under this contract shall be of specified / approved quality and the bidder shall have a QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) system during the performance of various activities at Construction Site and during the manufacturing of materials and equipment covered under the scope of the project/package.

Bidder shall develop a detailed Field Quality plan for the scope of work and submit the same for discussion and agreement during the pre-bid meeting and obtain the approval of the same from employer's quality team for implementation.

The Quality Assurance System plans / procedures of the Bidder shall be furnished in the form of a QA manual before the pre bid meeting and approval of employer's quality team shall be obtained before the kick off meeting as applicable.

The following shall be compiled by bidder in general.

- This document should cover details of the personnel responsible for the quality assurance, plans or procedures to be followed for quality.
- Various tests/inspections to be carried out as per the requirement of these Specifications and standards mentioned therein with applicable Codes & standards including the specified norms & acceptance criteria.
- Quality practices and procedures followed by bidder's (Contractor's) Quality Control Organization
- The relevant reference documents and standards and acceptance norms etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing.
- Method of vendor's qualification and approvals including the product inspection and acceptance procedures.
- Details of Quality inspection records preparation and maintenance.
- Various stages of inspections w.r.t methods for check with points and type of witness.

### **10.2.3. Bidder's Quality Organization Structure**

The project quality organization structure of the Bidder shall be proposed as part of the bid with the submission of project/package organogram & finalized during the pre bid meeting in discussions with the employer's quality team.

The minimum requirement being an dedicated quality-in-charge capable of implementing the Quality requirements as defined by employer which shall include, but not be limited to, the following:-

- Preparation, submission, and obtain Employer's approval of various QA documents.
- Functional & administrative control of field laboratory ensuring timely tests.
- Preparation and submission of all test & inspection records duly approved by Employer.
- Ensuring calibration of all measuring & test equipment.
- Test materials from approved independent labs as required by Employer.
- Conduct specialized field tests (NDT, etc.) from approved agencies as required by Employer.
- Conducting training internally to quality & construction teams of Bidder.
- Face quality audits conducted by Employer & close the NCRs identified.
- Closely coordinate with quality personnel of Employer & ensure compliance to various quality requirements of Employer.

**Note:** Bidder shall ensure that his quality-in-charge is adequately supported by a team of QA/QC staff to take care of the tests and inspections both at field lab as well as construction sites which shall also include quality personnel at manufacturing/fabrication at external site

#### **10.2.4. Bidder's communication procedure**

The communication procedure with the Employer's quality team to be followed by the Bidder shall be a seamless flow of information and eliminate communication gaps resulting into delays & re-works.

##### **10.2.4.1. Communication procedure for prequalification of Sub-supplier**

Bidders shall generally engage sub-suppliers which are approved by employer in reference to the list of approved supplier / sub-supplier enclosed with the Tender document or provided by employer during discussions during the Pre-award stage.

In specific cases where bidder wants to engage non-listed supplier / sub-supplier the bidder shall submit details of such proposed supplier / sub-supplier in approved formats to employer and obtain approval during the pre-award stage.

Bidder shall coordinate with Quality Manager of employer for obtaining such approvals which may involve the site/facility visits of the proposed supplier / sub-supplier by employer's Quality team.

Bidder shall coordinate & support the prequalification process including site/facility visits as required by employer.

**Note:** Decision of approval or rejection of such supplier / sub-supplier shall be the sole discretion of Employer and the decision shall be binding on Bidder.



#### 10.2.4.2. Communication procedure during Pre-Order stage

Bidder may hold discussions for any clarification required from the employer's Quality team during the pre-bid meetings.

During such meetings bidder shall communicate directly with employer's nominated Quality Manager regarding inputs like

- a) Clarifications on Technical specifications
- b) Specific QA requirements mentioned in the Tender
- c) In case any concessions/deviation required by them with respect to QA requirements.
- d) Clarification regarding tests & inspections,
- e) Nature of documentation required form & formats
- f) Mode of submission soft /hard / key in data in employer's system

**Note: It shall be responsibility of the bidder to understand & freeze the requirements, in concurrence with employer's quality team, for smooth implementation during post order or execution stage.**

#### 10.2.4.3. Communication procedure during Post-Order stage

Bidder shall submit an exhaustive list of bought-out materials duly categorized before the pre-bid meeting.

Source inspection of the brought out material shall be mandatory by employer's quality engineer as per approved categorization plan irrespective of the bought-out materials being procured from approved vendors or being pre-inspected from agencies like "RITES" and or Independent engineer (appointed by port authority) .

Bidders shall coordinate with employer's commercial & quality team and freeze the Categorization plan and obtain approval of employer before kick off meeting.

The categorization plan for the bought-out materials shall be of A, B, C categories as per inspection requirements as detailed below

- **Category-A:** Materials which shall be inspected by Employer (or TPIA nominated by him). The consignment items shall also be included in this category apart from other identified materials. Acceptance shall be based on IR & MDCC from Employer.
- **Category-B:** Materials which shall be inspected at source by bidder himself. Acceptance shall be based on inspection reports from bidder.
- **Category-C:** Materials which shall not require source inspection. Acceptance shall be based on document review only.

#### 10.2.4.4. Communication procedure during Post-Order (Construction)

##### **For Routine construction works:**

Employer's Quality Manager shall communicate up-front all hold points to Bidder in line with approved field quality plan or inspection & test plan (FQP/ITP) .

Bidder shall intimate all field inspection requirements to Employer's quality team in form of Request for Inspection (RFI).

In case employer's quality manager communicates to waive off the inspection at his level, bidder shall proceed with the work after duly inspection from his side and shall communicate the inspection results to employer's quality manager in all such cases.

For material testing at Field Lab bidder's quality shall inform employer's quality for witnessing the tests as specified in the quality plan.

Bidder shall intimate all quality issues & deviations to employer quality as & when they occur preferably on the same working day.

Bidder shall also make note & take action on quality issues identified by way of employer's surveillance and inspections.

Routine non-critical quality issues shall be notified to bidder by means of field notes or e-mails or through employer's functional module or by oral communications from employer's quality team mentioning the rectifications and or corrective measures. These shall be closed by communication between bidder and employer's quality with execution teams from both ends in the communication loop.

Issues which may essentially lead to following shall be **reported through NCRs**

- a) Process and/or Product /Structure failure,
- b) May have potential threat of product/structure failure

Bidder shall follow the below process as part of NCR reporting

- a) Employer auditor /assessor shall issue NCR to Bidder's auditee/assesse in specified format.
- b) Bidder shall coordinate with employer and respond & agree upon corrective action within three working days, this shall be treated as part of acceptance of NCR.
- c) Employer's quality team shall communicate all deductions and hold amounts from Bidder's RA bills with back-up (NCRs, Field notes, inspection reports, e-mails, etc.) through employer's area manager.
- d) Bidder's auditee/assesses shall propose the preventive action in the NCR after understanding the root cause of the issue /observation
- e) Employer's quality team and or the auditor shall perform the verification and shall initiate closure of NCR
- f) Bidder shall ensure that the employer's execution team is looped in all communications regarding the NCR.

**For source inspection of Contractor supplied bought-out materials**

- c) Bidder shall ensure MQP's (Manufacturing Quality Plans) for brought out material supplied under his scope are approved from the employer's quality team much before the manufacturing starts at vendor/suppliers works.

- d) Bidder shall submit the MQP (Manufacturing Quality Plans) based on the approved categorization plan for materials which shall be source inspected by Employer's quality team or his representative.
- e) Bidder's quality engineer shall coordinate directly with Employer's quality team and obtain approval of the MQPs.
- f) Employer's quality team shall directly communicate with bidder and his Vendor, as required, for various QA requirements (MQP, Data sheets, Manufacturing drawings, etc.).
- g) In specific cases Bidder's vendors may directly communicate with Employer's quality team and submit the required documents for validation /inspection & approval under intimation to Bidder.
- h) However this does not dilute or eliminate the responsibility of the bidder to submit all documents and provide inputs for approval of vendor /supplier MQPs.
- i) Bidder shall coordinate with their Vendors /suppliers and submit inspection calls directly to employer's quality manager with intimation to the Project manager of Employer.
- j) On completion of inspection employer's quality inspector shall submit MDCC & IR to the vendor & inform the bidder regarding the clearance.
- k) Employer shall instruct his vendor to dispatch the materials as per clearance received through MDCC.
- l) Contractor to submit original inspection reports along with original test report / certificates to Employer and three more copies at the time of handover.

#### **For receipt inspection of materials at site**

On receipt of the material at site bidder's Quality team shall ensure that the material is inspected with respect to quality requirements as per its technical specification/ standards and terms and conditions of PO/ TCS/ MTC/ MDCC.

He shall intimate Employer's quality personnel for joint inspection of the items received.

Employer's quality engineer shall carry out inspection to his discretion and accept the materials accordingly.

Any quality issue, if detected at receipt inspection, shall be immediately intimated to Employer's quality team.

Materials found defective in receipt inspection shall be segregated and rejected/repared by Bidder & his vendor's team as advised by Employer's quality.

#### **10.2.4.5. Communication procedure for approvals of quality deviations**

There shall be absolutely no deviations from the specified technical & quality requirements as per the contract, however, in exceptional cases where compliance to all such requirements may not be possible due to genuine reasons beyond control of the bidder, then a waiver/deviation permit process shall be initiated, and properly documented in specified format, by the Bidder for approval of deviations.

The communication process for approval of quality deviations for material & construction are detailed below:

**m) For Materials:**

If any deviation for the specified quality parameters for the materials is proposed by bidder then he shall immediately intimate the same to Employer's quality manager and the concerned site head & project head along with his proposed alternative scheme.

For the purpose bidder shall submit all required supporting documents like drawings, technical data sheets, test & inspection reports, etc. to employer's quality manager for review.

Employer's quality manager shall accord the approval of such deviation requests at his discretion after assessing the reasons of deviations sought as well as the adequacy of the alternative proposal of Bidder.

However if Employer's quality manager feels the requests are not valid he may reject the request in which case bidder shall either implement the original specified requirements or submit an alternative scheme and implement same subject to approval of employer's quality manager.

**n) For Construction:**

During execution of construction work, bidder shall raise request for waiver of applicable specifications only in case where genuine constraints are encountered, beyond his control, depending on site conditions.

In all such cases bidder shall immediately intimate the constraints and the deviation he seeks to employer's quality manager and the site & project head along with his proposed alternative scheme.

Bidder shall also submit all required supporting documents like drawings, technical data sheets, test & inspection reports, etc. to employer's quality manager for review.

Employer's quality manager shall review the requested waivers and shall approve the same, if considered in his opinion justified with respect to quality, operability and stability of the product/component.

In case the employer's quality manager feels the requests are not valid he may reject the request in all such cases bidder shall either implement the original specified requirements or submit an alternative scheme and follow the same approval process with the employer's quality manager.

In both above cases bidder shall document the Waiver/Deviation Permit in specified formats as approved by employer and shall submit a copy of all such approved deviations to employer's quality manager. Also Bidder shall maintain the approved waiver log in chronological order clearly mentioning the updated status.

### **10.3. Quality Plan**

#### **10.3.1. Manufacturing quality plan:**

Bidder shall submit MQPs (Manufacturing Quality Plans) for various materials and machines in his scope, for which source inspection (Inspection at vendor's site) is applicable prior to manufacturing starts.

Approval of Employer's quality manager shall be mandatory for all MQPs & for commencement of manufacturing for such source inspected material.

Based on the approved MQP the inspection shall be performed.

#### **10.3.2. Field quality plan:**

Bidder shall submit FQPs (Field Quality Plans) which includes inspection & test plans for all incoming construction materials (civil / Electrical / Mechanical) and construction works. Approval of Employer's quality manager shall be mandatory for all FQP's before commencement of works.

#### **10.3.3. List of Quality plans**

Successful bidder to submit the discipline wise templates, FQPs & MQPs to be deployed, which shall be submitted by the bidder as per his scope for discussion in detail with the employer's quality team during the kick off meeting before implementation.

Bidder shall ensure to get the approval of all the FQPs & MQP's from the employer's quality manager before the implementation.

### **10.4. Quality System Requirements**

#### **10.4.1. Deployment of Quality system procedures**

The Employer has detailed processes developed in line with leading practices and are being implemented as part of the project management in the organization.

A project quality plan is developed & approved by the bidder's quality manager and submitted to the employer's quality team; further the employer's quality manager consolidates the same in consensus with all the contractors /bidders at the early stage of the project for preparation of the PQP for the project.

#### **10.4.2. Source Approval process for bulk Materials**

The Bidder shall develop list(s) defining the items to be procured by him along with likely Vendors for approval of Employer.

The vendor list shall be in line with the contract document and approved technical specification.

In case, no vendor list exists in the contract for a particular item, the Bidder will propose a list of Vendors for the item.

Bidder has to satisfy himself with the capability of the vendor to deliver the product in time with quality before proposing him as a prospective vendor.

Bidder shall submit the QA/QC plans for all major items and carry out their procurement in line with approved plans.

The Bidder can either provide his own adequate qualified staff for inspection or employ a separate third-party inspection agency to carry out these functions.

***Third-party inspection agency appointed by Bidder shall be subject to approval by employer.***

The scope of Involvement of employer in the inspection activity shall be defined in the quality plan and agreed upon before approval.

All the raw materials which are naturally available and which will be used in the respective works shall be identified by bidder and approved by employer on the request of Bidder.

Bidder shall locate sources of raw materials for all works which conforms to the specified requirements as per approved plan and applicable Codes & Standards.

The source(s) shall be capable of consistently giving good quality materials meeting to the requirements, and supplying without interruption the entire quantity required for the works.

After getting approval of the source/vendor only the material shall be brought to the work site.

Without approval of the source/material/vendor, the material shall not be procured by the contractor or received at the site .

Bidder shall act as required by Employer's quality manager regarding source approval of their construction raw materials which may include joint visit to quarry, borrow areas, and other such source.

Joint sampling & submission of samples to approved laboratory as advised by employer's quality manager is done.

Employer's quality manager is the single point of contact for approval of the source based on satisfactory test results.

In case available raw materials do not comply with the specified requirements bidder shall propose alternate materials, which comply with the technical and quality requirements, and obtain approval of employer's quality manager after demonstration of its suitability by the required tests and submission of reports.

All raw material / manufactured materials shall be procured from Employer's approved sources.

#### **10.4.3. Pre-qualification of Sub supplier**

If there is any deviation from the approved vendor list given in the contract, specific approval from Employer shall be taken in the proper format.

For any bought out items where approved vendor list is not given in the contract and which are readily available in market, reputed vendors/brand/product shall be identified by bidder and approval for the same shall be taken from Employer before their procurement.

## **10.5. Audits**

### **10.5.1. Project Quality & Technical Compliance audit by Employer's Quality team**

Quality audits shall be conducted by employer's quality team periodically for quality and technical compliance for the bidder's scope of work.

Employer's quality team shall intimate bidder regarding the audit /assessment planned and shall communicate the schedule and specific areas of assessment reasonably well in advance.

Bidder shall participate and provide full support to the audit /assessment team and furnish all documents/reports/records as desired by the audit/assessment team.

Employer shall submit audit findings in form of a report, which shall brief the observation with identification of conformance /NC /AOI to the bidder apart from issuing the below reports subsequently.

#### **a) Non Conformance Report**

Where ever there is a strong evidence that the process deviation and or product deviation in terms of Good construction practices (GCP) specific NCR are given to the bidder for planning corrective & preventive measures .

#### **b) Areas of Improvement**

Where ever the auditor /assessor feels the findings are required to be highlighted as they can result in planning "Areas of improvements" the same is identified and formally issued for planning corrective & preventive measures.

#### **c) Conformance**

Where ever the auditor finds conformance the same are highlighted in the audit finding observation.

The bidder shall take all actions required to comply with the findings of the Audit Report and issue regular Compliance Reports for the same to Employer till all the findings of the Audit Report are fully complied.

### **10.5.2. Audit/Assessment by independent person / third party agency**

Employer reserve the right to appoint an independent person/Third Party Agency to conduct systems audit for full/part of the facilities being executed by the employer.

This audit will be in addition to the audits described above and may be carried out intermittently/continuously for all or part of the facilities being executed.

The programme, along with the scope of such audits, will be informed to the bidder well in advance. Bidder shall participate and provide full support to the Audit Team and furnish all documents/reports/records.

Nonconformities identified shall be communicated to the auditees with intimation to Project Manager of Employer.

Auditor shall prepare audit report and submit same to Employer's HQ for discussion.

Root-cause analysis shall be done in discussion with Bidder & Employer's quality manager and corrective actions shall be mutually agreed upon by both auditor & the auditee.

The corrective actions & the target dates shall be communicated to Bidder through proper channel.

Bidder shall ensure that all corrective actions finalized are implemented as required.

Employer's quality manager shall verify the corrective actions and shall intimate the concerned quality auditor about the closure of the non-conformities which shall be verified in the follow-up audit.

***Note: There shall also be unplanned audits & Surveillance based on the requirement by the employer from time to time.***

### **10.5.3. Control of non-conformance**

Bidder shall be responsible for identifying and closing all non-conformances with respect to incoming materials as well as construction & installation activities.

NCs shall be broadly classified into two categories namely:

- **Category-I:** (NCs which have direct bearing on structural stability and/or has appreciable impact on cost, quality and time of the project with reference to the end user's requirement).
- **Category-II:** (All other NCs not covered under Category-I. These are basically the noncritical defects which are rectified at verbal/field-note intervention without escalation. These have negligible or no impact on cost, quality and time of the project with reference to the end user's requirement).

Issues of moderate and high criticality shall be reported through NCRs and closed. Employer shall issue NCR to Bidder in specified format.

The NCR shall be issued to defined recipients depending on the stages/ phases of the project.

The corrective action for each NC shall be proposed by Bidder in discussion with the concerned area manager & project/site head.

The proposed corrective action shall be reviewed and approved by Employer's quality manager.

Corrective action shall be jointly agreed upon by Bidder & Employer mentioning the methodology and timeline of disposition.

Decision & instruction of Employer's quality manager regarding the corrective & preventive actions shall be final and binding on Bidder for closing NCs.

All NCs which demand dismantling of structures shall be done immediately without delay by bidder as per the requirement of the employer's area manager & quality manager.

Wherever inputs of Engineering function are required, for finalizing the corrective action bidder shall obtain engineering inputs duly approved by bidder's project engineering manager and submit the same to the auditor /assessor.



Employer's quality manager shall verify the corrective actions taken and shall validate the closure of the NC if found complying with the agreed terms of NC closure.

Employer's quality manager shall communicate all deductions and hold amounts from Bidder's RA bills with back-up (NCRs, Field notes, inspection reports, e-mails, etc.) through Employer's Execution In-charge.

#### **10.5.4. Non Conformance Reports & Summary:**

All NCRs shall be maintained by employer as mentioned above in a traceable manner. This shall include the NCRs issued internally by Bidder's Quality function also.

The corrective & preventive actions against each NCR shall be properly documented including the updated status and the closure verification records of Employer in the specified format.

All NCRs shall be closed by Bidder as per the terms agreed upon and shall be as required by Employer.

Bidder shall submit copies of all closed NCRs to Employer's quality manager as soon as they are closed.

