BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

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SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.1 SCOPE

The scope of this specification is to specify all details required by a supplier for preparation detailed fabrication drawings (structure assembly drawings), fabrication, protoassembly, galvanising and supply of galvanized steel structures for projects being executed by BHEL on turnkey basis for NTPC, PGCIL, SEBs and other Customers.

The detailed scope of work is preparation, submission and approval of detailed fabrication drawings (structure assembly drawings), fabrication, galvanizing and supply of all towers., beams, lighting/lightning masts, platform structures made of channels, beams, angles, etc., equipment supporting structures (lattice & pipe type), platform ladders, gratings/grills, base plates, stiffener plates, fixtures for supporting and operating mechanism boxes, control cabinets and other such items required to complete the job excluding all fixtures, such as nuts, bolts, step bolts and washers. However, detailed and accurate bill of quantities for nuts, bolts, step bolts and washers shall be given by the supplier in the drawings submitted by him. The detailed structure assembly drawing shall be prepared based on input/line sketches provided by BHEL **(For lattice structures fabrication drawings shall be provided by BHEL)** after award of work. Submission of 1 set of shop drawings for reference is also in the scope.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

The specific technical requirements shall be as per Standard Technical Specification (Refer Section 2).

1.3 QUANTITIES

The quantities indicated are tentative & it may change to the order of +/- 30% during detailed engineering at contract stage.

S.No.	Description	Quantity in MT
1	Preparation of shop drawings based on fabrication drawings provided by BHEL, fabrication,,protoassembly, submission of protocorrected drawings/BOMs, mass fabrication, galvanising, inspection and supply of ***lattice type galvanized*** steel structures. (Zinc coating 610 gms/sqm)	
2	Preparation of fabrication drawings based on inputs provided by BHEL, preparation of shop drawings based on approved fabrication drawings, fabrication,, protoassembly, submission of protocorrected drawings/BOMs, mass fabrication, galvanising, inspection and supply of ***pipe type galvanized*** steel structures. (Zinc coating 610 gms/sqm)	

3	Add extra on above for providing additional zinc coating of 100gms/sqm each or part thereof.	

SECTION - 2

2.0 GENERAL

This section covers the standard technical specification for GI Structures.

2.1 STEEL MATERIAL

Steel materials shall conform to IS:2062-1992.

For tubular type equipment support structures, ERW pipes conforming to IS:1161-1979 shall be used.

Steel shall not be pitted and should be free from scales and rust. If the rolled section and plates are bent or distorted, bend or distortion shall normally be removed by the cold treatment. Straightening under hot stage shall be resorted to only under specific permission from BHEL. If any rolling defects viz., laminations, cracks etc. are discovered in the steel during the processing, it is to be rejected.

TOLERANCE:

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS:1852-1985.

No rolled or fabricated member shall deviate from straightness by more than 1/1000 of the axial length or 10mm which ever is smaller.

2.2 FABRICATION

GENERAL:

All the workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined true and square where so specified. All holes and edges shall be free of burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished. Material at the shops shall be kept clean and protected from weather.

The fabrication of galvanized steel structures shall be carried out generally in accordance with IS:802 part. II, IS:800-1984. All materials shall be completely shop fabricated. Normally, butt splices shall be used. The components constituting the joint shall have a total strength greater than the heavier of the members connected. Lap splices may be used for connecting members of unequal sizes. The inside angle of lap splice shall be grounded at the heel to fit the fillet of the outside angle. The splices shall develop full strength of the members connected through bolts. Butt as well as lap splices shall be made as close to the main panel points as possible.

Joints shall be so designed and detailed as to avoid eccentricity as far as possible. However, where joints are such that the elimination of gusset plates would result into eccentric joints, gusset plates and spacer plates may be

used in conformity with modern practices. The thickness of gusset plates shall not be less than 6mm. Where a gusset plate is required to transmit stress; its thickness shall not be less than the thickness of the thickest plate plus 2mm.

The use of filler in the connections shall be avoided as far as possible. The diagonal members in tension may be connected entirely to the gusset plate where necessary to avoid the use of fillers. Each diagonal shall be in one piece without splices or center gussets, and it shall be connected at the point of intersection by one or more bolts.

The gap between the ends of two connected members in butt joints shall not be more than 6 mm and less than 4mm.

The switchyard structure members shall be accurately fabricated to bolt together easily at site without any undue strain on them or the bolts.

Drain holes shall be provided at all points where pockets or depressions are likely to hold water.

Pipe supports shall be fabricated from single un-jointed pipe and no welded joint shall be allowed along the length of the structure.

STRAIGHTENING:

For rolled steel material, if straightening or flattening is necessary, it shall be done by methods that will not injure the materials.

CUTTING:

Cutting may be effected by chopping, cropping, sawing or machine flame cutting. Sheared or cropped edges shall be dressed to a neat workmanlike finish and shall be free from distortion and burrs.

PUNCHING AND DRILLING:

Holes in members may be punched full size through material not over 12mm thick. Holes must be cleaned of burrs and ragged edges. Drilled holes shall be preferred. Holes made by drilling shall also be cleaned of burrs and ragged edges. Where several parts are to be drilled, they shall be first assembled, tightly clamped together and drilled through.

