
**PROJECT: 132 KV SWITCHYARD FOR 100 MW MONARCHAK GAS BASED
COMBINED CYCLE POWER PROJECT
CUSTOMER: NEEPCO**

Phase colour discs & Danger Labels

Technical Specification No. TB 331 316 040 Rev. No.00

SECTION –1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers manufacture, packing and dispatch of Phase colour discs & Danger Labels.

The equipment is required for the following two Projects.

Name of Customer : North Eastern Electric Power Corporation (NEEPCO)

Name of the Project : 132 KV SWITCHYARD FOR 100 MW MONARCHAK
GAS BASED COMBINED CYCLE POWER PROJECT

See Section-3 for project details and other technical requirements

1.1 SPECIFIC TECHNICAL REQUIREMENTS

Material of Danger label : M.S. Sheet

Material of Phase
Colour discs : M. S. Plate

Thickness of Danger label : 2 mm

Thickness of Phase
Colour discs : 2 mm

Inscription colour
for Danger labels/ Phase
colour discs : As per enclosed Sketch 1

Fixing Hardware : As per enclosed Sketch -1

1.2 Quantities are as follows complete with Hardware:

| S.No. | Description | Quantity |
|--------------|--------------------------------------------------------------------------------------|------------------|
| | | MONARCHAK |
| 1 | Danger Label as per enclosed Sketch-1(Sheet-1) (132kV) | 10 Nos. |
| 2 | RED, YELLOW, BLUE Phase coloured discs as per enclosed sketch-2 (Sheet-1) (132kV) | *39 Sets |

*Each set comprise Red, Yellow and Blue Phase Colored Discs (1 No. Each) complete with hardware as per specification

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SECTION 2

EQUIPMENT SPECIFICATION

2.1 GENERAL

This section covers the general technical requirements of the Danger labels and Phase colour discs. In case of any discrepancies between the requirements mentioned in this section and those specified in other sections of this specification the latter shall prevail and shall be treated as binding requirements.

2.2 APPLICABLE STANDARDS

The Danger labels and Phase colour discs shall strictly conform to the following Indian standards, as appropriate:

| | |
|----------------------|---------------|
| Danger Notice Plates | IS 2551; 1982 |
|----------------------|---------------|

| | |
|--------------------------------------------|------------|
| Colour for ready mixed Paints & enamels | IS 5; 1978 |
|--------------------------------------------|------------|

2.3 CONSTRUCTIONAL FEATURES

2.3.1 The Phase colour discs and Danger plates covered under this specification shall be of size and specification as per drawings enclosed & requirements as outlined in clause 1.2

2.3.2 All lettering shall be centrally spaced & in capitals only.

2.3.3 The material supplied shall be in a sound condition and of recent manufacture. It shall conform to requirements as specified in drawing. The finished material shall be free from defects, loose mill scale, slag fillings, rust, etc.

2.3.4 Enameling shall provide continuous adherent film of adequate thickness on the surface being coated and protect it from attack due to continuous exposure in industrial atmosphere prevailing at the site and exposure in continuous corrosive environment. Enameling shall be done on both sides of labels, discs and plates unless otherwise specified.

2.3.5 The design and manufacture of Danger labels shall conform to IS: 2551, 1982. The colour shades for all labels shall be in conformance to IS-5; 1978

2.3.6 Phase colour discs shall also be coloured as per IS: 5; 1978. Following colour shade scheme shall be strictly adhered to: -

Red colour No. 538 (Post office Red)

Blue colour No. 166 (French Blue)

Yellow colour No. 355 (Lemon Yellow)

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- 2.3.7 Size, type and style of lettering shall be as per drawing attached and letters shall be of uniform height and thickness.
- 2.3.8 All lettering in labels shall be centrally spaced. The label inscription shall be engraved.
- 2.3.9 These labels and phase colour discs shall be suitable for fixing on switchyard structure/ gantries etc.
- 2.3.10 All fastener items shall be of metric sizes as per standards and shall be as per enclosed drawing.

2.4 INFORMATION TO BE FURNISHED AT CONTRACT STAGE.

The following information shall be furnished immediately in the event of award of contract.

2.4.1 Drawings on scale 1:1 for all labels and phase colour discs.

2.4.2 Non-returnable samples of the following:-

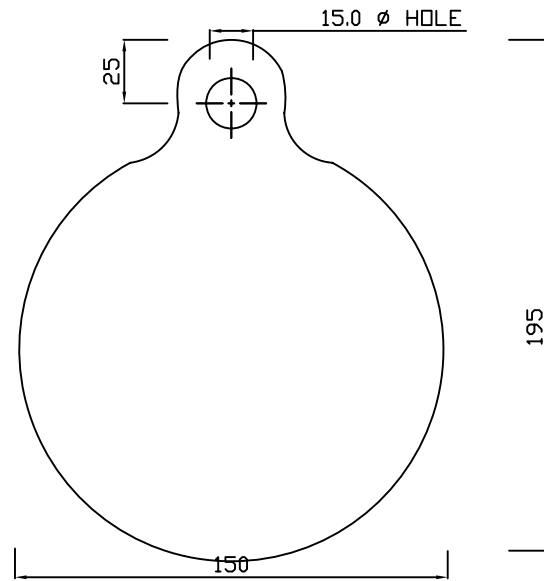
- Phase colour disc (typical) : One No.
- Danger Label (typical) : One No.

Note: Only on written approval (by BHEL) of drawing and samples of labels & phase colour discs, should the production work commenced.

2.5 TESTING and INSPECTION

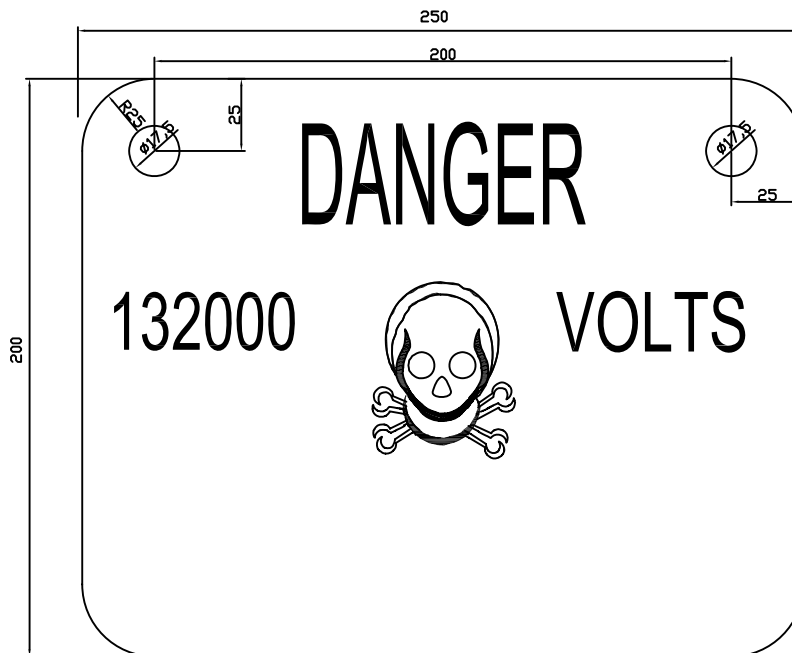
The test certificates for the full material received from the manufacturer should be furnished and shall be got approved. The finished material shall be offered for inspection as per data sheet/ test reports/ drawing, before commencement of supply.

SKETCH-2: PHASE COLOR DISC FOR 132KV YARD



SHEET 1 OF 1

SKETCH-1: DANGER LABEL FOR 132 KV YARD



SHEET 1 OF 1

SECTION-3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.1 PROJECT DETAILS

3.1.01.01 Introduction

North Eastern Electric Power corporation Ltd (NEEPCO) is setting up one gas based combined cycle power plant of nominal capacity of 100 MW+20% at 34°C, Relative Humidity of 85%, MSL 18 m at Monarchak under Sonamura Sub Division in West Tripura district of Tripura State, India.