Bidder shall maintain a NC log duly updated and submit same to Employer's quality manager regularly as required by him.

#### **10.5.5. Quality certification of RA bills**

Bidder's RA bills shall be subject to quality certification by Employer's quality team at site.

Employer's quality team shall be authorized to hold or deduct suitable amounts from RA bills as per his discretion on account of open NCRs, quality issues, and finishing issues and other defective works or lapses in quality compliance.

All open NCRs which are pending closure beyond specified timelines or not closed satisfactorily as required by Employer's quality team shall attract penalty in form of deduction/hold of suitable amounts from RA bills as decided by Employer's quality.

All the RA bills shall be submitted with relevant reports and certificates, no RA bills shall be processed without relevant reports.

Cost of all tests & inspections conducted by Employer at the cost of, or on behalf of bidder, shall be recovered from Bidder's RA bills for which the amount shall be at the discretion of employer.

#### **10.6. Quality Control, Document Management & Submission:**

Bidder shall be fully responsible for all quality control activities including creating and preserving all quality documents to ensure that the entity has fulfilled the requirements for quality.

All such documents shall be in hard as well as soft form, in a traceable manner, duly approved by employer as required by him.

Bidder is required to prepare and submit documents as evidence of the tests & inspections performed and quality of works to employer as per the contract.

This also includes preparation or keying in the required data in the employers system as part of documentation on day to day basis.

All Inspections and QA/QC test records are to be kept up to date by the Bidder and shall be made available to Employer, whenever requested.

These documents shall be handed over to employer by the bidder progressively as well as finally compiled as Project Dossier on completion of commissioning or as required by employer.

As applicable, depending on the nature of the documents, bidder shall obtain approval of Employer of all such documents where joint signature of employer is required.

The documents shall be compiled and submitted to employer's quality manager at a regular frequency as required by him.

With the objective of effective traceability of documents a suitable document numbering system shall be implemented by Bidder in line with the discussion during the Kick-off meeting which shall be applicable for all permanent quality records.

#### **10.6.1. Control of Field Inspection & Testing**

The QA plans for execution (FQP) shall be developed by the Bidder. Employer's approval shall be taken well before start of the work for the same.

The final Inspection & Test Plans (ITPs) shall be developed by Bidder as per contract specifications, drawings, applicable Codes & Standards and shall be subject to approval by Employer.

For the activities which are identified as Witness or Hold point, specific inspection calls shall be raised by Bidder with Employer in the requisite format (RFI) well before time.

Bidder shall be completely responsible for management of approved quality plans and Employer's involvement will be only be limited to surveillance in nature with random check of activities at selective/critical junctures.

Employer's role shall be to monitor that the Bidder is executing the quality plans as per the specified requirements, employing adequately qualified staff and other resources for various items of works.

Any deviation to the specifications shall be brought to the notice of Employer in proper formats by Bidder for approval.

Bidder will carry out tests & inspection, Non-destructive Tests, analyse and obtain acceptability of all materials and construction & installation works in accordance with approved Field Quality Plans (FQP), agreed procedures, specified technical standards & quality requirements and guidelines and shall carry out validation tests as required by Employer from time to time.

#### **The validation tests may or may not be specified in approved FQP.**

All lab tests and field inspections shall be conducted by Bidder as per the approved FQP in specified methodology and frequency.

Bidder shall intimate all field inspection requirements to Employer's quality personnel in form of RFI (Request for Inspection) for witnessing.

In case Employer's quality manager communicates to waive off the inspection at his level, bidder shall proceed with the work and inspect himself.

In all such cases bidder shall communicate inspection results to Employer's quality manager. All QC hold points shall be cleared through inspection by Employer's quality team.

No work shall proceed beyond QC hold points unless written clearance is provided by Employer's quality.

No concreting works shall be allowed without approved pour-cards in defined formats duly filled up by Bidder and approved by Construction site engineers/QC engineers of Employer, as the case may be.

Bidder shall stop the work immediately if there is a quality concern detected by him or if instructed by employer quality manager.

Corrective action as required by employer's quality team shall be done within the specified time and the work shall be offered for re-inspection to employer quality team.

For material testing at Field Lab Bidder's quality manager shall directly communicate with employer's quality for witnessing.

In case Employer's quality decides not to witness he shall communicate the same to bidder's quality manager to proceed with the test and the bidder shall communicate such results to employer's quality.

All test & inspection reports shall be properly documented in approved formats and submitted to Employer's quality manager regularly as required by him.

Bidder shall also conduct specific tests through approved agencies (NDT, and other such validation tests) as required by employer's quality from time-to-time and submit reports to him.

Alternately employer may also conduct certain validation test himself at his discretion if required by him.

Such tests shall be conducted with prior intimation to bidders who shall be responsible to provide all infrastructural and incidental support required for successful completion of the tests.

The bidder must arrange & organize the access for employer's representative at any time to place where the equipment is being manufactured or at location where the work is being performed in order to inspect the progress and the manner of manufacturer or construction, provided that the employer gives the bidder reasonable prior notice.

The employer's representative will have the right to examine and have access to documents relating to the manufacture and assembly of the equipment including the quality control and inspection documentation.

In case if any of the system/subsystem/ equipment or any part of work fails to pass any test and inspection, the Bidder must either rectify to the employer's satisfaction or replace such

system/subsystem/ equipment or part of the work and must repeat the test and inspection upon giving a notice.

No part of the work shall be considered to be completed unless and until the required test and inspection required are carried out under this contract and or the quality plan.

Bidder must give reasonable notice to the employer whenever any parts of the works are ready or about to be ready for test and inspection.

If required for re-confirmation the employer may request the bidder to uncover certain works or open up the completed work for inspection & tests.

All such works & openings shall be put in place as per the requirement of the employer's quality engineer and applicable standard & code and or contract.

In certain cases it is likely that the bidder may engage sub-contractor(s)/vendors for enhanced performance of the work, in such cases the sub-contractor(s)/vendors selection shall be done after evaluation by the Bidder in-line with contract requirements and shall be approved by employer's quality team before engaging them for the works.

Bidder shall be responsible for ensuring the implementation of approved QA plan, contract specifications and contract conditions through their sub-contractors to achieve the quality during all stages of construction.

It shall be the responsibility of the Bidder to ensure proper coordination between his sub-contractor(s) and other agencies working at site.

#### **10.6.2. Approved Quality Waivers, Deviation Permits & Design change Note:**

Bidder shall record & maintain all quality waivers & deviation permits in specific formats for the project.

This shall include the "approved design change notes (DCN) .

The bidder shall submit the following to the employer's quality team on approval

- The Quality waivers & deviation permits
- Design Change Notes

Bidder shall also maintain a log of all quality deviations and DCNs (both proposed and approved) duly updated and submit the same to employer's quality team as required from time to time.

#### **10.6.3. Drawings and other Engineering deliverables with transmittal:**

All GFC drawings, data-sheets, soil investigation reports, Material Take-off, item-wise Bill of Quantities, and other engineering deliverables shall be submitted regularly by bidder as follows:

- In Format as required by the employer's engineering team.
- GFC drawings shall necessarily be submitted along-with transmittal sheets.
- All engineering deliverables shall be submitted with 6 copies until otherwise specified by the employer's engineering team.

Bidder's engineering team shall also maintain drawing issue records clearly indicating the drawing-wise revisions issued in approved format. Such records shall be regularly submitted to Employer.

**10.6.4. Master drawing Index & Document Control Index:**

Bidder shall maintain updated Master drawing Index & Engineering Document Control Index in specified formats as required by employer's engineering team. These records shall be regularly submitted to employer after updating as required by him.

**10.6.5. Approved sub-vendor/sub-vendor's list:**

Bidder shall submit list of the proposed sub-supplier specified format for employer's approval.

The profiles of potential sub-supplier shall be submitted by bidder in specified formats.

In case the vendor is previously approved by the employer's organization the bidders shall submit the list of all such approved sub-suppliers, along with Employer's approval note.

**10.6.6. Approved material list:**

Bidder shall submit a list "for materials scope" applicable for the project along with Bid.

Bidder shall obtain prior approval of such materials & manufacturers from employer's quality team.

Subsequently Bidder shall submit a comprehensive "list of approved vendors for specific materials" applicable for the project.

**10.6.7. Quality Reports**

**a) Source inspection reports:**

Bidder shall submit to Employer's quality team all IRs (Inspection Reports) against all stage & final inspections of bought-out materials & machines done at source for all applicable materials as mentioned above in this document.

**b) Material Dispatch Clearance Certificate (MDCC):**

Subsequent to source inspections employer's quality inspector shall issue MDCC if materials are cleared in the inspection.

Copies of MDCC shall be maintained by Bidder and shall be sent to site along with each material consignment dispatched.

MDCC shall form a supporting document for billing for the supply wherever applicable as per Contract.

**c) Material receipt & Inspection reports (MRIR):**

Bidder shall conduct receipt inspection of all bought-out items received at site irrespective whether it is inspected at source or not.

Receipt inspection shall be done jointly with employer's quality engineer and Bidders shall record the receipt inspection reports in specified format of MRIR.

Bidder shall prepare & submit all MRIRs duly approved by employer's quality engineer regularly as required .

Corresponding MDCC, IRs, Manufacturer Test Certificates & lab test reports as applicable, shall be preserved with proper traceable link as required by Employer.

**d) Field inspection & test reports:**

Bidder shall record and maintain all field inspection & test reports (as per FQP) which shall consist of the following

- Laboratory test reports
- Field inspection reports of various construction activities
- NDT, and all validation test reports conducted by employer

Bidder shall ensure that reports are duly certified by employer's quality & compiled properly and submitted to the employer on a weekly basis, or as required by him.

All such compilations shall be monitored & reported indicating the inspections & tests planned for the period vis-à-vis achieved.

**e) Punch list:**

Punch list is generally a list of un-attended works or minor defects, pending rectification for work nearing completion.

Scope of issuing punch list is covered broadly during pre-commissioning, commissioning and handover/ start-up phases of the project.

During above mentioned phases of work, bidder shall ensure that the punch list is prepared by him internally covering all defects and deficiencies with a schedule of liquidation.

This internal punch list shall be submitted to employer for monitoring of their liquidation.

Further Employer shall also issue punch list to Bidder based on his own inspection. Bidder shall consolidate the list & close all the punch-points (both at mechanical completion as well as commissioning stages)

Bidder shall maintain records of punch list in a traceable manner with their updated status and submit the document to Employer as when required.

**f) As-built drawings:**

Bidder shall submit as-built drawings of all packages on completion of works to Employer's quality team.

Final bills shall be submitted along with As Built drawings and documents. Final As Built drawing shall be available during Final Load trial run of the system.

**g) Quality dossier (Hand-over document submittals :**

Bidder shall be responsible for submitting a compilation of quality documents required for handing over to User at the end of the project execution.

The contents and format shall be as required by Employer depending on the type of project documentation required to be handed over and other regulatory requirements of Users.

## **10.7. Commissioning Management**

### **10.7.1. Preparation of commissioning plan**

Bidder shall prepare a commissioning plan which shall also include trial run, testing & commissioning schedule in coordination with Employer's Project Manager and Quality-in-charge before the commencement of the commissioning phase and obtain approval of Employer.

The schedule shall be prepared taking into account liquidation of all construction punch-points.

Bidder shall incorporate all quality requirements in the testing & commissioning schedule as required by Employer's quality-in-charge.

### **10.7.2. Mechanical completion**

As soon as the bidder declares the system/subsystem/equipment as mechanically complete, he shall give a notice to the Employer's representative for inspection and punch listing for validating the mechanical completion.

The Employer's representatives shall inspect the works & either issues a certificate compliance/completion stating that the system/subsystem/equipment has reached mechanical completion & notify the Bidder of any defects and /or deficiencies detailing the same as "punch list" as the case may be.

In case of receipt of punch list the Bidder must then correct those defects and or deficiencies shall close all the punch points and offer for inspection by Employer.

The procedures described above must be repeated until the Employer issues a certificate of mechanical completion

After inspection of Employer and receipt of intimation on successful completion of punch points mechanical completion shall be declared by Employer.

The Bidder shall proceed for the pre-commissioning & commissioning process only when all the mechanical completion related documents have been completed including the checklists.

### **10.7.3. Pre-commissioning & commissioning**

Pre-commissioning essentially involves all test & checks which are required to ensure that the system/subsystem/equipment are ready for commissioning. Each compliance confirmation checklist for pre-commissioning is to be designed by the bidder and approved taken before implementation.

### **10.7.4. Commissioning**

Commissioning includes no load, load & the Performance tests to be conducted by the Bidder as per approved commissioning schedule to ascertain whether the system/subsystem/equipment can achieve completion and to ascertain whether the facility can meet the performance guarantees.

All performance tests must be conducted in a professional, timely, safe and environmentally responsible manner and in accordance with the schedule of scope of work and the schedule of tests, all other terms and conditions of this contract, applicable standards, laws, government approvals and must be accomplished at no additional cost or expense to the Employer. The system/subsystem/equipment must not be operated during any performance test in excess of the following:

- The limits allowed by any manufacturer to maintain its warranty.
- The limits imposed by the law and government approvals applicable standards.
- The limits stated in the schedule of tests.

If a performance test is interrupted or terminated for any reason, such performance test, must be restarted from the beginning, unless otherwise approved by the Engineer in Charge. The Owner or the contractor is entitled to order the cessation of any performance test if any of the following occurs:

- Damage to the works, the facility or other property or personal injury.
- Breach of the conditions specified in the relevant environmental laws or government approvals, is likely to result from continuation.

If the Bidder fails to pass a performance test (or any repetition in the event of prior failure) or if a performance test is stopped before its completion, such performance test shall be repeated subject to 24 hours' prior notice having been given by the Bidder to the Employer and the Employer's representative.

All appropriate adjustments and modifications are to be made by the Bidder with all reasonable speed and at its own expense before the repetition of any performance test.

The results of the performance tests must be presented in a written report, produced by the Bidder and delivered to the Employer's representative within 2 days of the completion of the tests. Those results will be reviewed & evaluated by the Employer's representative for their approval.

After the testing & trial run and joint inspection of Employer and Bidder a commissioning stage punch-list is prepared by the Bidder.

Liquidation and closure validation of same is done in the same process as in case of mechanical completion.

During commissioning of the system manuals, commissioning spares and commissioning protocols shall be submitted.

**Note: Inspection by the Employer's Engineer does not release the Bidder from any other responsibilities & obligations under this contract, including meeting the performance guarantees.**

#### **10.7.5. Project Close Out and hand-over documents**

As soon as the facility has passed the performance tests and in the opinion of the Employer, the facility has reached the contractor must give a notice to the Employer for issuing a commissioning / completion certificate.



The Employer's representative shall issue a certificate of completion stating that the facility has reached completion after finally inspecting the created facility and the commissioning & acceptance tests reports.

The issue of any certificate of completion in accordance with this clause will not operate as an admission that all the requirements of completion have been met and do not prejudice any of the Employer's rights, including the right to require the Bidder to satisfy all these requirements.

Bidder shall be responsible for compiling and hand-over of all documents as required by Employer in terms of the content and formats. Details have been mentioned in SI . No. 4 . If required by Employer the Bidder shall submit a Project Closure Report for which the contents and the template shall be as required by Employer.

Despite any other provision of this contract, no partial or entire use or occupancy of the site, the works or the facility by the owner, whether during the performance tests or otherwise , in any way constitutes an acknowledgment by the owner that final completion has occurred, nor does it operate to release the contractor from any of its warranties , obligations or liabilities under this contract including the satisfactory performance of its obligations during the defects liability period, the carrying out of the performance tests and meeting the performance guarantees and the emissions guarantee.

Vendor shall submit Four sets of hard copies and soft copies during the handover of the system.

**List of important documents to be submitted by the bidder to the employer's team**

- a) Field Quality Plans
- b) Manufacturing Quality Plans
- c) Engineering Quality Plans
- d) Project Quality Plan/Manual
- e) Construction Management Plan
- f) Project Execution Plan
- g) Engineering Management Plan
- h) Commissioning Plan
- i) Approved Vendor list
- j) Approved material list/Make
- k) Source approval list for all bulk material
- l) Approved Method statements
- m) Approved Level four checklist /templates for recording test results
- n) Approved compliance confirmation checklist including commissioning checklists.

## 11. SURFACE PREPARATION AND PAINTING

### 11.1 Scope

This document describes the procedure to be followed for surface preparation, paint application and inspection for MHS (Conveyor and all supporting manufacturing bought outs) structures during Manufacturing and erection.

In case of conflict between this procedure and contract specification the later shall govern.

### 11.2 Reference

ASTM D 3359, ASTM D 4541, NACE SP0188, IS: 1477-PART-1, PART-2, ISO-12944-4, ISO-8505, ISO-8501-1, ISO-8502-4, Customer technical specification.

### 11.3 Procedure

#### 11.3.1. Paint Material:

Paint material shall be identified as per Material receipt inspection procedure and Paint Manufacturers shall be as per **Jotun/Akzonobel/Sigma/Hempel**.

Following details shall be checked by QC Inward, before accepting the paint materials.

- Specification
- Manufacturer
- Batch Test Certificate
- Storage life period /Expirydate
- Storage area

#### 11.3.2. List of Hardware

- Compressor along with hose and nozzles
- Hoppers
- Paint agitators
- Paint spraying equipment

#### 11.3.3. Blast Cleaning-Air Blast Cleaning

To provide a surface which will ensure optimum coating performance, preparation is required to remove surfaces which have a sharp edge. These include, but are not limited to, plate edges, and plate lamination surfaces.

- Oil or grease, salts, dirt's, chalk marks and similar contaminants shall be removed as far as possible ,prior to surface preparation using an appropriate method in accordance to ISO12944-4.
- Sharp edges, Weld spatter, cavities and deformation are to be removed in accordance with ISO 8501-Table-3.

- Assess the steel surfaces for rust grade as per ISO-8501-1.
- Surface shall be cleaned by abrasive blast cleaning (ISO 12944-4 Cl 6.2.3.1.2) in accordance with ISO 8504-2 (Cl 5.1.2). Copper slag shall be used for surface preparation. Size of copper slag must be 0.5 mm to 2 mm max.
- External area, surface cleanliness shall be as per Sa2.5 and surface profile shall be 50 to 75 microns in accordance with ISO 8502-4.
- Internal area surface cleanliness shall be as per Sa2 or Sa2.5 and surface profile shall be 40-65 microns depending on the access area. If the area not assessable, then prepare the substrate with St2 or St3 method.
- Surface Salt concentration (e.g. Chloride deposits) shall be 5 µg/cm<sup>2</sup> prior to painting. If the value exceeds acceptable limit, surface to be cleaned using high pressure water cleaning 34-70 Mpa. Washing to be followed by drying and sweep blasting to required standard.
- Abrasive used for blasting should be dry and free from dirt, oil, grease or contamination and have content of water soluble matter not exceeding 0.05%. It's selection for type and size adequate to give required surface finish.
- The abrasive must be capable of producing the standard of cleanliness and surface profile specified (Sa 2.5 and profile of 50 to 75 microns). Visual appearance white metal or near white metal.
- The size of copper slag shall be between 0.5 to 2 mm.
- Abrasives should not be recycled and should not be contaminated with soil.
- The surfaces shall be blast cleaned using abrasives specified above at pressure of 7 kg/cm<sup>2</sup> (100 lbs. per sq. Inch) at appropriate distance and angle depending on nozzle size maintaining constant velocity and pressure.
- Compressed air shall be free from moisture and oil. On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster.
- Blasting can be done up to Rh value of 80% and where the location not met the requirement shall be reblasted to obtain the required surface.
- Primer or first coat of paint shall be applied within 4 hours of surface preparation. Blast cleaning shall not be done outdoors in bad weather without adequate protection or when there is dew on the area which is to be cleaned.
- Surface profile shall be uniform checked by profile gauge and should not exceed the range as specified above or in the contract specification.
- All the machined surfaces are not allowed for blasting and all the machined surfaces to be protected with grease or any appropriate suitable method.
- The surface where set of matching holes (HSFG connection) are observed should be free from paints and following procedure to be followed. (Any doubt the application contractor to clarify from engineer concern prior to start surface preparation)

- Blast the surfaces as specified above and should be same as job requirement.
  - Mask the holes area (HSFG area) by masking tape including adjacent area (Take matching plate size for adjacent area) on both the sides.
  - After painting remove the masking tape (Masked area-holes area) and protect the blasted surfaces with polyurethane sheet covered with masking tape on both the sides.
- For splice plates – Blast the surfaces as specified above and should be same as job requirement and protect the blasted surfaces with polyurethane sheet covered with masking tape on both the sides.

**Special Note: Painting not allowed on HSFG connections and Splice Plates.**

### **11.3.4. Painting Application**

#### **11.3.4.1. Weather Conditions**

Surfaces to be coated must have a temperature at least 3 °C (5°F) above the dew point, immediately following blasting and priming, intermediate and top coat application, and must also remain in this condition during curing of the coatings.

As a guide, relative humidity levels of 25-80 % give optimum painting conditions, although some applications may be carried out up to 85 % relative humidity.

Painting should not carry out during windy conditions.

#### **11.3.4.2. General Site Conditions**

Prior to any work being carried out there are a number of conditions which must be met.

##### **a) Cleanliness**

Any contaminants which may come in contact with the substrate (even before surface preparation comments) can compromise the performance protective coating system, and as such all effort must be made to keep the working area clean. It is good working practice to establish a clean area where painting is being done. Cleanliness must be maintained throughout all stages of the application.

##### **b) Weather Shelters**

Weather shelters should be made available to cover application equipment during mixing and application of material.

##### **c) Paint storage facility**

All paints should be stored ideally between 10 °C (50°F) and 30°C (86°F) and facilities may be needed to store the materials in correct temperature range prior to mixing and application.

#### **11.3.4.3. Stripe Coating**

Stripe coating is an essential part of good working practice, and stripe coats are highlighted in the detailed product specification sheets.

Stripe coats are applied to areas where it is difficult to get the required coverage including but not

limited to:

- Plate edges
- Difficult access areas
- Weld area.

Strip coats are normally applied to a specified firm thickness range via a combination of narrow angle airless spray and brush methods. Over coating intervals for the s t r i p e coats should be strictly adhered to as per individual product data sheet.

#### 11.3.4.4. Painting System

### External Surface

For Painting system for external, the surface profile should achieve 50 to 75 microns Primer

Coat –External-1 x 75  $\mu$

(Two Component Zinc Rich Primer Based on Zinc Powder, Epoxy Resin and Polymide-90% Zinc Content.)

Application: Airless Spray or Pressure pot (1:45 airless machine would be ideal) Mixing Ratio:

4:1 by volume (Base: Hardener)

Mixing the base using a power agitator Add C/A slowly during mixing and mix well for 5 minutes. Ensure complete mixing of base and C/A. If 10 litres complete mixing is not possible then proper measuring jars should be employed to ensure accuracy.

#### For Airless Spray

- Tip size 0.43-0.53mm (17-21 Thou).
- Output fluid pressure at spray tip: Not less than 176 kg/cm<sup>2</sup> (2500 PSI).
- Thinner (use only when required).Do not thin more than 10 %.
- Check WET during application using comb gauge.
- For 75 $\mu$  DFT the WET shall be 125 $\mu$ .Check and record.
- For air assisted spray application following WET film thickness to be maintained for various thinner quantities.

Over coating interval –min 8 hrs and max extended @25 °C. This will changed on the environment condition. (For complete details of the product we need to refer the product data sheet).

#### **a) Intermediate Coat –External-1 x 150 $\mu$**

(Two Component High Build Epoxy Polyamide polymer MIO coat)

Application: Airless Spray or Pressure pot (1:45 airless machine would be ideal) Mixing

Ratio: 4:1 by volume (Base: Hardener)

Mixing the base using a power agitator Add C/A slowly during mixing and mix well for 5 minutes. Ensure complete mixing of base and C/A. If 20 litters complete mixing is not possible then proper measuring jars should be employed to ensure accuracy.

- For Airless Spray
- Tip size 0.53-0.66mm (21-25 Thou).
- Output fluid pressure at spray tip: Not less than 176 kg/cm<sup>2</sup> (2500 PSI).
- Thinner (use only when required).The Thinner consumption should not exceed more than 20 %.
- Check WET during application using comb gauge.
- For 150μ DFT the WET shall be 188μ. Check DFT and record.
- Over coating interval –min 5 hrs and max extended @ 25 °C. This will be changed on the environment condition. (For complete details of the product we need to refer the product data sheet).

**b) Top Coat –External-1 x 70 μ (2X35 Micron may be apply as per Employer instruction)**

(Two component Top Finishes based on aliphatic acrylic polyurethane and hydroxyl containing resins.)

Application: Airless Spray or Pressure pot (1:45 airless machine would be ideal) Mixing Ratio:

6:1 by volume (Base: Hardener)

Mixing the base using a power agitator Add C/A slowly during mixing and mix well for 5 minutes. Ensure complete mixing of base and C/A. If 20 liters complete mixing is not possible then proper measuring jars should be employed to ensure accuracy.

**For Airless Spray**

- Tip size 0.33-0.45 mm (13-18 Thou).
- Output fluid pressure at spray tip: Not less than 155 kg/cm<sup>2</sup> (2205 PSI).
- Thinner (use only when required).The Thinner consumption should not exceed more than 10 %.
- Check WET during application using comb gauge.
- For 70μ DFT the WET shall be 122μ. Check DFT and record.

Over coating interval –min 6 hrs and max extended @ 25 °C. This will be changed on the environment condition. (For complete details of the product we need to refer the product data sheet).

**Total DFT= 295 Microns Min , Tolerance +10%, No negative tolerance acceptable.**

**Internal surface**

(Applicable for box/closed structure surface profile 40 to 75 microns and wherever non accessible areas the surface profile to achieve minimum 40 microns)

**Primer Coat –Internal –Surface Tolerant Primer with Aluminium pigment -1 x 100 μ**

Application: Airless Spray or Pressure pot (1:45 airless machine would be ideal)

Mixing Ratio: 5.67:1 by volume (Base: Hardener)

Mixing the base using a power agitator Add C/A slowly during mixing and mix well for 5 minutes. Ensure complete mixing of base and C/A. If 10 litres complete mixing is not possible then proper measuring jars should be employed to ensure accuracy.

**For Airless Spray**

- Tip size 0.45-0.58mm (18-23 Thou).
- Output fluid pressure at spray tip: Not less than 176 kg/cm<sup>2</sup> (2500 PSI).
- Thinner (use only when required). Do not thin more than 10 %.
- Check WET during application using comb gauge.
- For 100  $\mu$  DFT the WET shall be 145 $\mu$ . Check and record.
- For air assisted spray application following WET film thickness to be maintained for various thinner quantities.

Over coating interval –min 10 hrs and max extended @25 °C. This will change on the environment condition. (For complete details of the product we need to refer the product data sheet).

**a) Intermediate Coat –Internal -1 x 150  $\mu$**

(Two Component High Build Epoxy Polyamide polymer MIO coat)

Application: Airless Spray or Pressure pot (1:45 airless machine would be ideal) Mixing

Ratio: 4:1 by volume (Base: Hardener)

Mixing the base using a power agitator Add C/A slowly during mixing and mix well for 5 minutes. Ensure complete mixing of base and C/A. If 20 liters complete mixing is not possible then proper measuring jars should be employed to ensure accuracy.

**For Airless Spray**

- Tip size 0.53-0.66mm (21-25 Thou).
- Output fluid pressure at spray tip: Not less than 176 kg/cm<sup>2</sup> (2500 PSI).
- Thinner (use only when required). The Thinner consumption should not exceed more than 20 %.
- Check WET during application using comb gauge.
- For 150  $\mu$  DFT the WET shall be 188 $\mu$ . Check DFT and record.
- Over coating interval –min 5 hrs and max extended @25 °C. This will change on the environment condition. (For complete details of the product we need to refer the product data sheet).

**Total DFT= 250 Microns Min , Tolerance +10%, No negative tolerance acceptable.**

## **11.4 Inspection**

Following points for Inspection and checking shall be taken into Account.

Application Contractor to carry out stage wise Inspection before proceeding with the next stage.

Application contractor to Maintain daily log book for the following

- Air temperature
- Humidity condition
- Surface roughness
- Pressure at out let.

Surface preparation can be inspected with the help of comparator by comparing the visual picture shown in the ISO 8501-1:1988. For measuring the profile of the surface, profile meter will be used. The profile shall be within the permitted range as specified above.

All painting materials shall be accompanied by manufacturer's test certificates. Paint formulations without certificates are not acceptable. The painting work shall be subject to inspection by Engineer-in-charge/Paint manufacturer representative at all times. In particular, following stage wise inspection will be performed and application contractor shall offer the work for inspection and approval of every stage before proceeding with the next stage.

Stages of inspection are as follows:

- Surface preparation
- Profile Verification with Surface Comparator
- Primer application
- Each coat of paint
- WFT (wet film Thickness).

Any defect noticed during the various stages of inspection shall be rectified by the application contractor to the entire satisfaction of Engineer-in-charge/paint manufacturer representative before proceeding further.

Wet Film Thickness and Dry film thickness (DFT) shall be checked and recorded by application contractor after application of each coat in the painting log book and mist coat can be applied to get the required DFT. (Minimum 10 Nos reading of DFT shall be verified for each one sq. Meter area.)

The following test needs to be conducted by Paint manufacturer along with application contractor for conformity at the yard.

- Dry Film thickness (Maximum of +20 % from the specification is acceptable) and DFT reading to be recorded.
- Cross cut adhesion test based on ASTM D 3359.
- Random Pull off Adhesion tests based on ASTM D 4541, as per Employer recommendation.
- Salt Contamination test at Random as per Employer recommendation.
- Random Holiday Detection test based on NACE SP0188, as per Employer recommendation.



## 11.5 Repair Procedure

The repair procedure recommended will depend upon the extent of damage involved but can be split into:

- Repairs of Major /Minor areas when the primer paint is affected.
- Repairs when primer is intact & the second coat is damaged.
- Repairs when primer and second coat is intact but the third coat is damaged.

### 11.5.1. External:

#### a) Repairs of Minor/Major areas when the primer paint is affected.

A major repair should essentially be dealt with as if the project were beginning. The recommendations given earlier for steel preparation, coating application etc. , must all be adhered to. The original complete coating scheme should be applied. This is specific when the primer is damaged.

- After ensuring necessary surface preparation as above.
- Apply Primer, Intermediate and Final coats same as specified in original system.

#### b) Repairs when primer is intact and the intermediate coat is damaged.

Under this heading are repairs to areas damaged either at the initial coating stage or caused during service. Mechanical damages, handling damages etc, the principle requirements are

The area to be repaired must be fresh washed and dry. Remove any corrosion by means of either:

- Vacuum blasting
- Hand tool i.e. Disc sander and grinder.

Abrade area immediately surrounding repair to provide key for subsequent paint application.

Apply suitable repair primer (High build epoxyprimer MIO with Aluminium pigment) to 150 microns and final paint to 70 microns.

If small areas are involved and application is by brush, several coats may be required to achieve the correct dry film thickness. If the area is large then airless/air spray has to be employed. A full recoat would be required to maintain aesthetics.

#### c) Repairs when primer and intermediate coat is intact but the finish coat is damaged.

Under this heading are repairs to areas damaged either at the initial coating stage or caused during service, mechanical damage, handling damages etc, the principle requirements are;

- The area to be repaired must be fresh water washed and dry.
- Remove any corrosion by means of either
  - Vacuum blasting
  - Hand tool i.e. disc sander and grinder.

Abrade area immediately surrounding repair to provide key for subsequent paint application.

Apply suitable repair primer (High build epoxyprimer MIO with Aluminium pigment) to 75 microns and final paint to 75 microns.

If small areas are involved and application is by brush, several coats may be required to achieve the correct dry film thickness. If the area is large then airless/air spray has to be employed. A full recoat would be required to maintain aesthetics.

#### **11.5.2. Internal**

##### **a) Repairs of Minor/Major areas when the primer paint is affected.**

A major repair should essential be dealt with as if the project were beginning. The recommendations given earlier for steel preparation, coating application etc. , must al l be adhered to. The original complete coating scheme should be applied. This is speci fi c whe n the primer is damaged.

After ensuring necessary surface preparation as above.

Apply Surface tolerant Primer and Intermediate coats same as specified in original system.

##### **b) Repairs when primer is intact and the intermediate coat is damaged.**

Under this heading are repairs to areas damaged either at the initial coating stage or caused during service. Mechanical damages, handling damages etc, the principle requirement are;

- The area to be repaired must be fresh water washed and dry.
- Remove any corrosion by means of either:
  - Vacuum blasting
  - Hand tool i.e. Disc sander and grinder.

Abrade area immediately surrounding repair to provide key for subsequent paint application.

Apply suitable repair primer (High build epoxyprimer MIO with Aluminium pigment) to 150.

If small areas are involved and application is by brush, several coats may be required to achieve the correct dry film thickness. If the area is large then airless/air spray has to be employed. A full recoat would be required to maintain aesthetics.

#### **11.6 General Precautions**

The following precautions to be followed by Application contractor

- Thinner will be used as per Manufacturer recommendation.
- Type of thinner will be used as per manufacturer's recommendation
- The left out paint will be preserved in a drum with tight cover.
- Only paint brands and colour as per customer approved painting schedule s hal l be followed for painting.

- Material test certificate for each batch of primer and paint will be submitted for review.
- In addition to above recommendation the paint manufacturer's recommendation also shall be considered for mixing, thinning, storage, application of paint, drying time and weather condition.
- If there is rain just after application, before drying then protection will be done by covering tarpaulin.
- **Area not to be painted, like HSFG connection and Site weld joints of the product.(PAINTING NOT ALLOWED IN THIS AREA)**
- Surface shall not be coated in rain, wind, fog, mist or in areas where injurious air borne elements exist. When the steel surface temperature is less than 3 °C above dew point, and when the relative humidity is greater than 85%, the surface shall not be coated.
- Blast cleaned surfaces shall be coated with one complete application of primer as soon as practicable or within 4 hours after the surface blasted.
- Each coat shall be in proper state of dryness before the application of primer as soon as practicable but in no case later than the same day as sandblasted.
- Each coat shall be in proper state of dryness before the application of succeeding coat.
- Paint film thickness shall be maintained as specified in painting schedule and the painted surface shall be within allowable defects as specified above.
- All runs and sags shall be brushed out immediately or the paint shall be removed and surface re-painted.

#### 15.6.1 Safety Cautions:

- PPE shall be used during blasting and painting operations.
- Paint material shall be kept away from hot work areas.
- Material data sheets shall be made available at all times in the working area.
- Required permits shall be obtained during work progress.

### 11.7 Over Coating Interval

The coating has been applied at the normal recommended thickness.

Environmental condition both during and after applications were as recommended for that particular coating, especially in respect of temperature, relative humidity and ventilation.

The condition of the primer coating to be over coated must be in intact, tightly adherent, clean, dry and free from all contaminants. It should be recognised that the level of inter-coat adhesion obtained is also dependent upon the chemistry of the top coat.

If the over coating interval exceeds after 1st coat, whether it a repair or large area needed to prepare the substrate by ST2 or ST3 and apply the 2nd coat system.

Over coating intervals must be as per manufacturer recommendations only.

### 11.8 Acceptance Criteria

- Salt Contamination :  $\leq 5 \mu\text{g}/\text{cm}^2$
- Pull off Dolly Values :  $\geq 5 \text{ MPA}$  (ASTM D4541)
- Cross Hatch Test : Min 4 A Trace peeling or removal along incisions or at their intersection (4A rating as per ASTM D3359)
- Holiday Test : No holiday should present on the substrate.

### 11.9 Certification

Continuous Monitoring and inspection of surface preparation and painting shall be done by paint manufacturer.

Paint manufacturer to deploy competent and qualified personnel for inspection as specified in the above procedure also paint manufacturer to perform necessary testing as specified in the above procedure with free of cost.

Paint manufacturer to certify the each and every product conformity of surface preparation and painting.

- a) Employer approved all drgs/data sheets/ Tech specification/QAP/ITP/Check list/ protocol etc.
- b) This Procedure/QAP is for reference only, above requirements are minimum requirements. Specific requirements shall be included at the time of finalization of specific QAP/Procedure submitted by vendor.
- c) This procedure/QAP shall be read in conjunction of relevant standards/Codes/Specification/Employer approved QAP/ITP/Procedure /Drawings/Datasheets  
/protocol/Contract technical specification/any communication/Good engineering practices adopted by world wise best industries.
- d) In case of any conflict only stringent references and acceptances, standards & codes shall be applicable
- e) In case any dispute or conflict Employer decision will be the final decision, will be taken on the basis of practices adopted by world's best industries for the same product/component/activity delivery.
- f) This QAP/Procedure is subjected to change in case of any significant change observed in material requirement, operational requirement and specification requirement.

## **12. ERECTION, PERFORMANCE TEST & COMMISSIONING**

### **12.1 Responsibility of Contractor:**

The contractor shall make following arrangement (but not limited to) during Erection, No Load Test, Load Test, Performance Test and Commissioning of system, O&M Training and Handing over of the system;

- a) All kinds of required manpower including operational staff starting from Erection till completion of Performance Test.
- b) General and special Tools and tackles.
- c) Construction Power.
- d) General and special equipment(s) and vehicles starting from Erection till completion of Performance Test.
- e) Front End Loader, dossiers & Dumpers with operator and fuel for the duration of Load Testing, Commissioning and Performance Test.
- f) Testing kits & equipment(s) throughout the project.
- g) Required drawings and documents.
- h) Charges for required statutory clearance as per requirement starting from Design till commence of operation, will be reimbursed to the contractor by DPA during the contract period, on actual basis, on production of original receipts & documents of the authority. The same should be in the name of DPA.
- i) Required illumination at site.
- j) Required utilities and welfare facility at site.
- k) Communication arrangement at site.
- l) Transportation arrangement at site.
- m) HSE and Emergency requirement at site including Ambulance (Emergency vehicle) and First Aid Kits.
- n) It will be responsibility of contractor to arrange the Cargo for internal testing and Load testing of the System. However, in case, employer i.e. Deendayal Port Authority arranges the cargo and rakes for internal & load test depending on the availability, the contractor has to bear any penalty / demurrages arises (if any) due to failure / non-performance of the system / plant / equipment. Also refer Clause no. 12.2 (f).