3.1.01.02 Location

3.1.01.02.01 Administration location of the project area

The proposed 100 MW Tripura Gas Based Combined Cycle Power Project is located at Monarchak revenue Mouza in Melagarh R.D. Block under Sonamura Sub- Division of Tripura(West) District, Tripura (Exhibit 2.1 a.b).

3.1.01.02.01 Geographical Location

The proposed project site is located at 7 KM South of Sonamura Town on the left side of Sonamura-Belonia Road. The proposed project area is bounded by :- Northern Side- Kalapania mouza, Eastern Side- Forest area , Southern Side- Santinagar Village, Western Side- Sovapur (Balar Dhepa). The distance of International Boundary between India and Bangladesh falls on the western side at a distance of 1.5 KM. from the project site.

The Geodetic co-ordinates of the proposed project area at Monarchak, Sonamura, Tripura (West) are as follows:-

Latitude 23° 26' 32'' (N)

Longitude 91° 16' 54'' (E)

The project site is located at Monarchak Village, the latitude & longitude of the same being 91° 17' 00''(E) and 23° 26' 26''N respectively. The Drawing No: NEEPCO/TGBPP/01 attached with this section indicates the location of the proposed Tripura Gas Based Power Project.

3.1.02.00 Approach to Site

3.1.02.01 Road Approach

The approximate distance from the proposed project site to the various places/cities are given below:

Project site To Agartala (the capital of Tripura) 65 KM.

Project site To Kolkata 1765 KM.

Project site To Guwahati (Nearest 665 KM

Commercial Airport)

Project site To Shillong 565 KM.

Project site To Silchar 375 KM,
Project site To Badarpur Jetty 340 KM.
Project site To Agartala Airport 75 KM.
Project site To Kumarghat (Rly. Stn.) 220 KM.

The proposed Project site falls on the left side of Sonamura- Belonia road which is black topped.

On 18th K.M. from Agartala town there is one arch type R.C.C. bridge of Class 70 R loading at Bishalgarh over the river Bijoy. The vertical clearance for traffic over the bridge is limited to 5.5 M. only.

Agartala city is connected by road with the other North Eastern States by National Highway (NH-44).

It is the responsibility of the bidder to survey the entire route and make themselves aware for any transportation bottleneck. The Purchaser will not take any responsibility in any terms for transportation of the over dimensional consignments including any kind of construction/repair work required for the same.

The Project site is also accessible to Udaipur, a Sub-Divisional town, which falls on National Highway 44.

The distance of the project site is 66 km from Agartala city out of which 33 km falls on NH-44 up to Bishramganj, rest 33 kms by State PWD road.
Distance from the project site to Badarpur jetty in Assam is around 350 Kms.

3.1.02.02 Railway Approach

The nearest rail head in the state of Tripura is at Kumarghat on meter gauge rail line which is about 210 K.M from the project site by road. The nearest broad gauge railway station is Lumding in Assam but this Station does not seem to have adequate facilities for Stockyard. There is no direct accessibility to Agartala and site by rail communication.

3.1.02.03 Air Port

The nearest airport is at Agartala located at a distance of 70 km which is connected to Calcutta and Guwahati by regular flights.

3.1.02.04 Water way

The Inland Waterway available from Kolkata/Haldia port to Badarpur via Bangladesh which may be used for transportation of heavy equipments upto the project site.

There is a mutually beneficial arrangement between the Governments of India and Bangladesh for the use of waterways for trade and commerce between the two countries

and passage for transporting goods between two places in one country through the territory of the other.

Route to be followed

Kolkata-Raimongal-Mongla-Kaukhali-Barishal-Nandibazar-Chandpur-Narayanganj-Bhairab bazar-Ajmiriganj-Markuli-Sherpur-Fenchuganj-Zakiganj-Karimgang (India)-Badarpur.

For any further information the bidder may contact the Under Secretary, Ministry of External Affairs, Government of India, New Delhi, India.

Transportation of very heavy equipment, Over-Dimensional Cargo (ODC)

It is for the information of the bidder that NEEPCO had executed 4x21 MW (84 MW) Gas Based Open Cycle Power Project at Ramchandranagar which is 14 KM. east of Agartala. The ODC's in eight consignments each measuring Length-14 m. X width-4.5 m. X height - 5 m. with weight range 90-100 MT were transported via water route through Bangladesh upto Badarpur and then by National Highway-44 to the Project site. Bidder, in his own interest, should examine all the possible ways of transportation.

3.1.03.00 Meteorological Data

The meteorological data is available for the Agartala City (Latitude 23°52'35'', Longitude 23°52'35''). Monarchak being located around 70 km away from the Agartala city; the meteorological data concerning this city is being considered for the project and placed below:

METEOROLOGICAL DATA

The important meteorological data around the project site is as detailed below:

1. Air Temperature

- i. Maximum Dry Bulb Temperature : 38.7° C
- ii. Design Dry bulb temperature : 35.0°C
- iii. Minimum Dry Bulb Temperature : 4.1° C
- iv. Maximum Daily Average Temperature : 30.55° C
- v. Minimum daily average temp. : 20.7° C
- vi. Wet bulb temperature : 23°C

2. Humidity

- i. Maximum Relative Humidity : 100%
- ii. Minimum Relative Humidity : 21%
- iii. Average Relative Humidity : 85%

3. Rain fall

- i. Average Rainfall in a year : 2240mm
- ii. Maximum Rainfall in 24 hours : 242 mm
- iii. Rainy Season : April to October

4. Climatic Condition : Hot-humid

5. Maximum Wind Speed : 36 kmph

6. Seismic Data : As per IS:1893 Zone V

From the meteorological Data available, it may be seen that the project site is situated in a high rain fall area with the maximum anticipated rainfall of 242 mm in 24 hours as compared to the annual total of 2240 mm. It is also seen that the rainy season is spread over a period of 7 months from April to October. The wind speed prevailing in the area is 36 kmph and blows from the direction of South East to North West.

3.1.04.00 Transportation of plants and Equipments

3.1.04.01.1 General

The Transportation including intermediate storage /Handling of Plants and Equipments under this contract shall be to Bidder's account. The Bidder shall have full understanding of the Transportation network in and around the region and its prevailing condition during the submission of their Bid. Demurrage/wharfage if any shall be the responsibility of the Bidder.

3.1.04.01.2 The project site is located in West Tripura District which is around 66Km from Agartala City. The distance between project site to Badarpur (in Assam) is about 350KM out of which 317 K.M falls under NH-44 which is maintained by BRTF and remaining 33KM from Bishramganj to project site falls under Tripura State PWD.

3.1.04.01.3 Due to geographical location of Tripura, the transportation assumes a critical consideration in completion of the project within stipulated time schedule. Due to frequent land slides at different stretches along the road section between Badarpur and the Project site, transportation during Monsoon period is not advisable. The bidder may have to study all the aspects of transportation including scheduling for dispatch and arrival of cargo at Badarpur so that the same can be transported to the site

3.1.04.01.4 The NH-44 Road is of 70R specification

3.1.04.01.5 Mode of Transportation.

3.1.04.01.5.1 Road:

The road section between Badarpur and the Project site will have to be strengthened at some locations and also some bridges have to be strengthened/bypassed. The bidder shall have to undertake detail survey and examination of the road and bridges before quoting and consider all necessary measure towards improvement of road. The Road will pass through two overhead Railway bridges on the way to the site. This may restrict the ODC height to 4.8m. The road also passes through some of the weak bridges, narrow hair pin bends, and road under railway bridges enroute to the project site.

3.04.01.5.2 Rail ways

The meter gauge railway line is available up to Kumarghat from Lumding. There exists 37 tunnels in the section from Lumding to Kumarghat out of which the over dimensional consignments can not pass through 22 tunnels. More over, the load carriage in the meter gauge railway is restricted to 37.5 MT only. As such there is least possibility for transporting any heavy consignments by railways. NF railway shall have to be consulted for getting further information in regard to transportation by rail.

3.04.01.5.3 Water ways

The consignments can be transported by water ways from Kolkata/Haldia Port in West Bengal to Badarpur in South Assam by river Kushiara/ Barak. In this case, a jetty has to be constructed by the Contractor at Badarpur to facilitate unloading of the consignment at Badarpur. Subsequently, the consignment shall be transported from Badarpur to Project site by road ways.

3.04.01.6 Transportation limit

The maximum transportation limit of consignment shall be 100MT, as similar consignment has already been transported for other project of NEEPCO at Agartala. The maximum size of Over Dimensional Consignment shall be 14MX4.5MX5M which shall be confirmed during detailed engineering.

3.04.01.7 Conditions of Transportation

3.04.01.7.1 The entire responsibility of transportation of the consignments of any size shall lie with the contractor.

3.04.01.7.2 The cost towards transportation of equipments & materials including all transportation insurance, repairing/improving of roads, construction of bypasses, strengthening of bridges, widening of roads, construction of jetties, hiring of suitable cranes etc. and all other works and facilities whatsoever is required for safe transportation and handling of the equipments and materials up to site shall be in bidder's scope.

3.04.01.7.3 It will be sole responsibility of the contractor to obtain all kind of clearances from concerned agencies related to transportation of consignments and undertake all necessary action in order to deliver the materials at project site. Purchaser may only extend its support to establish contact with agencies.

3.04.01.7.4 The bidder shall undertake a detail survey of the transportation route. All actions required for enabling to transport the equipments shall be taken by him for safe delivery of consignments at project site. The survey and remedial action for transport of equipments in order to achieve the target of commissioning of the units shall be meticulously planned well in advance and submit to the purchaser.

3.04.01.7.5 The bidder shall specifically understand that the Employer will not entertain, under any circumstances, any claim for the extension of completion schedule of the project for his failure in timely transportation of equipments.

3.04.01.7.6 The inclement weather conditions and delay in transportation shall not be considered as Force Majeure Condition for claiming time extension and waiver of Liquidated Damages

3.04.01.7.7 The Bidder shall submit a detail Bar Chart indicating the schedule of loading of the consignments at manufacturer's works, enroute Haldia/Kolkata/Chittogong Port, arrival at Badarpur and then to project site for consideration of the purchaser.

3.2 **SITE CONDITIONS** (for design purposes)

3.2.1 Ambient Temperature

- a) Max. ambient air temperature : 45°C
- b) Min. ambient air temperature : 0°C
- c) Design ambient temperature : 45°C

3.2.2 Maximum Relative humidity : 90 %

3.2.3 Height above mean sea level : Less than 100 meters (MSL 18meters)

3.2.4 Pollution Severity : The area is generally rural in character. The sources of pollution are vehicular traffic, agricultural fields, unpaved roads and domestic fuel burning.

3.2.5 Seismic Coefficient : Though no seismic study was conducted during investigation period, but apparently it is located in the seismic zone V, according to the seismic zoning map of India i.e. In a highly seismically active region. Probably, the intensity of earthquakes in zone V corresponds to a Modified Mercalli Intensity MMI IX.

3.2.6 Criteria for Wind Resistant design of structures and equipment Standard Applicable - IS 875 (Part 3) 1987

- i) Basic Wind speed "Vb" at ten meters above the mean ground level. 55 m/ sec
- ii) Category of terrain Cat -3
- iii) Risk Coefficient 1.00

3.2.7 Auxiliary Supply

| Normal Voltage | Variation in Voltage | Frequency in Hz | Phase/Wire | Neutral Connection |
|----------------|----------------------|-----------------|------------|------------------------|
| 415 Volts | ± 10% | 50 ± 5% | ¾ wire | Solidly earthed |
| 220 Volts | ± 10% | DC | --- | Isolated 2 wire system |

All equipment shall be suitable for rated frequency of 50Hz with a variation of +3% and -5%, and $\pm 10\%$ combined variation of voltage and frequency unless specifically brought out in the specification.

Fault level shall be limited to 50kA for 415V system.

3.3 **GENERAL TECHNICAL REQUIREMENTS**

3.3.1 GENERAL

This part covers technical conditions which form integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and the requirements brought out in the various sections of this specification.

3.3.2 QUALIFYING REQUIREMENT

The sub contractor shall offer type tested equipment as per relevant National/International standards and the equipment shall be in operation for at least 2 years as on date of LOI placement i.e. 23.07.10.

3.3.3 LIMIT OF CONTRACT

Bidder may note that this is a turn key contract. Each part of the plant/equipment shall be engineered and designed in accordance with the specification requirement. All engineering and associated services required to ensure a completely engineered plant/equipment shall be provided.

All equipment furnished by the Contractor shall be complete in all respects, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment, as required by applicable codes, though may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with on another.

3.3.4 CODES AND STANDARDS

In addition to codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts systems and works covered under this specification shall comply with currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following -

- a) Bureau of Indian Standards (BIS)
- b) Indian Electricity Act
- c) Indian Electricity Rules
- d) Indian Explosives Act
- e) Indian Factories Act and State Factories Act
- f) MINAS(Minimal National Standard)
- g) Regulations of Central Pollution Control Board, India

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- g) Regulations of Ministry of Environment & Forest (MoEF), Govt. of India
- h) Pollution Control Regulations of Department of Environment, Govt. of India
- i) Tripura Pollution Control Board.
- j) Gas Cylinder Rules
- k) Electricity Act-2003/IE Rule-1956, Act-1910
- l) TAC
- m) Any other statutory codes/ standards/ regulations, as may be applicable.

Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions of the codes and standards given below shall also apply.

- a) Japanese Industrial Standards (JIS)
- b) American National Standards Institute (ANSI)
- c) American Society of Testing and Materials (ASTM)
- d) American Society of Mechanical Engineers (ASME)
- e) American Petroleum Institute (API)
- f) Standards of the Hydraulic Institute, USA
- g) International Organization for Standardization (ISO)
- h) Tubular Exchanger Manufacturers' Association (TEMA)
- i) American Welding Association (AWS)
- j) National Electrical Manufacturers Association (NEMA)
- k) National Fire Protection Association (NFPA)
- l) International Electro-Technical Commission (IEC)
- m) Expansion Joint Manufacturers Association (EJMA)
- n) Heat Exchange Institute (HEI)
- o) VDE, German Standards
- p) SAA, Standards Association of Australia

Other International / National standards such as DIN, VDI, BS etc shall also be applicable for only material codes and manufacturing standards, subject to the Owner's approval, for which bidder shall furnish, alongwith the offer adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned above together with the complete word to word translation to English, of the standard that is normally not published in English.

In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of this specification shall govern.

Copies of all Plant Standards used in the design/ manufacture of the plant and equipment shall be provided by the contractor to Owner after placement of order.

In case of any change in codes, standards & regulations between the date of bid opening and date when vendor proceeds with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

3.3.5 MAINTENANCE & AVAILABILITY CONSIDERATIONS

Equipment offered shall be designed for high availability, low maintenance and ease of maintenance. The bidder shall specifically state the design features incorporated to achieve high degree of reliability / availability and ease of maintenance. The bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirements during such operation. The intervals for each type of maintenance namely inspection of various parts, minor and major overhauls required shall be defined in man-hours along-with spare parts required.