### **12.2 Responsibility of Employer:**

The employer shall make following arrangement up on request and satisfactory compliance from the contractor and in line with the terms of the contract;

- a) Permission of site access to the Contractor personals.
- b) Work permit to the contractors.
- c) Main Electrical power supply at the nearby substation;
  - For charging and testing of substation and electrical equipment(s) after installation.
  - Operational power supply for No Load Testing, Load Testing, Performance Test and

## Commissioning of System and O&M Training.

- d) Water supply at Battery limits tapping point, if available.
- e) Ensure timely deploying of Employer personals for necessary inspection and monitoring at appropriate milestone or as per request from the contractor and in line with the terms of contract.
- f) Arrangement of Cargo during Internal & Load Trials: Upon successful completion of installation, Dry / No Load Test of entire system, for Internal tests and Load testing, the sufficient cargo will be arranged by the EPC contractor on prior approval of employer. However, in case, employer i.e. Deendayal Port Authority arranges the cargo for Internal & Load tests depending on the availability, the contractor has to bear any penalty / demurrages arises (if any) due to failure / non-performance of the system / plant / equipment. After load-tests, for Performance test with minimum 03 full ships as in proposed tender docs, cargo would be arranged by the Traffic Deptt. of DPA by directing the 03 Nos. Ship of full bulk cargo (as per availability) to Berth No.8 & 9. In this case also, the contractor has to bear any penalty / demurrages arises (if any) due to failure / non-performance of the system / plant / equipment and same will be deducted from the contractor payment. The contractor shall ensure unloading of cargo from vessel as per Port / Employer guideline and predefine time line. In case of any penalty related to cargo wastage, contamination etc. from Cargo importer during Load Trials, and Performance Test, same will be pass on to the contractor.

### 12.3 Erection

- The Contractor shall submit Construction, Erection & Commissioning Schedule along with list of Erection Equipment / Machinery / Tool / Tackles etc., to the Employer for their review/approval, prior to commencement of above work at Site. The Contractor shall strictly adhere to the approved Construction & Erection Schedule.
- All equipment under storage/erection shall be in the custody of Contractor's Watch and Ward. All equipment/material shall be taken care of by the Contractor himself.
- Contractor shall provide all construction and transport equipment, tools, tackle s, consumables, materials, labour, supervisor for erection & construction work and all other items/fittings etc. required for completion of his work. The required operators and personnel including watch and ward personnel, up to handing over of the system to the Employer shall be provided by the Contractor as per the site requirement.
- After installation of the entire System at site, each equipment/ item shall be thoroughly checked & inspected for correctness and its completion.

### 12.4 Field Tests

#### 12.4.1 Tests

The tests shall comprise the following but not limited to:

- o) Equipment / Unit assembly test.
- h) Adjustments, alignments and settings.

- i) Satisfactory completion of No Load Tests for each equipment's in the system.
- j) Final operational tests such as Performance Test and Commissioning of System.
- k) For carrying out tests, readiness of works supplied by other Contractor(s) interfaced with the equipment to be tested will be essential.

Before any electrical system is put to use, the Contractor shall carry out the tests, as detailed in Electrical section, to the satisfaction of the Employer.

#### **12.4.2. General**

Contractor shall be responsible for testing individual components / equipment, commissioning of the system as a whole.

For the period of adjustments and setting, the Contractor shall provide services of adequate number of teams of personnel which shall include, but not be limited to, Engineer, foremen, fitters, welders, electricians, etc., who apart from their technical experience are well acquainted with all the machinery and equipment.

All tests shall be carried out in the presence of the Employer and any corrections found necessary shall be approved by the Employer and the Contractor shall be responsible for producing all necessary work sketches and drawings for the approval of the Employer. The Contractor shall be responsible for obtaining the services of sub-contractors (as and when necessary).

Final operational tests by the Contractor with the cargo will depend on the availability of material and interfacing equipment/system falling under the scope of the EPC contractor. The Employer will set the date for operational tests after receipt of the notice (s) from the Contractor and the Contractor will be informed of this date in advance. The Contractor shall be responsible for any adjustments or corrections found necessary during these tests.

Employer will ensure that interfacing equipment/system (by others), are ready to work in conjunction with the system falling under the scope of the Contractor.

The Contractor shall be responsible to coordinate/exchange of technical inputs, as may be found necessary during load trials with the other Contractors.

Interruption/delay due to malfunctioning/adjustments in the system by other Contractor during commissioning may occur. The Contractor shall account for such interruptions/delay during the tests (except the Performance Tests).

The Contractor shall during the period of Field Tests instruct the Employer's staff in the operation of the conveyor system and acquaint them with the adjustments that are made. The Employer's staff shall be given reasonable opportunity to become conversant with the operating features of the equipment.

#### **12.4.3. Adjustments**

Contractor shall be responsible for all necessary alignment and adjustment of machinery and equipment to obtain efficient operation.

All critical and specialized adjustments shall be carried out in the presence of the Employer. Procedures and necessary precautions in regard to such adjustments shall be conveyed to the Employer in writing.

Special attention shall be given to final adjustment of:

- Load sharing by individual drives
- Brakes, Back-stops (if any), couplings
- Lubrication System
- Various interlocks and safety devices
- Proper tensioning of take-up arrangement
- Belt training

#### **12.4.4. No Load Tests**

- Employer shall provide electricity for conducting the no-load tests at single point (Proposed Substation). However, contractor need to give written requirement for power supply in advance to Employer with reports of completion of installation work, testing and necessary statutory approval from respective Government Body (if applicable) and employer personal.
- After completion of the erection the works under this contract shall be tested. The facility shall be run without load and all necessary adjustments shall then be completed. The no load tests are intended to demonstrate that all components will function successfully, separately and as components of an integrated facility in accordance with the requirements of the contract documents.
- After completion of erection, the entire system shall be tested individually and with related equipment by the Contractor. The system shall be operated ensuring that individual equipment supplied under the contract are functional while operating in conjunction with equipment.
- Each individual equipment shall be checked for the No load trial for 4 hrs minimum. Transformer shall be charged and put for No load test for 24 hrs.
- No load trials of system (individual or in group) shall be checked for 08 (eight) hrs with all safety device in place and with the communication established. No load test of 08 hrs to be taken with the vibration, temperature and relevant current, feed rate data.

#### **12.4.5. Load Tests**

Load Tests shall be undertaken in two phases:

##### **a) Phase A (Without Cargo)**

System testing of all components shall be conducted as a dry run. Each system or component shall first be run individually under manual control, then in automatic mode to check interlocks and the associated schematics, if any.

At this stage each equipment shall be completed in all respects excluding minor items like painting, etc.

##### **b) Phase B (With Cargo)**

When Phase 'A' is completed to the satisfaction of the Employer, the Employer on being intimated by the Contractor and subject to all statutory clearances obtained by the Contractor(s), Cargo shall be



furnished by the EPC Contractor (Also refer Clause 12.2 (f) above) and the equipment / facility interfaced with the conveyor system for carrying out the following tests:

- Wherever possible, all equipment's shall be tested independently / simultaneously. Contractor to show the capacity test with respect to design. Graphical representation shall be submitted for the reference document. Load test of 08 hrs to be taken with the vibration, temperature and relevant current, feed rate data.

If the Employer's obligations under the above sub-clause are fulfilled, Contractor(s) shall commence Load Trial under the supervision of the Employer. The Contractor will be responsible for co-ordination with all agencies concerned.

Load Trial by the Contractor(s) shall include but not necessarily be limited to the following:

- a) Check that all system is complete, clean and clear of obstructions and ready to test.
- b) Limit switches checked for location and that they operate satisfactorily adjust as necessary.
- c) Conveyor belts to be run and tracking of belt checked and corrected where necessary.
- d) All controls, monitoring devices, safety devices, visual and audible indications, etc., to be tested for successful operations.

However, a detailed programme for testing shall be submitted by the Contractor for Employer's approval including, check sheets, data log sheets etc.

Records shall be kept of the tests carried out, faults/defects noticed and corrections made, and four copies of such records shall be submitted to the Employer by the Contractor.

In the event of the equipment put into commercial use before the actual commissioning / completion of work as per the Contract, the Contractor shall be eligible for substantial completion. However, a pre-defined period (say 2 months) shall be granted to the contractor to complete the balance minor works as per the list of pending works as on the date of substantial completion. If the contractor completes all the works within the predefined period, the date of taking over shall be the date of substantial completion. Otherwise date of taking over shall be date of completion of all works.

#### 12.4.6. Performance Test and Commissioning of the System:

Contractor shall prepare and submit the Detail Performance Test Procedure and mythology including Check lists, Data Log sheets, resource plan etc.

- a) Performance Test shall be conducted within Two (2) months from the date of successful completion of Load Test. Performance tests shall be equivalent to 3 full ship load of cargo, which shall be arranged by the operational Traffic Deptt. of DPA.
- b) When the facility has operated under stable conditions, the Contractor shall give the Employer a notice that the Facility is ready for Performance Test.
- c) Performance tests shall be conducted as per the mutually agreed testing procedure.
- d) Immediately after the notice above, the Performance Test shall be conducted by the Contractor provided it is agreed by the Employer.
- e) The Performance Test shall be carried out in parts, if required.
- f) After successful completion of the Performance Test the Contractor shall give Notice to the Employer for Taking-over with a copy to the Employer.
- g) During Performance Testing, the Contractor shall ensure that the material handling system shall deliver the guaranteed discharge as given below, in case of shipping stream is achieved for 8 continuous effective working hours. Continuous 8 hours means a period of 8 effective working hours excluding minor stoppages.

Sr.No.	System Description	Desire Output
1	Ship Unloading - Receiving conveyor system – stacking in the 40 Ha. & 34 Ha. Yard.	2200 TPH (designed)

- h) Levels of Performance Guarantee acceptable by the Employer and commercial implications arising due to non-fulfilment of the Performance Guarantee shall be as under:

Sr.No.	Performance Parameters	Penalty
1	For an average output of not less than 90% of the 100% guaranteed discharge.	NIL
2	For an average output of less than 90% and not less than 85 % of the 100% guaranteed discharge.	0.2% for every 1% reduction from the 100% guaranteed output
3	For an average output of less than 85% and not less than 80% of the 100% guaranteed discharge.	0.25% for every 1% reduction from the 100% guaranteed output.

4	For an average output of less than 80% and not less than 75% of the 100% guaranteed discharge.	0.3% for every 1% of reduction from the 100% guaranteed output.
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**Note:** Above Penalty will be in addition to the levy of demurrage etc., if any, levied by the DPA / any other authorities.

- i) If the capacity achieved during the performance test is less than 75% of the guaranteed Capacity, the Employer will be entitled to reject the equipment/ system and claim refund of all the payments received by the Contractor together with interest thereon. However, the Employer shall not be entitled for any consequential or indirect damage.
- j) The above test will be carried out by the Contractor in the presence of the Employer.
- k) After successful completion of the Performance Test, the Contractor shall give Notice to the Employer for Taking-over of the Material Handling System with a copy to the Employer.
- l) Within 10 days of the Notice to the Employer for Taking-over, the Employer shall list out the minor shortcomings, if any. These shortcomings have to be set right by the Contractor without any cost implications to the Employer within an agreed schedule.
- m) Employer shall issue "Commissioning/Taking-over Certificate" to the contractor after successful completion of Performance Test and compliance of Quality, Quantity and Contractual requirement mentioned above and employer satisfaction.
- n) Subsequent to the 'Commissioning/Taking-over Certificate' of the Material Handling System under this Contract to the Employer, the Performance Guarantee will be applicable.

**Notes:-**

- a) Detail procedure for the performance test shall be prepared by contractor and submitted to Employer for approval.
- b) Performance Test shall be done with minimum man power requirement considering normal (routine) operation scenario.
- c) Generally minor shortcomings shall be those which, according to the Employer shall not affect safe operation and achieving peak output. Items which could be considered 'minor' would depend on the nature of malfunctioning and such decisions shall be taken solely by the Employer after completion of the Performance Tests.
- d) While conducting the tests mentioned in this section/specification and/or any other test(s) mutually agreed upon prior to the beginning of such test, the performance of other systems like, field devices, etc., shall also be tested both in manual control and in central-control modes, as long as the connected system will be in operation.
- e) The Contractor shall arrange for responsible representatives and competent engineers to be present throughout the tests.
- f) The Contractor shall have the option to carry out the tests/trials/handling of cargo during non-tests/trial period upto taking-over mentioned herein either entirely with his own personnel or assisted by the Employer's personnel. In either case Employer shall be informed in advance.

- g)** All materials and equipment which fail the tests during various tests shall be replaced by the Contractor without any extra cost to the Employer and the tests shall be repeated on the new equipment/item unless it is agreed otherwise by the Employer. All instruments and tools required for tests shall be supplied by the Contractor at no extra cost to the Employer.
- h)** Weigh Scales shall be used for weighment record unless agreed otherwise by the Employer. The Weigh Scales will be calibrated and Stamping certificate to be obtained from Legal Metrology, Weights & Measure Deptt. Govt. of Gujarat, prior to commencement of the Performance Test. The Employer at their discretion may get the Weigh Scale recalibrated by the Contractor/Supplier either during the Test or at the end of the Test. The Employer at their discretion may take note of the corrective factor for calculating the capacity of the respective equipment during Performance Guarantee Test.
- i)** In case, in the assessment of the Employer, the tests are unreasonably delayed or prolonged after commencement of testing, the Employer may discontinue the tests and instruct the Contractor to reschedule fresh tests.

### **13. TIME SCHEDULING, PROGRESS MONITORING, COST CONTROL & DOCUMENT CONTROL:**

#### **13.1 Introduction:**

This section of tender document indicates Employer's minimum requirement in terms of Time Scheduling, Progress Monitoring, and Document Control etc. Requirements indicated in this document are minimum and indicative only. Employer may, at any stage of the project, add further requirement or alter these requirements on above aspects of the project management and contractor shall adhere to all such requirements without any kind of resistance / claim of whatsoever nature.

#### **13.2 Key Dates and timelines:**

Contractor shall, at all times, put all their efforts to adhere to the project timelines and key dates defined in the project schedule. Contractor shall provide to Employer information about status of and issues related to such key dates during various project progress reporting.

Over all completion timelines for this package is **12 months** from effective date of contract. Contractor shall prepare detailed project schedule based on provided timeline.

#### **13.3 Contractor's deliverables:**

This clause is pertaining to contractor's deliverables. Contractor shall submit various kinds of deliverables during execution of the project for Employer's approval / review / records etc. purpose. Contractor shall submit all the deliverables as specified by Employer in this tender document without any deviation.

#### **13.4 Level of schedules:**

Contractor shall prepare integrated project schedule in MS Project Latest version software. Contractor shall share native file of the project schedule with Employer minimum on monthly basis. Contractor shall prepare the schedule based on schedule hierarchy agreed with Employer.

As a general guideline, contractor shall prepare milestone level L1 schedule and submit the same for Employer's review within 15 days of award of the contract. Milestone level L1 schedule should be submitted to Employer at least 2 days prior to the project kick off meeting. Contractor shall prepare Early Work Schedule covering various activities including mobilization, infrastructure setup, approvals, engineering, procurement and construction function to be taken up for immediate execution till next level (L3) of schedule is finalized. Early Work Schedule will form the basis for project monitoring till next level of schedule is in place. Contractor shall prepare and submit Early Work Schedule for Employer's review within 15 days of kick off meeting.

Contractor shall prepare WBS level L2 schedule within 15 days of kick off meeting and submit the same for Employer's review. Contractor shall prepare activity based L3 schedule within 60 days of kick off meeting and submit the same for Employer's review. Contractor shall prepare activity level, quantity loaded L4 schedule within 90 days of kick off meeting and submit the same for Employer's review.

### **13.5 Milestones – project & interface**

Overall completion timelines for this package is 12 months from effective date of contract. Various milestones shall be defined for this package. As a minimum requirement, 3 to 4 key milestones per month covering Engineering, Procurement, Construction and Commissioning activities should be defined, monitored and reported by the contractor during all kind of progress reports / review meetings. Contractor shall prepare their details project schedule based on these key dates.

Apart from these milestones, a detailed milestone schedule shall be prepared and agreed upon for facilitating monthly payments to the contractors against various monthly milestones. LD shall be applicable for not achieving milestones defined which a separate LD milestone schedule shall be prepared and followed.

Apart from these milestones, contractor shall identify key interfaces for the project. These interfaces should include all internal as well as external interfaces of the project. Interfaces should be captured in sample interface management document enclosed with this section, monitored by contractor on continual basis and reported to Employer on monthly basis as minimum. Interfaces shall be reviewed by Employer during various review meetings. All major interfaces should be captured by contractor in the project schedule.

### **13.6 Engineering schedule**

Contractor shall prepare and submit detailed engineering schedule listing all applicable deliverables for the project. All deliverables shall be further broken down into various progress milestones. Each milestone shall be having Plan, Actual and Forecast dates. DCI shall be updated and submitted to Employer on weekly basis. Contractor shall provide forecast dates for all backlog and future milestones. Format for DCI shall be provided by Employer upon award of contract.

### **13.7 Procurement schedule**

Contractor shall prepare and submit detailed procurement schedule listing all service orders and material order which are required to be issued to complete the scope of work assigned. All orders shall be further broken down into various progress milestones. Each milestone shall be having Plan, Actual and Forecast dates. Procurement schedule shall be updated and submitted to Employer on fortnightly basis. Contractor shall provide forecast dates for all backlog and future milestones. Format for procurement schedule shall be provided by Employer upon award of contract.

### **13.8 Construction schedule**

Contractor shall prepare and submit detailed construction schedule listing all packages, structures and substructures for all disciplines for complete scope of work. These packages, structures and substructures shall be further broken down into various associated construction activities. Quantity based weekly liquidation chart for all construction activities shall be prepared for progress computation and monitoring. Construction schedule shall be updated and submitted to Employer on weekly basis. Contractor shall provide forecast dates and catch up plans for all backlog activities on monthly basis.

### **13.9 Planning and schedule control:**

Contractor shall prepare detailed integrated activity level project schedule covering all aspects of the project (i.e. preconstruction activities, approvals, interfaces, engineering, procurement, construction, pre-commissioning, commissioning and handover etc.) in MS Project software with latest version.

As a mandatory requirement, contractor will not modify / alter integrated project schedule once approved by Employer without written consent of Employer. Schedule approved by Employer shall be the basis for project monitoring / review by Employer.

Integrated MS Project schedule shall be updated, as a minimum requirement, on monthly basis and updated schedule shall be shared with Employer in native file format. Upon updating the progress in integrated project schedule, contractor shall also provide critical path for the project schedule. Contractor shall provide detailed root-cause analysis for activities on critical path along with their impact of overall project schedule; catch up planning with resource management, forecast dates etc. and the same shall be discussed with Employer.