3.4 DOCUMENTATION TO BE FURNISHED BY THE CONTRACTOR

The number of copies/ prints, manuals and CD-ROM's/ manuals to be furnished for various types of document is given herewith:

DOCUMENTATION SCHEDULE AT CONTRACT STAGE

| A | | For Approval |
|-------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No of Print | No of CD-ROMs/ Floppies | |
| 8 | 4 | Copies of GA drawings with projects details, dimension, equipment weight, fixing details, tolerances and terminal details etc. (Preliminary and Revised) |
| 8 | 4 | Copies of type test reports |
| 8 | 4 | Copies of shipping list detailing the description & quantities of all items being dispatched separately, with shipping weights, number of cases and dimensions. |
| 10 | 4 | Copies of manufacturing and field quality plan. |
| 10 | 4 | Copies of installation, operation & Maintenance manual. |
| B | | After Approval and For Information/Distribution. |
| 11 | 4 | Copies of approved drawings |
| 11 | 4 | Copies of type, Routine & Acceptances manual. |
| 11 | 4 | Copies of Instruction, Operation & Maintenance manual. |
| 11 | - | Set's of 'As Built' drawings |
| - | 4 | All drawing/documents AS BUILT on CD-ROM. |

All documents submitted shall be in electronic form (soft copies) along with the desired number of hard copies as indicated above. The soft copies to be supplied shall be in CDs. Final copies of the approved drawings/documents shall be submitted in soft copies (in CDs) along with the desired number of hard copies as indicated above.

After final acceptance, all original drawings and documents for the equipment/systems to 'as built' conditions shall be updated and submitted in electronic form (soft copies) along with the desired number of hard copies as indicated above.

Drawings will also be submitted in mini cartridges in AUTOCAD Release -12 package or any other CAD package along with conversion files for all major items.

Time schedule of drawings/documents required at contract stage shall be furnished by the supplier.

Material shall not be dispatched without the approval of test certificates by purchasers.

The documentation shall include but not limited to the following as applicable, in addition to the documents if specified in Sections 1 and 2.

3.4.1 DETAILED ENGINEERING

- i) Layout, General Arrangements, Elevations and Cross Section drawings of all equipment and facilities of the plant.
- ii) Flow diagram, Process & Instrumentation Diagrams
- iii) Technical data Sheets.
- iv) Detail design calculations for components, system, piping etc. wherever applicable including sizing calculations.
- v) Characteristic Curves/ Performance Correction Curves.
- vi) Power Supply Single Line Diagram, Block logic, Control Schematics, Electrical Schematics etc.
- vii) Protection System Diagrams and Relay Settings.
- viii) Cable Schedules and interconnection diagrams
- ix) Cable Routing Plan
- x) Instrumentation schedule, measuring point list, functional write ups, installation drawings for field mounted instruments, wiring and tubing diagrams of the panels and enclosures etc.. Drawings for open and closed loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.
- xi) Alarm and annunciation/ Sequence of Event (SOE) list and trip set points.
- xii) Sequence and protection interlock schemes.
- xiii) Type test reports (of tests conducted within 5 years of date mentioned in Section 1)
- xiv) Control system configuration diagrams and card circuit diagrams and maintenance details.
- xiv) Detailed software manuals and software listing.
- xv) Detailed flow chart for digital control system.
- xvi) Mimic diagram Layout
- xvii) Civil drawings consisting of foundation and structural work, civil calculation sheets including structural analysis and design.
- xviii) Model study reports wherever applicable
- xix) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

3.4.2 INSTRUCTION MANUALS

The instruction manuals shall contain full details required for erection, commissioning and maintenance of each equipment. The manual shall be specifically compiled for this project. The instruction manual shall comprise of the following-

3.4.2.1 ERECTION MANUALS

The minimum contents of Erection Manual shall be as follows -

- a) Erection Strategy
- b) Sequence of Erection
- c) Erection Instructions
- d) Critical checks and permissible deviations/tolerances.
- e) List of tool, tackles, heavy equipment like cranes, dozers etc.
- f) Bill of Material
- g) Procedure for erection
- h) Procedure for initial checking after erection.
- i) Procedure for testing and acceptance norms.
- j) Procedure / Check List for pre-commissioning activities.
- k) Procedure / Check List for commissioning of the system.
- l) Safety precautions to be followed in electrical supply distribution during erection.

3.4.2.2 OPERATION AND MAINTENANCE MANUALS

The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give step by step procedure for all operations likely to be carried out during the life of the plant/equipment including operation, maintenance, dismantling and repair. Each manual shall also include a complete set of drawings together with performance / rating curves of the equipment and test certificates wherever applicable.

If after the commissioning and initial operation of the plant, the manuals require any modification/ additions/ changes the same shall be incorporated and the updated instruction manuals shall be submitted to the Owners for records.

A separate section of the manual shall be for each size / type of the equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.

The manuals shall include the following -

- a) List of spare parts along with their drawings and catalogues and procedure for ordering spares.
- b) Lubrication Schedules including charts showing lubrication checking, testing and replacement procedure to be carried out daily, weekly, monthly and at longer interval to ensure trouble free operation.
- c) Wherever applicable, fault location charts shall be included to facilitate finding the cause of the mal-operation or break down.

Detailed specifications for the consumables including lubricant oils, greases, chemicals etc. shall be required for the complete plant.

3.4.3 **DRAWINGS**

- a) All drawings shall be made in Autocad Release -14 or latest Version.

Title Block of drawings shall include the following details about the Customer and Project:

NAME OF CUSTOMER: NORTH EASTERN ELECTRIC POWER CORPORATION (NEEPCO)

NAME OF THE PROJECT : 132 KV SWITCHYARD FOR 100 MW TRIPURA GAS BASED
POWER PROJECT AT MONARCHAK

All drawings shall be plotted in ink. All dimensions and data shall be in SI metric units. All items of the equipment should be clearly identified by proper part numbers in the contract drawings. Such parts which are to be dispatched to site from works in dispatchable units and are re-assembled at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. All the items of the shipping list should be identified in the drawing. The language for all inscriptions shall be English.

- b) All drawings submitted by the contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials clearances and spaces required between various portions of equipment.
- c) Each drawing shall bear a title block at the right hand bottom corner with clear mention of the name of the Owner, the System designation, specifications title, specifications number the name of the Projects drawing number and the revisions. If standard catalogue pages are submitted the applicable items shall be indicated there. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be metric units. TITLE BLOCK TO BE FOLLOWED FOR THIS PROJECT IS GIVEN IN SECTION 5.
- d) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the Project. The review of these documents /data/ drawings by the Owner will cover only general conformance of the data/ drawings/documents to the specifications and contract, interfaces with the equipment provided by others and external connections of the dimensions which might affect plant layout. The review by the Owner should not be construed to be thorough review of all dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. The review and/or approval by the Owner shall not relieve the Contractor of any of his responsibilities and liabilities under the contract.
- e) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Owner.
- f) All manufacturing, fabrication and execution of the work in connection with the equipment/system, prior to the approval of the drawings shall be at Contractor's risk. The Contractor is not expected to make any change in the design of the equipment/system, once they are approved by the Owner. However, if some changes are necessitated in the design of the equipment/ system at a later date, the

contractor may do so, but such change shall be promptly be brought to the notice of Owner indicating the reasons for the change and get the revised drawing approved again.

- g) Drawing shall include all installation and detailed piping drawings. All piping of 100 mm and larger diameter shall be routed in detail and smaller pipe shall be shown schematically or by isometric drawing.
- h) As Built Drawings - After final acceptance of individual equipment/ system by the Owner the contractor will update all original drawings and documents for the equipment /system to "As Built" conditions.
- i) Drawings must be checked by the contractor prior to submission to the Owner. In case drawings are found to be submitted without proper checking by the contractor, the same shall not be reviewed and returned to the contractor for re-submission.
- j) The contractor shall submit the specified number of prints of drawings /data/ document for Owner's review and approval. The Owner shall review the drawings and return one (1) copy to the contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be resubmitted promptly, with revisions clearly marked for the final review. Any delays arising out of the failure of the contractor to submit /rectify in time shall not be accepted as a reason for delay in the contract schedule.

3.5 **QUALITY ASSURANCE PROGRAMME**

To ensure that the equipment and services under the Scope of Contract, whether manufactured or performed within the Contractor's works or at his Sub-Contractor's premises or at the Owners' site or at the other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programme shall be outlined by the Contractor and finally accepted by the Owner/ Authorized representative after discussions before the award of Contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality programme shall be generally cover the following :

- i) His Organization structure for the management and implementation of the proposed quality assurance programme.
- ii) Quality System Manual
- iii) Design Control System
- iv) Documentation Control System
- v) Qualification data for bidder's key personnel
- vi) The procedure of materials, parts, components, and selection of Subcontractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchased etc.
- vii) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- viii) Control of non-conforming items and system for corrective actions.
- ix) Inspection and test procedure both for manufacture and field activities.
- x) Control of Calibration and testing of measuring, testing equipment.
- xi) System for quality audits.
- xii) System for indication and appraisal of inspection status.

- xiii) System for authorizing release of manufactured product to the Owner.
- xiv) System for handling, stores and delivery
- xv) System for maintenance of records.
- xvi) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of the equipment/ component as per format enclosed at Section -5

3.5.1 QUALITY ASSURANCE DOCUMENTS

The Contractor shall submit the following Quality Assurance documents within three weeks after dispatch of the equipment.

- i) Material mill test reports on components as specified by the specification and approved Quality Plans.
- ii) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication.
- iii) The inspection plan with verification, inspection plan check points verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- iv) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- v) Non-destructive examination results reports including radiography interpretation reports.
- vi) Factory tests results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
- vii) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed customer hold points

During the course of inspection, the following will also be recorded.

- a) When some important repair work is involved to make the job acceptable and
 - b) The repair work remains part of the accepted product quality
- viii) All the accepted deviations shall be included with complete technical details.

3.5.2 ENGINEER'S SUPERVISION

To eliminate delays and avoid disputes and litigation all matters and questions shall be referred to the Owner and Contractor shall proceed to comply with the Owner's decision

The work shall be performed under the supervision of the Owner. The scope of the duties of the Owner pursuant to the Contract, will include but not be limited to the following.

- i) Interpretation of all the terms and conditions of these documents and specifications.
- ii) Review and interpretation of all the Contractor's drawings, engineering data etc.
- iii) Witness or his authorized representative to witness tests and trials either at the manufacturer's work or at site, or at any place where work is performed under the contract.

- iv) Inspect, accept or reject any equipment, material and work under the contract.
- v) Issue certificate of acceptance and/or progressive payment and final payment certificates
- vi) Review and suggest modifications and improvement in completion schedules from time to time and
- vii) Supervise the quality assurance programme implementation at all stages of the work.

3.5.3 INSPECTION, TESTING AND INSPECTION CERTIFICATES

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type test/routine tests/acceptance tests as specified shall be conducted in the presence of BHEL/NEEPCO. Wherever equipment similar to the one being offered has already been type tested in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, Type test reports of the same shall be submitted for approval of BHEL /NEEPCO.

If these are not found technically acceptable, sub contractor will have to carry out the type test without any extra cost and/ or delivery implications in presence of BHEL/NEEPCO.

Where specified by the purchaser, type tests will have to be conducted by the sub-contractor on the equipment in the scope of supply. Such test shall be witnessed by the customer and BHEL, for which the test charges and delivery implications if any shall be indicated separately by the sub-contractor.

The purchaser NEEPCO/BHEL or their authorized representative shall have at all reasonable times free access to the contractor's works and shall have the power at all reasonable times to inspect the material and workmanship of the works during manufacturing or erection if part of the works is being manufactured or assembled at other premises. Inspection may be made at any stage of manufacture, dispatch or at site at the option of NEEPCO/BHEL and the equipment if found unsatisfactory due to bad workmanship or quality is liable to be rejected.

- 3.5.3.1 The word 'Inspector' shall mean the Owner and/or his authorized representative and/or an outside inspection agency acting on behalf of the Owner to inspect and examine the materials and workmanship or the works during its manufacture or erection.
- 3.5.3.2 The Owner, his duly authorized representative and or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the contractor shall obtain for the Owner and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the contractors own premises or works.
- 3.5.3.3 The contractor shall give the Owner/inspector thirty (30) days (Sixty (60) days if outside India), written notice of any material being ready for testing. Such tests shall be to the contractor's account except for the expenses of the inspector's. The Owner/inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen(15) days of the date on which the equipment is noticed as being ready for tests/inspection and he shall forthwith forward to the inspector duly certified copies of test reports.

3.5.3.4 The Owner or inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Owner/inspector giving reasons therein, that no modifications are necessary to comply with the contract.

3.5.3.5 When the factory tests have been completed at the contractor's or subcontractors works the Owner/inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/inspectors the certificates shall be issued within fifteen (15) days of the receipt of the contractor's test certificate by the Owner/inspector. Failure of Owner/inspector to issue such a certificate shall not prevent the contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

3.5.3.6 In all cases where the contract provides for tests whether at the premises or works of the contractor or any sub contractor, the contractor except where otherwise specified shall provide free of charges such items as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Owner/inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the contract and shall give facilities to the Owner/inspector or to his authorized representative to accomplish testing.

3.5.3.7 The inspection by Owner and issue of inspection certificate there on shall in no way limit the liabilities and responsibilities of the contractor in respect of the agreed quality assurance programme forming a part of the contract.

3.5.3.8 To facilitate advance planning of inspection in a addition to giving inspection notice as per clause 3.5.3.3, the contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

3.5.3.9 All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The contractor shall maintain all the relevant records of periodic calibration and instrument identification and shall produce the same for inspection by Owner. Wherever asked specifically the contractor shall recalibrate the measuring test equipment in the presence of Owner engineer.

3.5.4 GENERAL REQUIREMENTS QUALITY ASSURANCE

3.5.4.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the contractor responsibility to

draw up and implement such programme duly approved by the Owner. The detailed quality plans for manufacturing and field activities should be drawn by the bidder, separately in the format attached at Section 5 and will be submitted to Owner for approval. Schedule of finalization of such quality plans will be finalized before award.

Manufacturing quality plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by contractor's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing performance testing.

Field quality plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the contractors site quality control organization, during various stages of site activities from receipt of materials/equipment at site.

However if Owners/ Purchasers Standard Manufacturing Quality Plan OR the Standard Check List is furnished at Section 5 of this specification or at contract stage separately, the bidder shall give his concurrence to the same. In case Owners Standard Manufacturing Quality Plan OR the Standard Check List is furnished then Contractor's Manufacturing Quality Plan is not required.

The bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in quality plans along-with quality plans. These quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans Owner shall identify Customer Hold Points (CHP), i.e test/checks which shall be carried out in presence of the Owner's engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and disposition.

The contractor shall submit to the Owner field welding schedule for field welding activities if applicable. The field welding schedules shall be submitted to the Owner along with all supporting procedures, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site. The format for the welding schedules shall be furnished at contract stage, if applicable.

- 3.5.4.2 No material shall be dispatched from the manufacturer's work before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspection by Owner's engineer/ authorized representative, and duly authorized for dispatch issuance of MDCC.

All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and

actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

3.5.4.3 WELDING AND BRAZING

All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other international equivalent standard acceptable to the Owner.

All welding/brazing procedures shall be submitted to the Owner or its authorized representative for approval prior to carrying out the welding/brazing.

All brazers, welders and welding operators employed on any part of the contract either in contractors/his subcontractors works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Owner

Test results of qualification tests and specimen testing shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorized representative.