### **13.10 Progress measurement and control, weightages:**

Contractor shall adopt a Progress Measurement Philosophy and weightages for various functions and activities as per guidelines given by Employer. In general, weightages of Engineering, Procurement and Construction function in the overall project weightage shall be 10%, 50% & 40% respectively. Engineering weightage shall be further divided into disciplines and deliverables based on criticality and efforts. Procurement weightage shall be further divided into various packages and bought out items based on criticality and value. Construction weightage shall be further divided into various packages, structures and sub structures based on criticality and efforts. Contractor shall finalize above weightages and the same shall be submitted to Employer along with their basis for Employer's approval. Approved weightages shall be used for computing and reporting progress of the project. Project progress computed based on approved progress measurement philosophy shall be included in the monthly progress report.

### **13.11 Reporting:**

Project reporting includes various kinds of report to be generated time to time on predefined periodic frequency basis for monitoring and reporting of the project status, risks, issues etc. Contractor shall adhere to standard project reporting philosophy approved by Employer. Contractor shall submit various kinds of progress report in native / editable format.

A list some of the formats is appended below for contractor's ready reference. Contractor needs to follow the same during executing of the project. The list is indicative, non-exhaustive and shall be reviewed / amended during execution of the project based on the project requirement. Employer can ask contractor to provide various additional status reports / data at any stage of the project as per project requirement.

Sr. No.	Template Name
	<b>Project Management</b>
1	Project Management Plan
2	Risk Management
3	Progress measurement philosophy - Weightage distribution
4	Project Review Calendar
5	Weekly project report
6	Detailed Monthly Project Progress Report
7	Milestone, L3/L4 Project Schedule on Monthly Basis.
8	Plan Vs Actual Payment Milestone Schedule Monthly Basis.
	<b>Engineering</b>
9	Document Control Index
10	Engineering Status Report
	<b>Procurement</b>
11	Material requirement list
12	Procurement status report
13	Procurement expediting report
14	Bulk material status report
	<b>Construction, Pre-commissioning, Commissioning</b>
15	Contractor DPR format
16	Equipment deployment plan
17	Manpower deployment plan
18	Commissioning plan
19	Project close out report



- All daily reports shall be submitted to Employer before 11:00 am of the following day
- All weekly reports shall be submitted to Employer before 11:00 am of following Monday
- All monthly reports shall be submitted to Employer before 11:00 am of 2<sup>nd</sup> of every month.

### **13.12 Document numbering**

Contractor shall adopt Employer's standard document numbering system for all the project deliverables. All deliverables being submitted to Employer shall bear document numbering as per given numbering system, not adhering to the same may call for disapproval of the deliverable by Employer. Employer's document numbering system shall be shared with contractor for implementation in the project upon finalization of the contract. The contractor shall be given the Employer's standard Drawing Title Block (template) wherein the contractor shall incorporate Employer's document number as well as Contractor's document number, if any.

### **13.13 Document tracking and control**

Employer recognizes that effective and consistent document tracking and control system are extremely important for the project. Contractor shall maintain proper document tracking and control set up for easy and timely tracking and retrieval of various project documents. Contractor shall demonstrate such document tracking and control system to Client during kick off meeting. As a standard operating procedure, contractor shall adopt following document submission procedure for smooth tracking of the documents.

The Contractor shall submit all the project related deliverables such as drawings and documents to the Document Controller, who in turn shall distribute to the respective internal engineering discipline personnel. The details of document controller shall be informed to the contractor during kick-off meeting.

All the initial submissions for the purpose of comments / approval, the contractor shall submit the documents in soft copy (pdf format). Once the documents are approved, the contractor shall submit requisite number of hard copies which shall be finalised at the time of kick-off meeting. In case of soft copy requirement in auto cad or any other native format as applicable by Employer on a case to case basis, the same shall be provided by the contractor.

Once the project is completed, the contractor shall submit the requisite number of final documentation in soft & hard copies, which includes QC dossiers (containing all approved QAPs, drawings, test reports, inspection reports, material despatch clearance certificates etc.) along with equipment installation manuals, whichever is applicable. The same shall be intimated to the contractor at a later stage.

Similarly the contractor shall intimate their single point contact person to Employer during kick - off meeting, so that the document controller shall interact with him on a regular basis to expedite the drawing / document submission / approval.

### **13.14 Reviews**

Project progress shall be reviewed by Employer at predefined periodic frequency basis. Contractor shall provide all relevant data and detail information to Employer before such reviews to the satisfaction of Employer. Over and above Employer review, contractor shall conduct their internal review sessions at predefined periodic frequency basis.

Contractor shall prepare a Project Review Calendar and submit the same to Employer for approval.

Contractor shall perform internal periodic reviews as defined in the Project Review Calendar. All project reviews shall be conducted based on set agenda and record notes of all such internal / external reviews shall be circulated to all concerned stake holders including Employer.

As a minimum requirement, following periodic reviews shall be conducted for the project. Employer at any stage of the project, depending upon the project requirement, may call for further reviews.

**Contractor's internal review**

- Engineering –Weekly
- Procurement –Weekly
- Construction –Daily
- Cross functional – Fortnightly
- Pre-commissioning –Daily
- Commissioning –Bi Daily

**Employer review**

- Engineering –Weekly
- Procurement –Weekly
- Construction –Daily
- Cross functional – Fortnightly/Monthly
- Pre-commissioning –Weekly
- Commissioning –Weekly

## **14. SITE REGULATION**

### **14.1 Objective**

Object of this section of the tender document is to indicate Employer's minimum requirement in terms of Site Regulations, Construction, Pre-commissioning and Commissioning activities during execution of the project. Requirements indicated in this document are minimum and indicative only. Employer may, at any stage of the project, add further requirement or alter these requirements on above aspects of the site management and contractor shall adhere to all such requirements without any kind of resistance / claim of whatsoever nature.

### **14.2 Site Correspondence**

All site related correspondence should be addressed to Employer's designated Project Manager / Area Manager as per communication matrix.

### **14.3 Procedures for the Construction Site**

#### **18.1.1 Contractor's general obligations during construction**

At all times the contractor shall keep itself familiarized with the terms and conditions imposed on or applicable to Deendayal Port Authority in relation to the existing Bulk Terminals, whether by any Government Authority or by any other person. The contractor will keep himself familiarized with the design and layout of the Bulk Terminal and the Project Facilities, the various Equipment used / to be used in the Bulk Terminal and the climatic and hydrological conditions affecting the Deendayal Port, Kandla Area or Port Limits or developing around the Port Area or Port Limits, or any Force Majeure Event affecting or threatening the Bulk Terminal, the Port Limits. The contractor may obtain all such information during site visit before submission of offer.

Ensure co-ordination with all staffs, operators, personnel and / or sub-contractors of ancillary services to ensure that the incoming and outgoing cargo at the Bulk Terminal and incoming and outgoing vessels at the Bulk Terminal are able to proceed seamlessly with minimum interruptions and within the timelines agreed for such movement in the Operations, Maintenance, Safety and Performance Standards. The Contractor shall ensure that appropriate systems, checks and balances are ensured and regular training of personnel is undertaken to eliminate any damage to, and/or theft. Detail Coordination procedure required for smooth execution of project & operations shall be finalized with user during Kick-off meeting.

Ensure nil disturbances to all employees / agencies engaged in the running of existing port or project facilities. Minimize disruption to traffic in the event of accidents or other incidents affecting the safety and use of the Project Facilities by providing a rapid and effective response and maintaining liaison with emergency services of appropriate agencies, including any Government Authority and neighbouring ports.

Extend all co-operations to all Persons representing any Government Authority, or any lender of Employer or any Person authorized by Employer in any site visits, inspections, or discussions.

## **14.4 Organization of the Construction Site**

### **14.4.1. Contractor's Organization**

Contractor shall deploy manpower as per work involvement. Manpower deployed by contractor should have sufficient relevant educational qualifications and experience. Contractor shall submit the organization chart for manpower to be deployed for the project assignment along with curriculum vitae of key personnel along with bid document for Employer's review and approval.

### **14.4.2. Subcontractor's Organization**

Contractor shall submit list of proposed subcontractors along with their credentials in bid document. Contractor shall obtain Employer's approval for any subcontractor prior to the deployment on project assignment.

### **14.4.3. Site Meetings**

In general, site meetings shall be conducted on daily basis for reviewing the progress of day to day site activities. In addition to daily meetings, weekly, fortnightly and monthly review meeting shall be conducted for review of progress with respect to specific planned activities and milestones.

### **14.4.4. Daily Reports**

Contractor shall provide Daily Progress Report (DPR) in the format approved by Employer. DPR shall cover all the areas / structures / fronts of the construction activities.

### **14.4.5. "Kick-off" Meeting**

Apart from project kick off meeting, a separate site kick off meeting shall be conducted at project site. Timeline and agenda for the same shall be decided after award of contract.

## **14.5 Construction Commencement**

Commencement of construction activities should be strictly as per milestone schedule. Contractor to ensure mobilization of adequate resources and infrastructure set up is done as per plan before commencement of construction activities.

## **14.6 Constructability Study**

Contractor should ensure that constructability aspect is taken care during engineering stage. This should be ensured by involvement of contractor's as well as Employer's construction team during finalization of various construction drawings. Apart from regular interactions with construction team during engineering stage, a planned meeting between engineering and construction team should at regular interval of engineering completion.

## **14.7 Site Access**

### **14.7.1. Site Access for Vehicles**

The work site is located in a high security area that is controlled by the Port Security Division. All are to respect/ obey the Deendayal Port Authority security policy. Contractor's vehicles shall be provided access to required areas only and permission for the same need to be obtained from authorities

### **14.7.2. Site Access**

Deendayal Port Authority (DPA) being operational site, contractor need to ensure that there are no hindrances to operational activities. Contractor to provide barricading of required nature around their battery limit / work area. Contractor shall be provided free access to their working areas only. Contractor shall issue identity cards to their staff / workers to ensure proper safety of the Port.

On arrival at DPA, the contract employees will be expected to pass through the company's security screening procedure. The contractor shall arrange the gate pass for all the contract labours with the help of the department head and the Security Officials of the Port. No person will be allowed to work without valid gate pass. Before leaving site they will be required to once again pass through the security screen.

It is mandatory to obtain police verification of all employees and workers prior to their involvement in the work. The contractor shall surrender to the Pass Issuing authority all the gate passes issued for a particular job after completion of the job. And no payment will be made to any contractor(s) who fail to comply with this.

DPA reserves the right to search any vehicles, person or property, on a random basis, whilst entering on or leaving DPA premises including the Contractor's personnel, vehicles or property.

#### **14.7.3. Material and Equipment Delivery and Return**

Contractor shall follow DPA's rules and regulations prevailing time to time for entry and exit of various constructions and enabling materials.

#### **14.8 Mobilization**

Contractor shall provide detailed site mobilization and infrastructure set up plan to client within 30 days of award of contract. As a minimum requirement, mobilization and infrastructure set up plan should include manpower, plant & machinery etc. Contractor should also submit proper plan for demobilization of various resources as required.

#### **14.9 Construction Site**

Construction site will be provided to contractor on as is where basis is. Contractor shall develop the site as per his requirement.

##### **14.9.1. First-aid Room, First Aid, Ambulance**

Contractor should set up adequate medical / first aid and ambulance facilities for their staff / workers as per prevailing regulations.

##### **14.9.2. Site Lighting / Illumination**

The contractor shall in connection with the works provide and maintain at his own cost all lights, guards, fencing and watching when and where necessary or as required by the Project Manager / Area Manager for the protection of the workers or for safety and convenience of the public or others. The contractor shall be responsible for all damages and accidents caused due to negligence in this regard.

It will be the entire responsibility of the contractor to protect the work(s) carried out by them including the fittings, fixtures and other accessories provided by them till the entire work is satisfactorily handed over to the Employer.

##### **14.9.3. Contractor's Site Facilities and Site Offices**

Contractor shall set up adequate site facilities required for timely execution of the project at designated area provide by Employer. Upon completion of the work, contractor should ensure that no debris left out at site of work. All debris shall be disposed-off in the manner advised by the Project Manager / Area Manager, within 15 days from the date of completion of the work of each area. In case the contractor fails to comply with the requirements of this clause, the Employer shall have the right to get this work done at the cost and risk of the contractor. Before taking such action, Employer will give seven days' notice in writing to the contractor.

##### **14.9.4. Canteen Facilities, Drinking Water, Urinals**

Contractor shall set up and operate at its own cost, necessary canteen, drinking water and urinal facilities for their staff and workers.

#### **14.10 Erection Equipment, Implements and Erection Aids**

All erection equipment, implements and aids used shall comply with applicable safety rules and regulations.

#### **14.11 Communication Facilities**

Contractor at its own cost shall set up adequate communication facilities for effective and hassle-free communication at work site during execution of the project.

#### **14.12 Storing and Disposing of Hazardous Substances**

Any hazardous material being stored, handled or disposed-off by contractor should follow applicable rules and regulations of respective authority / DPA.

#### **14.13 House Keeping**

Contractor shall ensure proper housekeeping are maintained at all the work places and site office at all the times. All unwanted material lying in and around work site should be removed and stored properly at designated location.

#### **14.14 Delimitation of Erection Areas**

Contractor should ensure necessary demarcations / barricading, required safety precautions at the erection areas at all times as instructed by Project Manager / Area Manager.

#### **14.15 Obstructions by Others**

DPA being operational port, there may be obstruction by other agencies operating at the port / project site. Contractor should co-operate with Employer / other agencies in this regard.

#### **14.16 Damage**

The contractor shall be responsible for any damage of property or loss of life happens due to the act of contractor's negligence. The contractor shall make good at his own expense all losses or damages whether the loss happened to the Contractor itself or DPA / DPA employed any other agency. DPA is not responsible for any loss of life or property whatsoever may be the cause in connection with or as a result of the execution of works until the completed work has been taken over by DPA. Any cost and compensation towards loss or damages (including that payable under the provisions of the Workmen's Compensation Act or any statutory amendments thereof) to any person or persons sustaining damage because of the contractor are to be borne by the contractor.

#### **14.17 Scaffolding**

Scaffolding includes raised platforms and related structures for holding workers and/or materials. The complete scaffolding material supply (As applicable) and erection & dismantling of scaffolding with necessary resources will be under the scope of the contractor. No final certificate of completion shall be issued, nor shall the work be considered to be completed until the contractor shall have removed from the premises on which the work shall be executed, all scaffolding, required for his/their work.

#### **14.18 Protection of existing infrastructure**

DPA being operational port, contractor should ensure to protect all existing infrastructure and facilities of the operational port / project site. In case of any damage to such facilities, contractor shall be responsible for repair / replacement of the same at its own cost and risk.

#### **14.19 Working Hours**

From the commencement of installation of the Facilities at the Site until Operational Acceptance, the Contractor's Representative shall appoint a suitable person as the construction manager (hereinafter referred to as "the Construction Manager"). The Construction Manager shall supervise all work done at the Site by the Contractor and shall be present at the Site throughout normal working hours except when on leave, sick or absent for reasons connected with the proper performance of the Contract. Whenever the Construction Manager is absent from the Site, a suitable person shall be appointed to act as his or her deputy.

Contractor shall follow the normal shift working hour norms prevailing at DPA. However, contractor, if wishes to work for extended hours / round the clock basis, shall inform DPA in writing and obtain permission from relevant authorities in advance.

The Employer may by notice to the Contractor object to any representative or person employed by the Contractor in the execution of the Contract who, in the reasonable opinion of the Employer, may behave inappropriately, may be incompetent or negligent, or may commit a serious breach of the Site regulations provided in tender document. The Employer shall provide evidence of the same, whereupon the Contractor shall remove such person from the Facilities. If any representative or person employed by the Contractor is removed in accordance with this clause, the Contractor shall, where required, promptly appoint a replacement.

Contractor shall follow holiday calendar issued by Employer time to time. Contractor shall intimate Employer in written about any kind of holiday being observed by contractor's site team well in advance.

#### **14.20 Labour Laws**

The contractor shall ensure strict compliance with all labour related laws & acts not limited to the followings. DPA has the rights to ask for all relevant documents related to these laws. In case of non-compliance contract is liable for termination.

- The Contract Labour Regulation & Abolition Act 1970.
- The Payment of Wages Act 1936
- The Minimum Wages Act 1948
- The Bonus Act 1965
- The Provident Fund & Miscellaneous Act 1952
- The Gratuity Act 1972
- The Industrial Dispute Act 1947
- Industrial Establishment (National & Festival Act) 1969. EPF Act 1952 EPS (Employee Pension Scheme) -1995, Minimum Wages Act 1948.
- Indian Labour Act
- The Public Liability Act, 1991
- Public Liability Insurance Act, 1991

#### **14.21 Damage to property or loss of life**

The contractor shall be responsible for any damage of property or loss of life happens due to the act of contractor's negligence. The contractor shall make well at his own expense all losses or damages

whether the loss happened to the Contractor itself or DPA / DPA employed any other agency. DPA is not responsible for any loss of life or property whatsoever may be the cause in connection with or as a result of the execution of works until the completed work has been taken over by DPA. Any cost and compensation towards loss or damages (including that payable under the provisions of the Workmen's Compensation Act or any statutory amendments thereof) to any person or persons sustaining damage because of the contractor are to be borne by the contractor.

#### **14.22 Erection (method statement) / Installation of Materials and Equipment**

Contractor shall follow all safety regulations / guidelines imposed by DPA or any other regulatory authority time to time. Contractor should submit method statement for all erection / installation activities and obtain Employer's approval for the same before erection / installation work.

#### **14.23 Work Safety Regulations**

##### **14.23.1. Construction Site Emergency Response Plan**

Following safety regulations of the Port are mandatory & in case of non-compliance the contract shall be terminated.

- a) Personal Protective Equipments to all workmen shall be provided by the contractor.
- b) Speed limit of 30KMPH should be ensured.
- c) No mobile phones to be used by any employee during working & driving.
- d) In respect of all labour, directly or indirectly employed in the work for the performance of Contractor's part of this agreement, the contractor shall at his own expense arrange for all the safety provisions as per;
  - The Dock Workers (Safety, Health & Welfare) Regulations/act.
  - The Electricity Act
  - The Motor Vehicle Act
  - Labour Laws and Regulations,
  - The Building & other construction workers (Regulation of employment & Conditions of service) act 1996 & rules 1998 as applicable.
  - Workmen compensation act.
  - The gas cylinder rules
  - The hazardous wastes Rule
  - The environment protection Rule & Act
  - Safety Code of DPA and Rules and order made there under and such other acts as applicable. The contractor may obtain the document/ information during site visit.
  - Rules & Orders made there-under
- e) The Contractor shall observe and abide by all fire and safety regulations of the DPA. Before starting any work, contractor shall consult DPA's Safety Department & Engineer In-charge.
- f) The contractor shall ensure that all equipment, plant, machinery and apparatus brought onto or used on the port is safe and without risk to health, safety, or the environment and is



maintained to an acceptable standard. All necessary test and examination certificates must be available for inspection at all times.

- g) DPA retains the right to stop any construction activity or erection of plant/equipment etc., if it is considered that there is a hazard to the safety and health of site personnel (or others) or the possibility of environmental or ecological damage.
- h) Contractor shall abide the Safety code provision as per Dock Workers (Safety, Health & Welfare) Regulations, ILO code of practice (Safety & Health in Port), Indian Standard Safety & DPA safety Code framed from time to time.

#### **14.24 Acceleration / Recovery Measures**

Contractor shall, in case of any back log in the project progress with respect to plan, prepare a detailed catch up plan for accelerating the progress with proper back up for adequate resource and material planning. Such catch up plan shall be finalized in consultation with Employer and progress of such catch up plans shall be reported to Employer on regular basis.

#### **14.25 Tests, Inspections, Acceptance Tests**

##### **14.25.1. Performance of Tests and Inspections**

The Contractor shall at its own expense carry out at the place of manufacture and/or on the site all such tests and/or inspection of the Plant and Equipment and any Part of the facilities as are specified in the contract. The employer and the Project Manager / Area Manager or their designated representatives shall be entitled to attend the aforesaid test and/or inspection, provided that the employer shall bear all costs and expenses incurred in connection with such attendance including, but not limited to, all travelling and boarding & lodging expenses.

The Project Manager may require the Contractor to carry out any test and/or inspection not required by the Contract, provided that the Contractor's reasonable costs and expenses incurred in the carrying out of such test and/or inspection shall be added to the Contract Price. Further, if such test and/or inspection impede the progress of work on the Facilities and/or the Contractor's performance of its other obligations under the Contract, due allowance will be made in respect of the Time for Completion and the other obligations so affected.

##### **14.25.2. Notification**

Whenever the Contractor is ready to carry out any such test and/or inspection, the Contractor shall give a reasonable advance notice of such test and/or inspection and of the place and time thereof to the Project Manager. The Contractor shall obtain from any relevant third party or manufacturer any necessary permission or consent to enable the Employer and the Project Manager (or their designated representatives) to attend the test and/or inspection.

##### **14.25.3. Documentation of Test and Inspection Results**

The Contractor shall provide the Project Manager with a certified report of the results of any such test and/or inspection. If the Employer or Project Manager (or their designated representatives) fails to attend the test and/or inspection, or if it is agreed between the parties that such persons shall not do so, then the Contractor may proceed with the test and/or inspection in the absence of such persons, and may provide the Project Manager with a certified report of the results thereof.

##### **14.25.4. Deviations**

If any Plant and Equipment or any part of the Facilities fails to pass any test and/or inspection, the

Contractor shall either rectify or replace such Plant and Equipment or part of the Facilities and shall repeat the test and/or inspection upon giving a notice.

#### **14.25.5. Acceptance**

Acceptance of any / all items / structures / substructures / assets shall be based on technical specifications and other parameters indicated in relevant sections of this tender document. Contractor shall adhere to acceptance procedure indicated in relevant sections of this tender document or issued by Employer time to time.

#### **14.25.6. Final Check List**

Contractor shall adhere to the final check list format as provided by Employer time to time.

#### **14.26 Idle Time and Lost time**

Deendayal Port Authority being operational port, contractor shall plan his various construction activities at micro level in consultation with Employer for smooth execution. Any idle or lost time claim of whatsoever nature / type from contractor shall not be entertained by Employer.

#### **14.27 Exceptionally Adverse Weather**

Deendayal Port Authority being located on western coast and prone to cyclones and other adverse weather conditions, contractor shall take appropriate measures for safety and security of all materials and properties during such conditions. Contractor shall adhere to instructions issued by DPA authorities during such conditions.

#### **14.28 Demobilization**

Contractor shall prepare demobilization plan for various resources like manpower, plant & machinery etc. and submit the same for Employer's review. Such demobilization plan shall be reviewed by Employer on periodic basis. Contractor shall adhere to all procedures prevailing at DPA time to time for taking resources out of DPA premises.

#### **14.29 Expediting and Progress Control by Contractor**

Contractor shall adopt a robust mechanism for expediting the progress whenever there is a backlog with respect to planned progress. Contractor shall prepare a detailed catch up plan indicating resource and material allocation and monitor & report to Employer progress of such catch up plan on regular basis.

#### **14.30 Quantity Surveys, Verification of Services, Invoices**

Contractor shall deploy adequate manpower in terms of quantity surveying, verification of completed work and processing of contractor's invoices for smooth, hassle-free and timely processing of various invoices.

#### **14.31 Pre-commissioning**

As soon as installation of the Facilities or any part thereof has, in the opinion of the Contractor, been completed as specified in the Technical Specifications, excluding minor items not materially affecting the operation or safety of the Facilities, the Contractor shall so notify the Employer in writing. After checking of such facilities by Employer's representative and attending punch points raised by him, contractor shall obtain Employer's permission for pre-commissioning of such facility and commence pre-commissioning of the Facilities or the

relevant part thereof in preparation for Commissioning. Contractor shall follow guidelines provided in other sections of this tender document for detailed pre-commissioning procedure. A detailed plan and procedure for pre-commissioning activities shall be prepared by contractor as per guidelines given by Employer and submit the same for Employer's approval and follow the same during pre-commissioning stage.

#### **14.32 Commissioning**

As soon as all works in respect of Pre-commissioning are completed and, in the opinion of the Contractor, the Facilities or any part thereof is ready for Commissioning, the Contractor shall commence Commissioning of the facilities. As soon as Commissioning is satisfactorily completed, the Contractor shall so notify the Employer in writing. Commissioning of the Facilities or any part thereof shall be completed by the Contractor as per procedures detailed in the Technical Specifications. Contractor shall follow guidelines provided in other sections of this tender document for detailed commissioning procedure. A detailed plan and procedure for commissioning activities shall be prepared by contractor as per guidelines given by Employer and submit the same for Employer's approval and follow the same during commissioning stage.

## **15. HEALTH SAFETY AND ENVIRONMENT**

The Bidder shall establish the construction HSE Plan in line with the Employer's HSE Policy requirements including the content detailed below which essentially cover the following:

- a) Construction Site HSE Plan
- b) Construction Site Emergency Response Plan
- c) HSE Project Strategy
- d) Applicable Legal & Regulatory requirements

The Bidder shall prepare the draft HSE Plan and submit the same to the Employer's HSE team for validation & approval.

Review /approval of the HSE Plan (for his scope of work) by the Employer shall not dilute the responsibility of the Bidder for adherence to any of the legal & regulatory requirements during execution and or the HSE policy requirements from time to time.

### **15.1 HSE POLICY, STANDARDS AND OBJECTIVES**

#### **15.1.1. Project HSE Policy**

The HSE policy of the Employer contains the overall intentions and directions of Top Management with regards to HSE Management system implementation and is approved by Top Management.

**The Bidder shall establish the HSE Policy in line with employer policy.**

#### **15.1.2. Project HSE Standards, PPE, Waste Management & House keeping**

##### **15.1.2.1. Performance Standards**

Project HSE standards are to be established for the project Site by the Bidder in line with requirements & the scope of work awarded, each person undertaking work at project Site must work to meet the standards outlined in the Project HSE Plan submitted by the Bidder before award of Contract to protect himself from hazards and risks associated with project activities.

The specific safety standards applicable to are indicative and are for the Bidders reference and are not limited to:

- a) The Building and Other Construction Workers Act 1996 & The Building and Other Construction Workers Rules 1998
- b) Indian Electricity Act (amendment) 2004 &
- c) The Indian Electricity Rules, 1956
- d) Central Motor Vehicles Act 1988 &
- e) Central Motor Vehicles Rules, 1989 /amended 2001
- f) The Environment (Protection) Act 1986 amended 1991 &
- g) The Environment (Protection) Rules 1986, amended 2004
- h) Hazardous Wastes (management, handling and trans-boundary movement) Rules 2008 / 2009

- i)** The Air (Prevention and control of Pollution) Act, 1981
- j)** The Water (Prevention and Control of Pollution) Act, 1974
- k)** The Chemical Accidents (Emergency Planning, Preparedness & Response) Rules, 1996 / 2000
- l)** Manufacture, Storage and Import of Hazardous Chemicals Rules 1989
- m)** Noise Pollution (Regulation & control) Rules, amended 2010
- n)** The Batteries (management & handling) Rules 2001 / amended 2010
- o)** Biomedical Waste (management & handling) Rules 1998 / amended 2003
- p)** The Explosive Act 1884. & The Explosive Rules, 1983.
- q)** The Explosives substance Act 1908.
- r)** The Static and Mobile Pressure Vessel (unfired) Rules, 1981
- s)** The Gas Cylinder Rules 1991, amendments 2004.
- t)** The Petroleum Act 1934 & Petroleum Rules 1976
- u)** The Public Liability Insurance Act 1991
- v)** The Workmen's Compensation Act 1923
- w)** The Contract Labour (Regulation & abolition) Act, 1970
- x)** The Child Labour (Prohibitions & Regulations) Act, 1986 and Rules 1950
- y)** The Minimum Wages Act, 1948 and Rules 1950
- z)** Employee State Insurance (Central Rules), 1950
- aa)** The Recycled Plastic Usage Rules, 1998
- bb)** Notification, Central Ground Water Board, Act January 1997
- cc)** Notification on Control of Noise from Diesel Generator (DG) sets, 2002
- dd)** Notification on Fly ash utilization, Sept 1999 as amended in August 2003
- ee)** National Building Code, 2005
- ff)** Indian Road Congress Code IRC: SP: 55-2001 'Guidelines on Safety in Road Construction Zones
- gg)** OSID - Guidelines 156 (Oil industry Safety Directorate), Fire Protection Facilities for port oil terminals.
- hh)** Guidelines Fire Advisor, CCE & DG FASLI, Government of India.
- ii)** National fire Codes (National Fire Protection Association -USA)
- jj)** Drill manual for the Fire Service of India.
- kk)** ISPS (International Ship & Port Facility Security) code (2003 Edition)

#### 15.1.1.1 International Standards, Guidelines & Certifications

- a) The works should be undertaken in accordance with the applicable international guidelines, standards and specifications on IMS.
- b) The important Indian Standards and British Standards as applicable to the work of the specific Contract.
- c) Bidder shall participate and comply for requirements asked by owner to fulfil Integrated Management System requirements.
- d) Every Contractor shall aim to achieve certifications listed below during the execution:
- e) OHSAS 18001:2007 Occupational Health and Safety Management System and / or
- f) ISO 14001:2004 Environment protection standard

#### 15.1.1.2 Personnel protective equipment

The Bidder at all times should keep & maintain adequate supply of suitable standard (IS) personnel protective equipment which shall be readily available for use at all times at Site which shall include among others the following items

- a) Safety helmets
- b) Hearing protections
- c) Respiratory protections
- d) Eye protections
- e) Protective gloves
- f) Safety Footwear
- g) High visibility clothing
- h) As guided by product manual and MSDS

Minimum PPEs applicable at Site would be hard hat, safety boots and high visibility clothing; Bidder must keep sufficient stock to issue to all workmen & staff including the visitors.

The Bidder shall ensure to maintain PPE standards at Site and defaulter must be removed from the Site.

#### 15.1.1.3 Waste Management and Environmental Standards

The Bidder shall ensure the impact of waste on the environment shall be minimized firstly by elimination, otherwise by recycling and reuse or finally by treatment and disposal.

The details of the waste management process shall be defined clearly by the Bidder and followed for his scope of work and shall be in line with legal requirements and policy.

The Bidder shall ensure that at the end of each shift, or on task completion it is the responsibility of each line supervisor to ensure that all scrap material has been collected in dustbins / scrap containers. Bidders shall arrange for collection and safe disposal of waste / scrap generated in their respective work area.

#### 15.1.1.4 House Keeping:

**Cable Management (Power and IT):** Bidder's Construction Manager shall ensure & make provision for the routing and support of cables and hoses in use in each area. The endeavour is to keep all walkways and access ways clear and free from trip hazards. For Mechanical/Electrical phases of the project, facilities will be placed that enable all temporary cables to be strung out in a safe manner.

The Bidder shall ensure basics of housekeeping by creating awareness & deploying the 5 S concept, in brief housekeeping means a place for everything and everything in its place in an orderly manner.

Good housekeeping practices are an essential safety function that contributes to efficient operations, better productivity and reduction in accidents, improving the environment and enhancing workers moral.

**Other Aspects of House Keeping, which need to be ensured by the Bidders' are:**

- a) Keep the work place clean and orderly at all times.
- b) No pipe line, power cable or hoses shall run across path ways thus creating a tripping hazard.
- c) Unwanted materials should be removed from workplace.
- d) Oil rags, cloths soaked in oil should be put into waste bins/drums provided in work Site. Separate bins/drums are provided at Site for segregating the waste. Use them properly.
- e) Do not leave tools, tackles, nuts, bolts and other equipment in walkways, staircases or any vulnerable place wherefrom it can fall or create trip hazard.
- f) Materials shall not be stored close to any edge of a floor, platform or on any opening of floor as to endanger persons below.
- g) Do not throw material from high elevation. Always lower it by means of a rope.
- h) Separate areas should be earmarked for storing gas cylinders, fuel and combustible items.
- i) Provide a tray to collect the leads of welding rod while welding at Site.
- j) Follow the procedure regarding stacking & Un-stacking of materials.
- k) Separate areas should be earmarked for storing gas cylinders, fuel and combustible items.
- l) Electrical systems shall be laid as per safe work methodology.
- m) Adequate firefighting facilities and equipment must be available in working condition at the Sites.
- n) Toilets should be maintained clean always.

#### 15.1.3. Project HSE Objectives

Project HSE objective is to achieve industry best HSE performance through the following which the Bidder shall ensure to implement for his scope of work:

- a) Apply a "zero tolerance philosophy" as the standard for health, safety and the environment.
- b) Continuously develop a HSE culture to reduce human error and focus on individual commitment, responsibility and accountabilities.

- c) Encourage open communication and employee participation in all activities related to improvement and fulfilment of all Health, Safety and Environmental issues.
- d) Seek continuous improvement to achieve “best practice”.
- e) Identify and analyze all hazards to personnel, working environment, external environment and Employer assets, initiate corrective actions and verify that corrective actions are effective.
- f) Maintain a system in compliance with statutory requirements,
- g) Ensure that a process of continual improvement is achieved through periodic objective setting, auditing and performance reviews.

Activity specific HSE Objectives can be established after reviewing the Hazard Identification and Risk Assessment. Identify the areas where there is a scope for improvement and establish HSE Objectives & Management programs.

The Bidder can use following guideword to establish HSE Objectives & Management program.

- a) **Eliminate:** Eliminate the hazards altogether or combat the risk at source, (Eliminate all hazardous events, usage of hazardous substances, unsuitable equipment).
- b) **Provision of Substitution:** Use of safe substances or defining the method statements defining alternative ways of carrying out field tasks to ensure safety.
- c) **Provision of Engineering Controls:** Machine guarding, proper platforms, acoustic enclosures, automation instead of manual operations.
- d) **Increase / Improvement:** Near miss reporting, awareness through training, use of personal protective equipment, compliments /awards incentives, appoint safety stewards across all the activities.
- e) **Sustain / Continue:** Work place inspections, Cross functional audits, Vendor audits. Periodic Campaigns and Safety Patrols.
- f) **Reduce:** Hazardous conditions, (e.g. Relating to slips/trips and falls), Exposure to hazardous substances. (Specify quantitative target with defined time frame).
- g) **Introduce:** Risk Assessments, Emergency Plan, Active Monitoring system, Work Permit system for specified tasks. Training etc. (Specify a date for achievement).

While establishing the objectives and programs the following is to be considered:

- a) Legal and other requirements
- b) HSE risks
- c) Technological options
- d) Financial requirements
- e) Operational and business requirements
- f) Views of interested parties
- g) Potential emergency situations



HSE Objectives shall be documented and shall indicate the time frame for achieving the targets. HSE Objectives and targets shall be Specific, Measurable, and Achievable and shall be in line with the HSE Policy.

HSE Objectives shall be established at relevant levels and functions depending upon the complexity and nature of activities involved along with the Employer's HSE Team.

Responsibility for achieving the Objectives shall be clearly specified and agreed upon by the Bidder and the Employer.

#### **15.1.4. Management Programs:**

Bidder's HSE team shall identify action plan for management program for each HSE objective identified along with Employer's HSE team.

- a) These programs shall clearly indicate the various action plans for achieving the defined objective, responsibility and timeframe for completion of each action plan.
- b) Programs shall be reviewed by Employer's Project Head and update the progress / status of action plans as may be relevant.
- c) Progress / Status of HSE objectives will be reviewed by Project Head along with Site Safety Head, concerned HODs/ area managers of both Bidder & Employer's side at least once in 6 months and the status of HSE objectives shall be discussed in the Management Review Meeting with representation from the Bidders team.

### **15.2 HSE Organization**

#### **15.2.1. Organization**

Bidder shall identify the Organization structure & get the same approved from the Employer's HSE team before award of the Contract which shall be relevant & depending up on the size & nature of the project Site & the Bidder's scope, The Bidder's Project Head will lead the Project Organization and Site safety Head will lead the Site Safety Organization.

#### **15.2.2. Roles and Responsibilities**

Bidder's Project Head has ultimate responsibility for Health, Safety and Environment with delegation to appropriate Functional Managers who are responsible to providing HSE leadership in their respective areas. They will ensure implementing program to satisfy HSE requirements of established HSE Plan.