For all pressure parts and high pressure piping welding the latest applicable requirements of the IBR(Indian Boiler regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipment /systems shall also be complied with.

All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

No welding shall be carried out on cast iron components for repair.

Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

All non-destructive examination shall be performed in accordance with written procedures as per International Standard. The NDT operator shall be qualified as per SNT-TC-IA(of the American Society of Non-destructive Examination). NDT shall be recorded in report which includes details of methods and equipment used, result evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

3.5.4.4 SUB-VENDORS

All the sub-vendors proposed by the contractor for procurement of major bought out item including castings, forging, semi-finished and finished components/equipment, list of which shall be drawn up by the contractor and finalized with the Owner shall be subject to Owners approval. The contractors proposal shall include vendors facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. alongwith his own technical evaluation and shall be submitted to the Owner for approval prior to any procurement. Such vendor approval shall not relieve the contractor from any obligation duty or responsibility under the contract.

For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the contractors shall call for quality plans to be submitted by the suppliers alongwith their proposals. The quality plans called for from the vendors shall set out, during the various stages of manufacture and installation, the quality practice and procedures followed by the vendor's quality control organization, the relevant reference documents/standards used, acceptance level, inspection of documentation raised etc.

Such quality plans of the successful vendors shall be finalized with the Owner and such approved quality plans shall form a part of the purchase order/contract between the contractor and vendor. Within three weeks of the release of the purchase order/contracts for such bought out items/components, a copy of the same without price details but together with the quality plans and delivery conditions shall be furnished to the Owner by the contractor.

- 3.5.4.5 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the contractors or their sub-vendors quality management and control activities. The contractor shall provide all necessary assistance to enable the Owner to carry out such audit and surveillance.

The contractor shall carry out an inspection and testing programme during manufacture in his works and that of his sub-contractors and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identify and acceptability of all materials parts and equipment. He shall carry out all tests/inspection required to establish that the items/ equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

- 3.5.4.6 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings etc.

- 3.5.4.7 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

- 3.5.4.8 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/authorized representative

- 3.5.4.9 Seismic Criteria: All equipments shall be designed to withstand seismic loading in addition to pressure, dead or live loading etc. without exceeding allowable stresses. The structure in which the equipments will be installed will be located in Zone-V area as defined in IS-1893 "Criteria for earthquake resistant design of structure"

3.5.5 FIELD INSPECTION & TESTS

The following field inspections and tests will be carried out in the sequence detailed below, and the successful performance and completion of all the tests taken together shall constitute the OWNER ACCEPTANCE TESTS -

- a) On completion of erection of the equipment and before start-up, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner and the contractor for correctness and completeness of installation and acceptability for start-up, leading to initial pre-commissioning tests at site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the contractor's quality assurance programme.
- b) The contractor's commissioning/start-up engineers, specially identified as far as possible shall be responsible for carrying out all the pre-commissioning tests at site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over the complete equipment shall be placed on initial operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.
- c) All piping system shall be flushed steam blown as required and cleanliness demonstrated using acceptable industry standards procedures to accomplish this work shall be submitted for approval to the Owner six months prior to the respective implementations. The Owner will approve final verification of cleanliness.
- d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- e) The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owners commissioning (start-up) Engineer(s) should be checked out and cleaned. The checking and inspection of individual system should then follow a prescribed schedule to be agreed by Owner.
- f) The contractor during trial operation and performance testing conduct vibration testing to determine the base line of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

3.6 GENERAL TECHNICAL SPECIFICATIONS

3.6.1 MATERIAL AND WORKMANSHIP

All material used for the construction of equipment shall be new and shall be in accordance with the requirement of this specification. Material utilized for various components shall be those which have established themselves for use in such applications.

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surfaces of castings, which do not undergo machining, shall be free from foundry irregularities. The casting shall be tested for NDT, chemical, mechanical and metallographical tests. This shall be specified in quality plan for the specific equipment. Iron casting material shall be in accordance with ASTM A 126 class B. Steel casting shall be manufactured in accordance with ASTM A 27 and shall be subject to appropriate tests and inspection.

If requested by Owner, forgings shall be tested by magnetic particle, dye penetration, radiographic, ultrasonic or any combination of methods which may suit material type and forging design. The testing is to be carried out according to appropriate ASTM standards. The forging shall be tested for mechanical and metallographical tests as per ASTM.

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM. Structural steel rolled shapes, bars, etc. shall comply with the latest ASTM for A36.

All or a representative number of such components shall be subjected to one or more of the tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiograph. These tests shall be in accordance with the ASTM. The acceptance shall be as per ASTM Specifications.

All joints and fastening shall be so designed, constructed and registered that the component part may be accurately positioned and restrained to fulfill their required function. The heads of all bolts shall register flush on the surfaces, which they fasten.

All the information concerning materials or components to be used in manufacture, machinery, equipment, materials and components supplied, installed or used shall be submitted for approval. Without such approval the Contractor shall run risk of subsequent rejection. The cost as well as time delay associated with such rejection shall be borne by the Contractor.

All components exposed to rain shall be designed with sloped upper surface to avoid water pools.

3.6.2 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor and indoor equipment supplied shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mild dew.

3.6.3 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material to prevent any contact between the wires. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built in to an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value, which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.6.4 VENTILATION OPENING

In order to ensure adequate ventilation, components shall have ventilation openings provided with fine wire mesh of brass or galvanized steel to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

3.6.5 TROPICALISATION

All equipment shall be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions as specified. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to a tropical environment.

3.7 SURFACE TREATMENT

3.7.1 GENERAL

All metal surfaces shall be treated to provide anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. All steel conductors including those used for earthing /grounding (above ground level) shall also be galvanized according to IS-2629.

3.7.2 GALVANIZING

The minimum weight of zinc coating shall be 610 gm/sq.mm and the minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6 mm thickness requirement of coating shall be as per relevant ASTM. For surface, which shall be embedded in concrete, the zinc coating shall be 610-gm/sq.mm minimum.

The galvanized surface shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, shelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing no drilling or welding shall performed on the galvanized parts of the equipment expecting that nuts may be threaded after galvanizing, sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS 2633.

Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the standard preece test. All coatings shall withstand six immersions. The following tests should essentially be performed as per relevant IS

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

3.7.3 PAINTING

All sheet steel work shall be degreased, pickled, and phosphated in accordance with IS 6005 “Code of practice for phosphating iron and steel”. All surfaces, which will not be easily accessible after shop assembly shall before hand, be treated and protected for the life of the equipment. The surfaces, which are to be furnished, painted removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

After phosphating through rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and over drying. The phosphate coating shall be sealed with application of two coats or ready mixed, stoving type zinc chromate primer, the first coat may be flash dried while the second coat shall be stoved.

After application of the primer, two coats finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat painting.

The exterior color of the paint shall be as per shade 697 of IS-5 and inside shall be glossy white. Each coat of primer and finishing slightly be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipment.

In case then bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, the same shall be submitted for BHEL/NEEPCO approval.

3.8 CASTING

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surface of castings, which do not undergo machining, shall be free from foundry irregularities. The casting shall be tested for NDT, chemical, mechanical and metallographical tests. This shall be specified in quantity plan for the specific equipment. Iron casting material shall be in accordance

with ASTM A 126 class B. Steel casting shall be manufactured in accordance with ASTM A 27 and shall be subject to appropriate tests and inspection.

3.9 FORGINGS

If requested by purchases, forging shall be tested by magnetic particle, dye penetration, radiographic, ultrasonic or any combination of methods, which may suit material type and forging design. The testing is to be carried out according to appropriate ASTM standards. The forging shall be tested for mechanical and metallographical tests as per ASTM.

3.10 FABRICATED COMPONENTS

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM. Structural steel, rolled shapes, bars etc. shall comply with the latest ASTM for A36.