Joint responsibilities of Site management:

- Provide leadership, resources and commitment
  - Promote safety and health awareness and motivation
  - Ensure risks are managed so as to bring within acceptable level
- a) Project Head has overall responsibility for HSE on project Site, Include:
- Ensure compliance with all relevant regulatory and legislative HSE requirements
  - Implement the project HSE policy objectives

- Identify legal responsibilities associated with the workplace activities
  - Providing HSE leadership promoting a HSE culture across the Project Site and driving continual improvement in the project HSE performance.
  - Coordinating the preparation and Implementation of the project safety plan.
  - Identify potentially hazardous activities of project Site and Implement appropriate procedures & controls.
  - Assigning and documenting written HSE responsibilities to all project personnel.
  - Ensure sufficient resources are provided to implement HSE programs, including Emergency response & evacuation.
  - Authorizing Project specific HSE procedures.
  - Participating in Project HSE meetings and programs and review the HSE plan.
  - Review of accident & incident reports, meeting minutes, HSE audit / Inspection reports for the Project.
  - Support Site team (including Department head, managers, supervisors etc.) for implementation of HSE plan.
  - Ensuring appropriate first-aid equipment and amenities at the Project Site are available and maintained.
- d) Bidder's Site Safety Head shall be responsible to the Project head for the implementation of HSE plan on project Site, Include:**
- Developing, implementing and continuously Improving HSE policies and systems.
  - Promotion of HSE awareness.
  - Monitoring and benchmarking HSE performance.
  - Driving continuous improvements in HSE performance through, for example, transfer of lessons learnt between other project Sites and adopting appropriate best practices.
  - Organize HSE Committee' meeting for reviewing safety performance of project.
  - Ensuring the HSE of all visitors to the Site.
  - Conducting HSE Induction program for all Site personnel & visitors
  - Ensuring appropriate HSE training is provided to all employees.
  - Assessing sub-Contractor compliance with HSE Plan.
  - Assessing sub-Contractor work practices and HSE performance.
  - Initiation of accident & incident investigation and maintain injury register.
  - Ensuring access is available to qualified HSE professional at all times and that the availability is known by all project personnel.
- e) HSE Supervisors shall be responsible to the Site Safety Head for the implementation of HSE**

plan on project Site, Include:

- Implementation of HSE Plan.
  - Promotion and stimulate high level of HSE awareness at all the time.
  - Assisting sub-Contractors and employees with the provision of HSE advise.
  - Assess the planned work for potential hazards in consultation with employees
  - Assisting in identification and preparation of project specific HSE procedures.
  - Participating in HSE meeting and HSE Programs.
  - Daily inspection of project activities and suggest corrective measures.
  - Take part in accident investigation.
- f)** Head of Departments shall be responsible to the Project head for the day to day operation of the project Site or delegated areas include.
- Understanding and assisting role of line management in the implementation of project HSE plan / other requirements.
  - Regularly identifying workplace HSE hazards and taking appropriate corrective measures.
  - Ensuring implementation of SOPs, HSE procedures and work permits.
  - Planning of work activities to ensure the identified hazards will be effectively controlled.
  - Reporting and investigating all incidents, accidents and near-misses.
  - Effectively communicating HSE requirements and procedures to all employees and Contractors.
  - Ensure appropriate additional controls where safety critical jobs are performed;
  - Reviewing with Project head and Site Safety head accident / incident investigation reports.
  - Reviewing with Project head and Site Safety head sub-Contractor compliance.
  - Participating in HSE meeting and HSE Programs.
  - Assisting inspection and auditing activities.
  - Ensuring safe plant and equipment is provided and maintained.
  - Maintaining records, documents, procedures, work instructions and other essential information e.g. MSDS at work place for easy reference.
- g)** The following additional personnel will also be responsible for ensuring compliance to Safety guidelines at Project Site:

Bidder's Construction Manager is the overall in-charge for execution of construction activities of the project and coordinates with various agencies. He has to ensure the practical implementation of the construction safety programme and will specifically be responsible for the following:

- Ensure that the safety resources provided on the project meet the needs of the project in terms of personnel and organization
  - Ensure that an effective co-ordination process exists between disciplines and other Contracting parties to ensure that all interface problems are recognized and resolved
  - Ensure that all employees have been made aware of their roles and responsibility with regard to this plan and the safe working requirements of the project construction work
  - All supervisory staff and workers are assigned on job after Safety induction and training.
  - Co-ordination of key construction personnel and their work activities, with endeavour of minimizing interface problems.
  - Attend and chair the construction safety committee meetings.
  - Ensure that a mechanism is in place for developing, reviewing and approving work method statements and risk assessments.
  - Personally review and approve all critical operations that have a high-risk potential e.g. heavy lifts.
  - Initiate investigation process of incidents/accidents occurring at Site to find out basic causes and remedial measures for implementation. He will approve all the FARs and implement remedial measures to prevent recurrence.
  - All such incidents /accidents and near miss cases shall be reported immediately latest by at the end of the shift to safety head in writing in established templates.
  - All major & fatal accidents are to be reported immediately to project head & the HSE head immediately.
  - Set a personal example and promote the enthusiasm necessary for providing a good safety performance
- h) Construction Engineers will be responsible for safety at Site for all jobs carried out under their supervision. They will ensure that all jobs are carried out after proper planning and establishing safe work methods based on risk assessment. They will have following responsibilities:**
- To organize an introductory meeting with major Contractors involving safety Department.
  - To ensure that Contractor's safety induction is done
  - To ensure safety induction / training of Contractor's supervisory staff and workers before assigning them on job
  - To review/approve risk assessments/work methods and execution plan for work being carried out in their area. They will authorize jobs under their supervision at construction Site and use work permit system

- Monitor various Site activities in their respective areas
  - Carry out weekly audits of the areas under their control with the Site Safety Department and liaise regularly with the safety officer/manager for joint inspections
  - To observe that approved procedures, proper work methods are used and proper tools /machinery are deployed by the Contractors and ensure safety compliance at work.
  - To co-ordinate with the safety department for safety meetings that involve personnel and supervisors working in their areas and attend safety meetings.
  - To participate in the investigation of any incident/accident that result in serious injuries or serious property damage occurring in areas under their control.
  - To set a personal example and assist in the proactive promotion of safety as a personal objective.
- i) Safety Inspectors (Site) shall be responsible to the Site Safety Head for the day to day operation of the project Site or delegated areas including:
- Assisting field HSE Supervisors and Contractors in safe execution of jobs.
  - Monitoring safety compliance at Site and ensure that corrective actions by area construction engineers/Contractors are taken.
  - Carrying out field inspections to identify unsafe conditions /unsafe practices and to get them corrected.
  - Keeping a record of activities and safety violations/unsafe conditions which are not corrected and follow up for compliance.
  - Participating in safety talks /tool talk programs at Site.
  - Validating and signing work permits/and checklists where applicable.
  - Interacting with Contractor workers and field supervisors to help them in promoting safe work practices.
  - Recording information/facts on incident/accident at Site, (if any) and reporting to the HSE Head (both Bidder & Employer).
  - Helping Site workmen in emergency response, in case of any emergency.
- j) Bidder shall nominate a rigging/Heavy Lift Manager who shall be working with the Construction Managers and will have the following responsibilities:
- Shall implement a system that evaluates and tests all cranes and lifting equipment being brought to Site.
  - Will keep a record of all certification of such lifting equipment used on Site.
  - Will establish a schedule of inspections for monitoring the cranes brought on Site.
  - Will evaluate the competency of equipment operators and where necessary they shall be removed or retrained.
  - Review and approve heavy lift plan.

k) Plant Operations Manager, will have the following responsibilities at the time of starting commissioning/start up activities:

- Ensure that all equipment, ready for Start-up are clearly marked and that controls are in place to ensure that unauthorized personnel are kept away from the area.
- Ensure that all pressure test, pump runs etc., are carried out in accordance with the permit system and barriers/warning signs erected.
- Co-ordination with the HSE to discuss the start-up programme and the establishment of safe working procedures.
- Liaise with the Area Construction Manager and co-ordinate with them start-up activities and ensure that interface problems are resolved before work commences.
- Plan the work in a manner that ensures that all equipment necessary for the safety of personnel and plant is provided and available on Site.
- Coordinate with HSE and Fire services for smooth start-up and emergency preparedness.

### **15.3 HSE Administration**

#### **15.3.1. HSE Committee**

The objective of the Bidder's HSE committee shall be to promote a safe and healthy work environment for the project Site by creating a strong awareness of environment safety & health and reducing or eliminating accidents, injuries, and illnesses throughout the completion of scope of work.

The HSE committee represents the mutual interests of all project participants in completing the work with zero injuries.

**Note:** Bidder's HSE committee shall attend all meetings of the HSE committee and update the on all concerns regarding HSE including the actions taken and or to be taken.

**Progress Review Meetings:** Safety will be an agenda in the Fortnightly and Monthly Progress Review meetings. All meetings shall begin with the HSE Status and Concerns for the Project. The Minutes of Meeting will be as per format agreed between Employer and Bidder.

#### **15.3.2. HSE Awareness**

The Bidder shall ensure to establish an awareness program consistent with the HSE awareness campaign (e.g. Display of policy, Posters, stickers, signs, banners, and Bulletin boards). This program promotes worker awareness of safety goals and daily risks, hazards, and exposures in the field.

#### **15.3.3. Rewards and Penalty (-Not Applicable-) (Latest Dock Safety rules applicable)**

This procedure includes all applicable penalty obligations; this shall be applicable to Bidder. Employer will reserve all rights to impose those penalties (as applicable and agreed between Employer and Bidder) in case of non-compliances.

### PENALTY FOR VOILATION OF OHS NORMS

SN	Topic	Safety Violation	Financial Penalties
1	Working at Height / Ladders and Scaffolds	Not use of Full body harness / Fall arrestors and Non anchoring of full body harness  No protected against falling of person by suitable means	Rs.10,000 per violation
2	Lifting Appliances and Lifting Gears	Use of Lifting Appliances without Third party inspection certification under the Act.	Rs.10,000 per violation
3	Personal Protective Equipment	Not wearing / using PPE required for the Job. Using damaged PPE. Using wrong PPE. Using PPE without conform to BIS Std.	Rs.200 per single violation
4	Traffic Management	Over loading of vehicles Unfit Drivers or Operators Unlicensed vehicles	Rs.5,000 per first violation and Rs.10,000 for subsequent violations
		Absence of Reversing Alarm or Absence of fog light (at winter) or Hand brakes not in working condition. Mishandling/ Splashing of material on roads Non-cleaning of Vehicles and thereby creating a traffic safety hazard to road User	Rs.1,000 per first violation and Rs.2,000 for subsequent violations
5	Occupational Health / Others	Violation of any clause as described in Factory Act & Rules Dust control measures at sites not practiced.	Rs.5,000 per single violation Compounded to a maximum of Rs.25,000 at any single instance
6	Injury and Incidence Reporting	Fatal accidents	Rs.5, 00,000 or 5% of the Contract value, whichever is less, for first fatality,  Rs.10, 00,000 or 10% of the Contract value, whichever is less, for second and their after Owner may at its discretion impose appropriate penalty or may terminate/reject the Contract at the risk &

			cost of the Contractor
		(b) Grievous Injury (Grievous Injury as defined by Workmen Compensation Act)	Rs.3,00,000 or 3% of the Contract value, whichever is less, for first injured person and Rs.5,00,000 or 5% of the Contract value, whichever is less, for every subsequent grievously injured person
		(c) Dangerous Occurrence	Rs.1,00,000 or 1% of the Contract value, whichever is less, for first violation and Rs.2,00,000 or 2% of the Contract value, whichever is less, for subsequent violations
		(d) Any Incident Involving injury to the Public	Rs.50,000 or 5% of the Contract value whichever is less for first violation and Rs.1,00,000 or 1% of the Contract value whichever is less for subsequent violations
7	Electrical Safety	Non-compliance of Electrical safety norms Exposed electric lines fermentative damage and circuits in the workplace. Inserting of wires directly into the socket. Improper grounding for electrical appliance Electrical cables running on the ground	Rs.2,000 per single violation Compounded to a maximum of Rs.50,000 or 5% of the Contract value, whichever is less, at any single instance
8	Welding & Cutting Safety	Flash back arrester, NR valve and regulator not present or not in working condition. Fail to put cylinders in a cylinder trolley. Damaged hose and fail to use hose clamps. Using Domestic LPG cylinders Isolating switch not provided on Welding m/c Improper grounding and return path. Damaged / Bare welding cable.	Rs.5,000 per single violation Compounded to a maximum of Rs.20,000 at any single instance



**Consolidated penalty shall be maximum limit of 10% of the contract value.**

Penalties once deducted can be reversed partial or full to bidder as reward, if owner's safety representative and site head monitor good safety implementation maintained by bidder afterward. Final approval for any such reward will be approved by competent authority from Employer.

#### **15.3.4. HSE Management**

##### **15.3.4.1. Hazard Identification Risk Assessment and Controls (HIRAC) / Job Safety Analysis (JSA)**

The Bidder shall establish the procedure for HIRA and JSA in line with procedure detailed below:

- a) Identify Occupational Hazards and Associated Risks.
  - l) Evaluate the Occupational Health and Safety risks of all activities, products and services.
  - m) Identify the Significant / Unacceptable hazards.
  - n) Identify and implement necessary controls for Significant / Unacceptable hazards.
  - o) Keep information up-to-date in respect of HSE Hazards and Risks.

The basic steps for process of Hazard identification and risk assessment are as follows:

Respective Areas within the Construction core team shall list out routine and non-routine activities/processes in their department / area / function and gather the following information for each work activity.

- Nature of Activities being carried out; their duration and frequency.
- Location / s where the activity is carried out?
- Who normally carries out the activity?

Hazards and associated risks at each step in respect of activities, products and services executed directly or through agencies and monitored by the departments are documented.

##### **Sequence of Risk Control Activities**

- a) Classify work activities
- b) Identify Hazards
- c) Determine Risk
- d) Qualitative risk assessment
- e) Quantitative risk assessment
- f) Assess the level of significance
- g) Determine the Existing control
- h) Prepare Risk control plan
- i) Establish control measures

**j) Review and Update as relevant**

Procedure for Hazard Identification, Risk Analysis and Control (HIRA) and Job Safety Analysis (JSA) shall be applicable to Bidder to Project Site.

**15.3.4.2. Aspect-Impact analysis, and register of regulations**

The Bidder shall establish the procedure for Aspect Impact analysis and to maintain a register of applicable rules and regulations line with procedure detailed below:

- a)** Identify environmental aspects and it's impacts with using analysis as set by Employer or as per ISO 14001 standard.
- b)** Bidder has to identify EMPs to maintain and manage risk within limit.
- c)** Optimization of environmental resources must be in line with 3R principles as reduce, reuse and recycle.
- d)** Bidder shall establish emergency management plan to address emergency leak/spill control and to encounter post incidental measures.
- e)** Keep information up-to-date in respect of latest applicable legal requirements.
- f)** Bidder shall establish procedure of keeping all legal requirements in a register, and to update this on regular interval with having legal audits.

**15.3.4.3. Design Safety Review**

- a)** Bidder's HSE Manager will work towards ensuring HSE compliance at project Site for his scope of work; he will also be responsible for safety of plant design for safe operations. Ensuring the safety of engineering design is the joint responsibility of Project Engineering Manager (PEM) and Project HSE Manager. Design safety will be enforced on the project primarily through Design Safety Checklist (DSC).
- b)** As part of the engineering management process, the PEM will create a checklist that covers necessary items for HSE compliance. This checklist needs to be jointly reviewed with the HSE Manager so that project and Site specific requirements are identified and listed.
- c)** Once agreed, the final checklist needs to be approved by HSE Manager before it is used by engineering team.
- d)** It is the responsibility of PEM and Discipline Leads (DL) to ensure complete compliance to DSC before approving and releasing any deliverable. No deliverable should be approved/ released without ensuring compliance to DSC. The DSC also provides a mechanism for the HSE manager to review/ audit the adherence DSC during design stage.

**15.3.4.4. Contractor HSE Evaluation**

The Bidder shall ensure that following are submitted along with the bid in case the same is not submitted during prequalification for evaluation.

These documents shall also be submitted to Employer's HSE team for evaluation during sub-Contractor pre-qualification.

**15.1.1.4.1 Safety statistics of last 5 years**

#### 15.1.1.4.2 Safety Policy

#### 15.1.1.4.3 Safety Organization

#### 15.1.1.4.4 HSE Management system accreditation (if any)

#### 15.1.1.4.5 Safety equipment etc.

### 15.3.4.5. Meeting

Meetings are required to ensure that Bidders understand the HSE requirements for project work, including expectations for safety and health performance and to review project safety philosophy, principles, and Parsons' requirements with all prospective of Bidders. Although, all this information is included in the bid, the meeting reinforces the messages.

### 15.3.4.6. Submission & Review of Bidder's HSE Plan

Successful Bidders must submit HSE Plan to the Employer's Site Safety Head for review after award of the Contract and ensure getting the same approved before the execution start on Site.

The Employer's Project Director and Project Safety Manager will review the approved Contractor's construction HSE Plan to ensure that it meets Project HSE requirements to be implemented at the execution stage.

The Bidder's construction HSE Plan must address all the elements as defined in the table of content including the following:

- a) Safety policy, Safety Organization, Role & Responsibility, Safety Communication
- b) Hazard Identification & Risk Assessment confirming OHSAS 18001 (latest version)
- c) Specific activity hazards analysis (AHA).
- d) Aspect – Impact assessment confirming ISO 14001 (latest version)
- e) Legal register
- f) JSA of all activities
- g) Accident investigation & reporting, Hazard correction
- h) Training and instruction, record keeping
- i) Employee orientation program- Includes location specific safety & health issues
- j) A Site-specific emergency action plan that includes a list of key management contacts
- k) Safe operating procedures in editable format
- l) Welfare facilities, provision of toilets, rest shelters and accommodations
- m) A Site-specific medical emergency plan that lists qualified first aid personnel etc.

\*Above documents shall be produced to Employer in editable format.

#### 15.3.4.7. Kick off & Mobilization including sub-Contractor's introduction

The Project Director may hold a pre-construction safety meeting before the execution work begins at Site.

This may be included as part of the Project Kick off/ Mobilization meeting.

The meeting includes Bidder's & sub-Contractor representatives, Head of Department or Manager (representatives) from all disciplines, including Employers safety.

#### 15.3.4.8. HSE Personnel competency & evaluation

All Bidders must submit approval form for deployment of HSE Officer at project Site for HSE implementation.

The minimum qualification and no of staff requirement will be as follows:

Safety staff Deployment requirement:	Safety Officer	Safety supervisor
CLASS – A: Deployed employees more than 200 Nos. or/and Contract Value above Rs. 100 Lac in a year.	Minimum One	Plus One for Every 100 employee
CLASS – B: Deployed employees more than 100 up to 200 Nos. or/and Contract Value above Rs.50 Lac up to Rs. 100 Lac per year.	Nil	Minimum One and thereafter additional One for every 100 employee.
CLASS – C: Deployed employees up to 100 Nos. or/and Contract Value up to Rs. 50 Lac in a year	Nil	Minimum One and thereafter additional one for every 100 employee
<b>Safety Officer:</b> Minimum qualification B.Sc. With Diploma in Industrial Safety from recognized institute & good communication skill with an attitude to implement safety at his Site. Safety Officer shall have minimum 03 years of experience in similar jobs. <b>Safety supervisor:</b> Minimum qualification Intermediate with good communication skill. He shall have experience as Safety Supervisor for a period of minimum 03 years in in similar jobs.		

#### 15.3.4.9. Consequence management action policy

Bidder shall frame and communicate a policy to his employees and to his subcontractor's stating consequences action apply towards major incident resulting LTI, fatality, major fire, environmental loss, legal consequences, permanent and or partial disabilities happened due to gross negligence of responsible employee.

## **15.4 Work Permit**

### **15.4.1. Objective of Work permits**

Certain types of work are not to be started until approval is given in the form of a signed permit.

Bidder shall implement the work permit at the construction Site which is basically a written, properly authorized permit required before beginning of any specific high risk activities.

Detailed work permit procedure shall be provided to Bidder at the time of Kick-off meeting.

### **15.4.2. Height Work Permit**

Required before starting of any Height work on above 02 meter elevated location (have potential of fall hazard) on project Site.

### **15.4.3. Confined Space Entry Permit**

**Required before entering into Confined or enclosed space includes Storage Tanks, Tankers, Process Vessels, Bins, Ventilation or exhaust ducts, Tunnels, Silos, Sewers, Underground Utility Vault / Chambers, Pipelines, Pits, & open top spaces more than four feet in depth. (Open top space having depth of more than the height of working personnel)**

Confined Space means any space (any unclosed or partially closed space) having restricted access or egress and/or which may be subjected to the toxic or flammable contaminants or an oxygen deficient atmosphere that have been under construction or in service or connected to operating process equipment and may contain potentially hazardous atmospheric conditions.

### **15.4.4. Radiography Test Work Permit**

Required before starting of any Radiography test work (have potential of radiation hazard) on project Site.

### **15.4.5. Electrical Work Permit**

Required for the service and maintenance of electrical system and equipment in which the unexpected energization (have potential of electrical hazard) or start-up of the machines or equipment, or release of stored energy could cause injury to workers on project Site.

### **15.4.6. Excavation Work Permit**

Required before starting of any excavation work at a depth greater than one meter to minimize hazards arises during excavation work and ground breaking operations, specifically when a machine or hand tools are used.