All or a representative number of such components shall be subjected to one or more of the tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiograph. These tests shall be in accordance with the ASTM. The acceptance shall be as per ASTM Specifications.

3.11 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable.

The junction boxes shall be made of minimum 2 mm thick sheet steel. Gland plates shall be removable type and made of 3 mm thick sheet steel. The boxes shall be provided with detachable cover or hinged door with captive screws. Top of the box shall be arranged to slope towards the rear of the box. The box shall be painted and shall be provided with suitable neoprene gaskets to achieve requisite degree of protection. Adequate spacing shall be provided to terminate the external cables. The boxes shall be suitable for mounting on various types of steel structures.

These housing shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surface, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosures the thickness of aluminum shall be such that it provides adequate rigidity and long life as sheet steel of the specified thickness.

All enclosures shall provide a degree of protection of not less than IP 55 as per IS-13947 and one enclosure of each type shall be tested for the same or evidence of testing shall be furnished in lieu of type testing.

Housing shall be free standing floor mounting type or pedestal mounting type as required.

Housing shall be provided with double hinged doors and / or removable covers with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The hinged frame and doors shall be connected to main cubicle frame with tinned copper braids.

All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM. The EPDM gasket shall be tested in presence of purchasers according to the quality plan. The quantity of gasket shall be such that it does not get damaged/ cracked during the ten years of operation of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilation louvers, if provided shall have screen and filters. The screen shall be of fine wire mesh made of brass.

All housings shall be designed for the entry of cables from the bottom by means of weatherproof and dust proof connections. Boxes and cabinets shall be designed with generous clearance to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the housing. A suitable cable gland plate projecting at least 150mm above the base of the housing shall be provided for this purpose.

Housing shall be provided with lifting lugs. Positive earthing of the housings shall be ensured by providing two earthing pads suitable to receive 50 X 6 mm GI flat. All housings shall be equipped with an earth bus securely fixed along the inside base. The material and size of the bus bar shall be at least 50 mm X 6 mm GI flat or equivalent copper.

A 240V, single phase, 50Hz, 5/15 amp socket shall be provided in the housing with ON – OFF switch suitable to accept standard Indian plugs. Plug and socket shall be industrial grade. For illumination a 20-Watts fluorescent tube of 15W CFL shall be provided. The switching of the fittings shall be controlled by the respective panel door switch.

Each panel/cubicle shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signaling, lightning and space heater circuits. The incoming and sub-circuit shall be separately provided with switch fuse units.

All control switches shall be rotary type and toggle/piano switches shall not be accepted.

Instruments for sensing, transmission and measuring system shall be of electronic type with signal transmission in current mode of 4-20 mA DC. For interrogation of potential free contacts, 48 V DC power supply shall be employed.

3.12 TERMINAL BLOCKS AND WIRING

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be moulded, complete with insulating barriers, stud type terminals, complete with washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals.

The terminal blocks provided shall be of 650 V grade, rated for 10 A for control cables. Suitable numbering for terminal blocks shall be done. In case of junction box for power cable, the box shall be rated for maximum current carrying capacity. Terminal blocks shall be of one piece, Klippon RSF-1 or ELMEX CSLT-1 type with insulating barriers.

Terminal blocks for current and voltage transformers secondary leads shall be provided with test links and isolating facilities. The current transformers secondary leads shall also be provided with short-circuiting and earthing facilities.

The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristics to prevent cable from escaping from the terminals clamp unless it is done intentionally.

Terminal block design shall include a white fiber-marking strip with clear plastic, slipon/clipon terminals covers. Markings on terminal strip shall correspond to wire number on wiring diagrams. The terminal blocks shall be of extendable design. The terminal blocks shall have locking arrangements to prevent its escape from the mounting rails. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing barriers.

Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors on each side:

- a) All circuits except CT circuits: Minimum of two 2.5 sq mm copper flexible
- b) All CT circuits: Minimum of four 10 sq mm copper flexible

The cubicle shall be arranged in such a manner that it is possible to safely connect or disconnect terminal; on live circuits and replace fuse links when the cabinet is live.

At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal blocks.

There shall be a minimum clearance of 150 mm between the first/bottom row of terminal blocks and the associated cable gland plate. Also the clearance between two adjacent rows of terminal blocks shall be a minimum of 150 mm.

All terminal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters/troughs shall be used for this purpose.

Wire termination shall be made with solders crimping type of tinned copper lugs, which firmly grip the conductor and insulation, insulated sleeves, and shall be provided at all the wire terminations.

Engraved/painted core identifications plastic ferrules marked to correspond with panel wiring diagram numbering shall be fitted at both ends wire. Ferrules shall fit tightly o wires and shall not

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fall off when the wire is disconnected from the terminal blocks. Ferrules using digits 0,6,8 and 9 shall be used only with an underline/dot to avoid reading upside down.

All wires directly involved in trip circuits should be distinguished by the addition of a red colored unlettered ferrule.

All terminals of equipment within panels, boxes or cubicles shall be wired on to terminal blocks, whether they are used or not.

3.13 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of the plant shall have permanently attached to it, on a conspicuous position, a rating plate of non-corrosive material upon which, shall be engraved manufacturer's name, equipment type or serial number together with details of the ratings, service conditions under which the item of the plant in question has been designed to operate, with diagram plates as may be required by the Owner.

Each item of the plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Owner or as detailed in appropriate section of the technical specifications.

Such nameplate or labels for Cabinets/ panels/ boxes shall be of non-hygroscopic material. Cabinets/ boxes shall be provided with danger plates and internal wiring diagrams pasted on inside of the door. The front label shall be on a 3 mm thick plastic plate with white letters engraved on black background.

Items of plant such as valves which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel.

Hanger / support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall have stamped upon it the designed hot and cold load which it is intended to support.

Valves, steam traps and strainers shall be identified by the Owner's tag number of the metal tap permanently attached to non pressure parts such as the yoke by the stainless steel wire.

Safety and relief valves shall be provided with the following -

- a) Manufacturer's identification
- b) Nominal inlet and outlet sizes in mm.
- c) Set pressure in Kg. Cm² (abs)
- d) Blowdown and accumulation as percentage of set pressure

All such plates, instruction plates shall be bilingual with Hindi inscription (or local language) first followed by English. Alternatively, two separate plates one with Hindi (or local language) and other with English inscriptions may be provided.

All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

Danger plates shall be provided as per requirements. Wherever, motion/ flow of fluids is involved, plates showing direction of flow shall also be provided.

3.14 GROUND TERMINAL

Each equipment shall be provided with two grounding pads, each with two holes for M12 bolts and spring washers suitable for connection to 75mm x 12mm galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment.

3.15 TERMINALS

Each equipment shall be supplied with necessary terminals (studs or pads) as required by the ultimate design for the particular installation. The terminal shall be in one piece and not laminated. All ferrous parts shall be hot dip galvanized.

3.16 HIGH VOLTAGE TERMINAL

The high voltage terminals shall be preferably made of aluminum or aluminum alloy. If copper terminals are used, they shall be tin-plated. The conductor termination of equipment shall be either expansion, sliding or rigid type suitable for 4" IPS Aluminum tube.

3.17 BOLTS, NUTS AND WASHERS

Bolts, nuts and plain washers of size M12 and above shall be hot-dip galvanized, while sizes below M12 shall be electro-galvanized or stainless steel. All spring washers shall be electro-galvanized mild steel suitable for at least service condition -3 as per IS-1573.

In general, screw threads shall be standard metric threads. The use of other thread form will be used only after prior approval. The Contractor shall furnish locking devices for threaded fasteners, which will lock them in such a manner so as to prevent them from coming loose in transport and in service.

3.18 Electric Motors

A.C. Motors shall be squirrel cage induction motors for direct on-line starting. Motors shall be of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall conform to type tests as per relevant standards. Three phase motors shall conform to standards as per IS 325 / IEC 60034 and single phase motors shall be IS 996 / IEC 60034. DC motors shall be shunt wound conforming to IS 4722.

Motors shall be continuously rated (S1). Maximum continuous rating (MCR) shall have at least 10% margin over maximum load demand including voltage and frequency variations, temperature rise and other variations.

Motors shall have class B insulation. Insulation shall be non-hygroscopic, oil resistant and flame retardant.

Temperature Rise of air cooled motors shall not be more than 70 deg. (by resistance method).

The motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable

winding temperature even when the supply voltage drops down to 80% of the rated voltage. The motors shall also be capable of running at 80% of rated voltage for at least five minutes.

Motors shall be capable of withstanding the electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

Motors when started with the driven equipment imposing full starting torque the supply voltage conditions specified above shall be capable of withstanding at least two hot starts in succession, with motor initially at normal running temperature.

The locked rotor current shall not exceed six (6) times the rated full load current, subject to tolerance as given in IS 325. The motor operating mechanism shall be subjected to blocked rotor test and measurement of current as sample test. The locked rotor withstand time under hot condition at highest voltage limit shall be 2.5 secs more than the starting time for motors with starting time upto 20 secs at minimum permissible voltage. For motors starting between 20 secs and 45 secs the withstand time shall be 5 secs more and for than 45 secs starting time, withstand time shall be 10% more of the starting time.

Noise level and vibration shall be limited within limits prescribed in IS:12065 & IS 12075 respectively. Motors shall withstand vibrations produced by driven equipment.

Accelerating torque at any speed with the lowest permissible voltage shall be atleast 10% motor full load torque. Pull out torque at rated voltage shall not be less than 205% of full load torque.

The motors shall be provided with two earthing points on opposite sides of the motor for bolted connection of earthing conductor.

Motors shall have drain plugs so located that they will drain water resulting from condensation or other reasons from all pockets in the motor construction.

3.19 PROTECTION CLASS OF CABINETS/PANELS, ENCLOSURES, MOTORS ETC.

- a) All panels desk cabinets and enclosures furnished shall at least comply with the requirements of protection classes as indicated below unless otherwise specified in Section 1 or 2:
- | | | |
|----|------------------------------------------------------------------|------|
| 1. | Indoor air conditioned (AC) areas | IP31 |
| 2. | Indoor Non AC areas | IP52 |
| 3. | Outdoor (Distribution boxes, junction boxes, terminal boxes etc. | IP55 |
| 4. | Motors | |
| | Indoor motors | IP54 |
| | Outdoor Motors | IP55 |

3.20 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of valves and piping and conduit equipment connections shall be

properly sealed with suitable devices to protect them from the damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/ paints / shall take into account the hot humid, corrosive and saline atmospheric conditions applicable for a coastal area.

All exposed metallic surfaces subject to corrosion shall be protected by the shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to finish painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Owner regarding quality of the primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Owner.

All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Owner.

All piping shall be cleaned after shop assembly by shot blasting or other ,means approved by the Owner. Lube oil piping or carbon steel shall be pickled.

All metal surfaces shall be treated to provide anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. High Tensile steel nuts and bolts and spring washers shall be electro-galvanized to service condition 4. All steel conductors including those used for earthing / grounding (above ground level) shall also be galvanized according to IS-2629.

FUNGISTATIC VARNISH -Special moisture and fungus resistant varnish shall be applied to parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface or part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

All Switchgear panels and Control / Relay Panels shall be painted by powder coating. Paint shade for electrical equipment shall be 692 for indoor and 631 of IS : 5 for outdoor equipment.

3.21 **WELDING**

If the manufacturer has special requirements relating to the welding procedure for the welds at the terminals of the equipment to be performed by other the requirements shall be submitted to the Owner in advance of the commencement of the erection work.

3.22 **SEISMIC WITHSTAND TEST**

The seismic withstand test on complete equipment shall be carried out along with the supporting structure.

The Contractor shall arrange to transport the structure from the structure Contractor's works/ project site or alternatively arrange the structure as per approved drawings for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pads of the equipment and any other point as agreed by the Owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Owner.

3.23 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling, jigs and fixtures for maintenance and calibration/ readjustment. Checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The prices of each tool/ tackle shall be deemed to have been included in the total bid price. The tools and tackles shall be separately packed and sent to site. This set of tools and tackles shall not used by during erection, erection and trial operation. For this purpose a separate set of tools and tackles shall be brought/ supplied by the Contractor. In case the above mentioned set is used during erection, commissioning or trial operation the same shall be refurbished repaired/ replaced as required to the satisfaction of the Owner before handing over. All tools and tackles shall be of reputed make acceptable to the Owner.

3.24 PACKING AND TRANSPORTATION

All the equipment shall be suitably protected, coated covered or boxed and crated or prevent damage of deterioration during transit, handling and storage at site till the time of erection. The contractor shall be fully responsible for any loss or damage during transportation, handling and storage. While packing all materials, the limitations from the point of view of weight, sizes as per the road condition prevailing in the state of Tripura should be taken into account of. Exclusive survey of the road from Badarpur in Assam to the project site shall be undertaken so that heaviest packages can be transported in time.

Details of the packing and preservations material used, validity of these packing and preservation for necessary subsequent preservation and packing for equipments and spares shall also be furnished to the purchaser.

Galvanized materials must be transported properly to ensure that galvanized surface is not damaged during transit. Application of zinc rich paint at site shall not be allowed.

PACKING IN CRATES

For the equipment packed in crates, the packing wood shall be as per relevant Indian/ International standards. The base of the crate shall be made of wooden batons and planks giving necessary reinforcement, so that the bottom of the equipment is at a height of 100mm minimum from the ground level. The size of the plank shall be decided by the sub-contractor to suit the weight of

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equipment. Minimum thickness of the plank shall be 25mm and minimum width shall be 150mm. Crate shall be made while keeping the gap from 25mm to 200mm depending upon the size of equipment and weight. However, the responsibility of proper packing and safe delivery of the equipment to site lies with the supplier

3.25 DEVIATIONS FROM SPECIFICATIONS

Deviation, if any, from any these specifications shall be listed out separately. Bidder shall attach a separate sheet titled as “DEVIATIONS FROM SPECIFICATIONS” and list all deviations details of each deviation Section wise and Clause wise. In absence of any deviation listed out separately, adherence the specifications shall be assumed.

3.26 INFORMATION TO BE FURNISHED BY THE CONTRACTOR/ SUB CONTRACTOR

Information/ documents to be furnished at the TENDER / CONTRACT STAGE shall be as given below: (marked 'X' in the appropriate column)

| DETAILS OF DOCUMENTATION TO BE FURNISHED | At Tender Stage | At Contract Stage |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|
| Technical offer with details of equipment, scope etc | X | |
| Guaranteed Technical particulars | X | X |
| Schedule of Tests to be conducted | X | |
| Schedule of deviations, if any, Section wise, clause wise, with respect to technical specifications | X | |
| List of past supplies complete with purchase & project ref., quantity, order ref., etc. where identical equipment have been supplied. | X | - |
| Manufacturing Quality Plan/ Standard Check List | X | X |
| Field Quality Plan | X | X |
| GA drg with dimensions & weight and foundation/ fixing details | X | X |
| Drg & Data submission schedule (to be furnished at contract stage shall be specified date-wise here). | X | X |
| Type test Reports. | X | X |
| Bar chart showing the time schedule indicating the time required for design submission of drawing, manufacture of eqpt, test and inspection. | X | |
| Routine / Acceptance test reports. | | X |
| Installation , Operation & Maintenance Manual | X | X |
| Field Quality Plan for receipt and storage, installation, testing and commissioning with details of test equipment, tests to be conducted and acceptance values | X | X |

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