### **15.4.7. Hot Work Permit**

Required before any flame or spark producing activity can begin in any production, operating, or some construction areas of the project Site.

This includes, but is not limited to:

- a) Any welding and /or cutting working scrap / stores / Cooling Tower having PVC material or fines / storage of Chemicals / Gas cylinder storage / other areas containing hazardous or flammable materials or the area where hazardous or combustible or flammable materials is likely to be present.
- n) Any hot work on carbon steel pipe lines, vessels, equipment, etc. that may have contained

Sulphuric acid will not be permitted without extensive review with project and plant personnel due to the possible generation of hydrogen gas.

#### **15.4.8. Blasting Work Permit**

Required before starting of any Blasting work (have potential of explosion hazard) on project Site. Detailed procedure shall be provided to Bidder upon request.

#### **15.5 Medical Requirements and Occupational Health Management**

The Bidder shall ensure that following medical requirements are implemented in accordance with the Legal & statutory requirements

##### **15.5.1. Medical Services**

The Bidder's Project manager along with the HSE Head shall ensure the following necessary Medical facilities as prescribed under law to treat emergency and non-emergency work-related injuries and illnesses such as:

- a) Medical service providers / Qualify medical physician and paramedical staff
- b) Emergency First Aid Centre
- c) Ambulance

Employer have defined detailed medical procedure which shall be provided at the time of kick-off meeting and the same shall be applicable to Bidder for maintaining all medical requirements to project Site.

##### **15.5.2. Pre-Employment medical Test**

The Bidder's Project Manager along with the HSE Head shall establishes Pre-employment medical test certification procedure as per Legal requirement and in Performa prescribed (under the act & rules) from medically qualified physician (under the act & rules) is compulsory prior to engaging any personnel either Bidder's employee or Contractor / sub-Contractor employees on the project Site for work.

Outcome of the Project Site specific Risk analysis issues relative to health shall be consider for pre-employment medical test criteria.

##### **15.5.3. Periodic medical Test**

The Bidder's Project manager along with the HSE Head shall establishes Periodic medical test survey procedure as per Legal requirement and in Performa prescribed (under the act & rules) for personnel either Bidder's employee or Contractor / sub-Contractor employees working on the project Site.

##### **15.5.4. Health Campaign**

The Bidder's Project manager along with the HSE Head & Doctor / physician on project Site shall conduct Health campaign, where necessary for personnel either Bidder's employee or Contractor / sub-Contractor employees working on the project Site.

##### **15.5.5. Emergency Response, first aid, medical facility & Hygiene**

The Bidder's Project Manager along with the HSE Head in consensus with the Employer's Site head & HSE Head shall establishes the emergency response plan, identify team who will be responsible & organise mock drill to ensure the effectiveness of the preparedness during emergency.

Emergency Response, first aid, medical facility & Hygiene procedure shall be applicable to Bidder for

preparing and maintaining all emergency response requirements to project Site. Employer shall share detailed Emergency Response, first aid, medical facility & Hygiene procedure at the time of kick-off meeting or upon request from Bidder.

### 15.6 Work Environment Management

The Bidder shall take responsibility to implement the work environment control and occupational health measures to provide for a safe working environment, as well as to provide safety and health protection to the construction workers.

Work Environment Management Procedure shall be applicable to Bidder for maintaining all industrial hygiene requirements to project Site. Detailed Work Environment Management Procedure shall be shared with Bidder at the time of Kick-off meeting.

#### Minimum illumination intensities

<b>Illumination level in Lux</b>	<b>Area of operation</b>
54	General construction areas; concrete placement, excavation and waste dumping areas; access ways; active storage areas; loading platforms; refuelling and field maintenance areas.
54	Indoors, Warehouses, Corridors, hallways and exit ways.
108	General construction plant and shops (for example, batch plants, screening plants, mechanical & electrical equipment rooms, carpenter shops, rigging lofts, active store rooms, barracks or living quarters, locker or dressing rooms, mess halls and indoor work rooms).
325	First aid Stations, infirmaries and Offices.

### 15.7 HSE Procedure for Plant & Machinery: Usage & Maintenance

Bidder shall ensure that relevant information relating to any equipment, machines or plants that is used by personnel on the project Site should be maintained in relevant register, along with necessary fitness certification, licenses / Legal forms under the rules & regulations where necessary.

It is necessary that all critical equipment, (i.e. Lifting tools & tackles, power tools, etc.) machines (i.e. Lifting machines such as Hydra, cranes, elevated work platforms, etc.) or Plants (i.e. mobile Boiler plant, etc.) have operating manuals and maintenance records available on Site, which reflect the requirements by the manufacturer.

The indicative Plant and Machinery requirements for construction Site are given below for reference:

- a) Crawler Crane – Third Party Inspection Certificate, Valid Insurance Certificate and Operator License/Authorization Letter
- b) Hydra – Third Party Inspection Certificate, Valid Insurance Certificate, Operator License, and Pollution Under Control (PUC) Certificate,
- c) Tandem lifting with using two or more hydra and similar pick n carry cranes is

prohibited, however a plan with JSA and work permit ensuring safe lifting can be permitted by Employer's Site head in case of emergency.

- d) Use of Diesel generators sets without confirming acoustic enclosures are prohibited, Bidder shall ensure consent to establish and consent to operate.
- e) Tyre Mounted Crane – Third Party Inspection Certificate, Valid Insurance Certificate, Operator License, Registration Certificate, and PUC Certificate
- f) Transit Mixer/Dumper/Tripper– Valid Insurance Certificate, Operator License, Registration Certificate, and PUC Certificate
- g) JCB – Valid Insurance Certificate, Operator License, Registration Certificate, and PUC Certificate
- h) Excavator –Valid Insurance Certificate and Operator License
- i) Daily checklist shall be furnished by Bidder and it's Employer to maintain safety and maintenance of all lifting machinery.

Bidder shall provide "Fit For Purpose" certificate of competent authority for all major construction equipment before deploying at works.

Please note that the Bidder shall submit the medical fitness certificate of all the operators and drivers at Site prior to engaging them.

## **15.8 Hazardous Material Handling**

Relevant information relating to all hazardous substances that is stored, handled and used by personnel on the project Site should be maintained in relevant register, along with necessary Material Safety Data Sheets (MSDS).

It is necessary that all hazardous substances that are stored having necessary MSDS and approved storage accordance with Legal licenses / form under the rules & regulations where necessary.

Hazardous Material applicable to the project is indicated below:

### **15.8.1. Chemicals / Hazardous Substances**

Prior to bringing on Site any chemical agent that constitutes a hazard to health, the Procurement Department will submit a copy of the material safety data sheet to the Safety Manager for his review. Considerations will include:

Procedure shall be applicable to Bidder for maintaining all chemical handling requirements to project Site. Detailed Procedure shall be shared with Bidder at the time of Kick-off meeting.

### **15.8.2. Radioactive Materials**

The Bidder shall establish a procedure for the control and use of radioactive materials that includes consideration for NDT use as well as process instrumentation that may be installed. Control measures to be implemented will include:-

NDT Contractor will be asked to produce a copy of his local rules and emergency procedure.

Procedure shall be applicable to Bidder for maintaining all Radiation safety requirements to project Site. Detailed policy shall be shared with Bidder at the time of Kick-off meeting.

## **15.9 Operations Control Procedures**



The Bidder shall establish & display Operational Control Procedures which are aimed to minimizing the HSE risks at work place. These procedures are applicable to all operations and activities carried out at the Project Site.

Operations Control Procedures provides relevant information and work procedures to be followed by Bidders and monitored by Project execution Site engineer & HSE team in order to create safe workplace & safe activities without any posing any Health and safety risks.

Operation Control Procedure must address the following elements:

- Purpose
- Scope,
- Responsibility,
- Procedure,

The specific Operations Controls Procedures are listed as below; Bidder shall follow all standard procedures available with Employer.

Procedures required as per the list below shall be produced to Employer for his approval and review.

- 1 OHS-01 OHS plan and policy
- 2 OHS-02 Employee involvement program
- 3 OHS-02A-Hazard Reporting
- 4 OHS-02B-Safety Committee
- 5 OHS-02C-Safety Ambassador
- 6 OHS-02D-Safety Poster display-Rotation
- 7 OHS-02E-Safety Rule chanting at the gate
- 8 OHS-02F-Reward and recognition
- 9 OHS-02G-Safety Mela
- 10 OHS-02H-Safety Kumbh
- 11 OHS-02-I-Safety Virus
- 12 OHS-03 Safe working procedures
- 13 OHS-03A-Abrasive Blasting
- 14 OHS-03B-Blasting operation (Rock)
- 15 OHS-03C-Chlorine handling

- 16 OHS-03D-Concrete constriction and steel erection
- 17 OHS-03E-Critical interlock bypass
- 18 OHS-03F-Drilling Piling operation
- 19 OHS-03G-Flammable & combustible
- 20 OHS-03H-Gas cylinder
- 21 OHS-03I-H<sub>2</sub>S handling
- 22 OHS-03J-Hand and Power tools
- 23 OHS-03K-Ladders and scaffolds
- 24 OHS-03L-Laser Safety
- 25 OHS-03M-Lead safety
- 26 OHS-03N-Machines & Machine guarding
- 27 OHS-03O-Mine safety
- 28 OHS-03P-Office safety management
- 29 OHS-03Q-Outdoor work, under the sky
- 30 OHS-03R-Port and Dock Safety
- 31 OHS-03S-Powered industrial trucks, forklift
- 32 OHS-03T-Pressure vessel management
- 33 OHS-03U-Sign, Signals and Barricades
- 34 OHS-03V-Site traffic Management
- 35 OHS-03W-Smoking in Workplace
- 36 OHS-03X-Spray painting and powder coating
- 37 OHS-03Y-Storage and warehousing
- 38 OHS-03Z-walking working surfaces
- 39 OHS-03AA-Welding & Gas cutting
- 40 OHS-03AB-Work on or near water

- 41 OHS-03AC-Working in Isolated area (Lone)
- 42 OHS-04 –Incident Reporting, Investigation & Follow-up
- 43 OHS-05- Induction and Training
- 44 OHS-06- Planned Safety inspections
- 45 OHS-07 -Personal Protective Equipment
- 46 OHS-07A- Respiratory PPE
- 47 OHS-08 -Contractor safety
- 48 OHS-09 -Emergency Preparedness
- 49 OHS-10 -Fire Prevention and protection system management
- 50 OHS-11- Job Safety analysis & Risk assessment
- 51 OHS-12- Permit to work system, High risk activity- High risk Process management
- 52 OHS-12A-Hotwork
- 53 OHS-12B-Confined space
- 54 OHS-12C-Work at height- fall protection
- 55 OHS-12D-Excavation Trenching
- 56 OHS-12E- Radiation safety
- 57 OHS-12F-Electrical safety
- 58 OHS-12G- Lockout- Tagout
- 59 OHS-12H- Crane and Rigging
- 60 OHS-12I-Restricted work Authorization
- 61 OHS-12J- Equipment decontamination, cleaning.
- 62 OHS-13-Management of change Review
- 63 OHS-14-Chemical Management
- 64 OHS-14A-Transport of hazardous material/ goods
- 65 OHS-14B- Underground and overhead storage tanks of hazardous material

- 66 OHS-15-Industrial Hygiene
- 67 OHS-15A- Asbestos Safety
- 68 OHS-15B- Hearing conservation
- 69 OHS-15C- Lead Safety
- 70 OHS-15D—lighting and illumination
- 71 OHS-15E—vibration control
- 72 OHS-15F- Air quality and ventilation
- 73 OHS-15G—Work place stress
- 74 OHS-15H-Fiber and dust inhalation control
- 75 OHS-15I-Food, water safety & hygiene
- 76 OHS-16-Ergonomics
- 77 OHS-16A-Manual material Handling
- 78 OHS-17- Motor Vehicle Safety
- 79 OHS-18-Medical Services
- 80 OHS-18A- Blood borne pathogen control
- 81 OHS-18B- Epidemic- Infectious disease control
- 82 OHS-18C- Fitness check for hazardous work
- 83 OHS-19-legal Compliance Assessment
- 84 OHS-19A-Insurance and Risk cover
- 85 OHS-19B-Product Safety- stewardship
- 86 OHS-20-Program Evaluation

## **15.10 Training Program, Safety Orientation And Gate Introduction**

### **15.10.1. Training to Contractor's & sub Contractor's workers/employees**

- a) It shall be the responsibility of Bidder to impart job training and safety training to all his workers /employees including his sub-Contractor's workers /employees.
- b) Each worker shall be issued a safety training card duly signed by the trainer in confirmation

of safety training to worker.

- c) No worker will be assigned to work without safety training. The workers shall be visiting Employer's Safety Education Centre on scheduled dates and times or as per plan (to be discussed with safety Dept.).
- d) Visit to Safety Education Centre is compulsory by all workers.
- e) Procedure attached as OHS-05 shall be applicable to Bidder for maintaining all training related requirements to project Site.

## **15.11 Implementation, Monitoring, Reporting And Review**

### **15.11.1. HSE Monitoring**

Bidder shall establish a mechanism for monitoring of Project Health, Safety and Environmental Objectives (proactive and reactive both) which are essential to confirm that activities are being performed at the construction Site are in accordance with the project HSE plan and regulatory requirements.

This also ensures HSE Objectives are being achieved and as a means of measuring and improving health & safety performance, this shall be undertaken regularly for the duration of the project.

Monitoring activities shall include such activities as:

#### **a) Proactive Monitoring**

- Site inspections, including inspections of premises, plant, equipment and instrumentation;
- Risk based safety tours;
- Direct observation of work & behaviour of workforce against procedures, rules & standards
- Questioning of relevant individuals and examination of documents and records;
- A review of reports to establish safety statistics related to accident, incident and dangerous occurrence and sickness and absences;
- A review of system management processes/procedures
- A review of feedback/complaints from the public and other parties.

#### **b) Reactive Monitoring**

- Investigating accidents, incidents and dangerous occurrences following an accident, incident or near miss
- Investigating sickness absence
- Investigating safety concerns raised by project staff
- Investigating complaints

The Bidder shall ensure that the monitoring performance shall be reported through monthly MIS to Employers Project Head and Safety Heads every month.

Project HSE performance, HSE Objectives achievement, compliances of legal requirements and non-

compliances are reviewed by Top Management in Management Review meeting half yearly.

#### **15.11.2. Safety Inspection**

Safety inspections shall be conducted by the Bidders Site Engineer/ HSE personnel daily to ensure that workplaces are adequately maintained to minimize risk of incidents; employees are performing work activities with use of necessary personal protective equipment and safety devices.

The observed unsafe act / unsafe condition should be entered in the format and it should be rectified within an appropriate period.

The Engineer-In-Charge, responsible for the compliance of HSE observations shall review and monitor compliances and close observation in system or report to the HSE manager.

The Daily Inspection Format is shall be shared to Bidder at the time of kick-off meeting or upon request.

#### **15.11.3. Incident Reporting, Investigation and Analysis**

The Bidder shall thoroughly investigate every incident, regardless of severity, to determine the actual causes, and to determine potential corrective actions to prevent future incidents.

Procedure shall be applicable to Bidder for maintaining all incident reporting requirements to project Site. Detailed Procedure shall be shared with Bidder at the time of Kick-off meeting.

#### **15.11.4. Safety Audits**

Bidder shall allow the Employer and /or his representative to perform assessment as part of Safety audit (Internal & External audits) periodically, to determine compliance status of project HSE Plan with respect to the following

As whether or not it,

- Conforms to planned arrangements including the requirements of the HSE specifications and relevant legislature requirements.
- Has been properly implemented and maintained.
- Is effective in meeting the HSE policy and objectives.
- Review the results of previous audits and
- Provide the information on the results of audit to the Management.

##### **a) Internal audit**

The Employer plans the internal audit normally with a frequency of six months. The frequency and coverage of HSE audits are linked & related to the risks associated with the failure of the various elements of the HSE management system, the output from management reviews and the extent to which the HSE management system in which it operates are subjected to change.

##### **b) External audit (Third party audit)**

The Employer plans the internal audit normally with a frequency of once in a year. The frequency and coverage of HSE audits are linked & related to the risks associated with the failure of the various elements of the HSE management system, the output from management reviews and the extent to which the HSE management system in which it operates are subjected to change.

The Employer shall notify the internal audits program to the Bidder at least a week in advance, the

audit plan covering the date of the audit, name of the department to be audited & name(s) of auditor(s)  
One or more trained personnel, independent of the areas being audited are designated to carry out audit.

Prior to the audit, the internal auditor gives an overview of the audit to be performed including the focus regarding the objectives and the methodologies to be adopted for assessment.

#### **15.11.5. Management Review – HSE**

The Employer shall review the project HSE plan periodically to ensure its continuing suitability, adequacy and effectiveness, set objectives for continual improvement of HSE performances through Bidder's project manager & HSE head, the management review shall preferably be as follows.

- a) **Monthly review:** Project HSE performance reported by Bidder through MIS are reviewed by Employers Site Head and Safety Heads every month.
- b) **Six Monthly:** Project HSE performance, HSE Objectives achievement, Compliances of legal requirements, and Non compliances are reviewed by Employers Site Head and Safety Heads
  - Management Review Meeting (MRM) shall be held at least once in 6 months and chaired by Employer's project head.
  - The Management Review Meeting (MRM) shall be attended by, Site Safety Head and any other relevant Department heads or members from the Employer & Bidder's team.
  - Site Safety Head shall collect all information that has to be brought to the MRM for review.
  - The agenda for the MRM shall include the following:
    - Follow up actions from previous Management reviews.
    - Results of Internal audits.
    - Results of evaluation of Compliance to Legal and other requirements.
    - Results of participation and consultation.
    - Communication from external interested parties, including complaints.
    - HSE performance indicators (Results of monitoring and measurements).
    - The extent to which HSE Objectives are met.
    - Status of Incident investigation, Corrective / Preventive actions.
    - Need for changes to HSE policy, Objectives / management programs.
    - Changing circumstances, including developments in Legal and other requirements related to HSE.
    - Recommendations for improvement.

The output of Management reviews shall contain the decisions, action plans for improvement, Responsibility and time frame for completion of action plans. All shall be recorded in the minutes of Management review meeting and maintained.

## 16. DRAWINGS:

Following listed drawings are attached with Tender.

S. No.	Drawing number	Drawing Description
1.	GACE/22-23/105/DTEFR/DWG/01	General Layout
2.	GACE/22-23/105/DTEFR/DWG/02	Berth Arrangement & Culvert Position
3.	GACE/22-23/105/DTEFR/DWG/03	Conveyor Cross-Section
4.	GACE/22-23/105/DTEFR/DWG/04	Typical Culvert Detail

**Note:**

- a) Above drawings are indications of minimum requirement of Employer.
- b) Above drawings are just for reference and understanding of Bidder. Bidder shall prepare his own drawings and detail for bidding purpose.
- c) It should be noted by the bidders that the information, size, specifications, design & dimensions mentioned in this Volume and drawings, are indicative. As in EPC Contracts, the successful bidder shall workout detail design & drawings during detail engineering stage meeting the functional, operational & performance requirements & as per relevant IS standards, well within the sanctioned estimate, and submit the fresh design & drawings for approval to employer.