Punched holes must be square with plates and the walls of the holes shall be parallel. The following maximum allowance in accuracy of punched holes is permissible:

i) Holes must be perfectly circular and no tolerance in this respect is permissible.

ii) The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8 mm, i.e. the allowable taper in punched holes should not exceed 0.8 mm in diameter.

iii) Holes must be square with the plates. Holes at angle or slant shall not be permitted.

The minimum spacing of bolts and edge distances shall be as given below:

Bolt Diameter	Minimum Bolt Spacing	Maximum edge distance	
		Hole center To rolled Edge	Hole center to cut/ flame edge
(mm)	(mm)	(mm)	(mm)
16	40	20	23

WELDING:

The work shall be done as per approved fabrication drawings, qualified welding procedure specifications (WPS) and by qualified welders. Procedure qualification records (PQR) shall be maintained. Electrodes for shielded arc manual welds shall comply with the requirements of IS:814 - 1991. All welds shall be free from defects like blow holes, slag inclusions, lack of penetration, under cutting, cracks etc. All welds shall be cleaned of all slag or flux before galvanizing.

MARKING OF MEMBERS FOR IDENTIFICATION.

All members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on. The erection mark shall be stamped with a metal dye with figures at least 16 mm high and to such optimum depth as to be clearly visible, even after a member is galvanized. All erection marks shall be on outer surface of all sections and near one end, but clear of bolt holes. Marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location.

Erection marks on like pieces shall be in identical locations. Members having lengths of 3.0 M or more shall have the erection mark at both ends.

PROTOTYPE ASSEMBLY:

Towers, beams, equipment structures, etc. shall be trial assembled at shop before galvanizing i.e. prototype assembly keeping in view the actual site condition prior to dispatch to erection site. The prototype assembly of each structure shall be got approved from BHEL/Customer as directed. Necessary match marks shall be made on each components before dismantling the prototype assembly and galvanizing. Any error shall be rectified at the expense of the contractor.
No extra charge on account of erecting the assemblies or getting them inspected will be permissible. It is however to be mentioned that the responsibility for proper fitting of various members for the erection of the

structure in the field will rest with the supplier and any discrepancy found at the time of erection will have to be rectified by the contractor at his cost.

2.3 GALVANISING:

All structural steel works and single pipe supports shall be hot dip galvanized after fabrication. Galvanizing of each members shall be carried out in one complete immersion and double dipping shall not be permitted.

Zinc required for galvanizing will have to be arranged for by the Contractor. Purity of zinc to be used for galvanizing shall be 99.5% as per IS:209-1992.

All burrs and irregular edges shall be ground smooth before galvanizing.

After all shop work is complete, all structural materials shall be punched with the Erection Mark and be hot dip galvanized. Before galvanizing the steel section shall thoroughly be cleaned of any paint, grease, rust, scale, acid/ alkali or such other foreign matters as are likely to interfere with the galvanizing process or with the quality and durability of the zinc coating. Pickling shall be carefully done and shall be proper.

Minimum weight of zinc coating shall be 610gms/sqm. However, higher coating may be provided as per requirement.

The galvanized surface shall consist of a continuous and uniformly 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, spelter 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.

There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633 - 1986.

When the steel section is removed from the galvanizing kettle excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose.

Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specification, or lack of quality control in any manner in the galvanizing plant shall render the entire production in the relevant shift liable to rejection.

All the galvanized structural steel members and accessories shall be treated with sodium dichromate or an approved equivalent solution after galvanizing, so as to prevent white storage stains.

If the galvanizing of any member is damaged, BHEL shall be shown of the extent of damage and if so directed the galvanizing may have to be redone in the similar manner as stated above at no extra cost.

Contractor shall also furnish sufficient quantity of appropriate paint, free of cost, for repairing galvanized surfaces damaged in transit, and minor modifications done at site during erection.

Galvanizing tests shall be made from time to time on as many samples as may be considered necessary. The supplier shall supply all samples and equipment and carry out the tests without any extra cost.

2.4 INSPECTION OF MATERIALS

GENERAL:

Contractor shall give notice to BHEL in advance for inspection of materials. All rejected material shall be promptly removed from the shop and replaced with new material for BHEL approval/ inspection. The fact that certain material has been accepted at Contractor's shop shall not invalidate final rejection at site by BHEL if it fails to be in proper condition or has fabrication inaccuracies which prevents proper assembly. No materials shall be painted, galvanized or dispatched to site without the inspection and approval by BHEL unless such inspection is waived off in writing by BHEL.

Shop inspection by BHEL, for submission of test certificates and acceptance there of by BHEL shall not relieve contractor from the responsibility of furnishing material conforming to the requirements of these specifications, nor shall it invalidate any claim which BHEL may make because of defective or unsatisfactory material and workmanship.

Contractor shall provide all the testing and inspection services and facilities for shop work. For fabrication work carried out in the field the standard of supervision and quality control shall be maintained as in shop fabricated work. The inspection and testing shall be conducted in a manner satisfactory to BHEL.

The inspection and tests shall be as given below and the minimum requirement shall be as per quality plan attached. The final Quality plan shall be decided between Supplier, BHEL and Customer/ Owner.

MATERIAL TESTING

If mill test reports are not available for any steel materials the same shall be got tested by the contractor and demonstrate conformity with the relevant specification to the full satisfaction of BHEL. The cost of such tests shall be borne by the contractor.

DIMENSIONS AND WORKMANSHIP:

The Structural Steel members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment and surface finish, are in accordance with the requirements shown in Contractor's approved shop drawings.

INSPECTION OF TEST FAILURE:

In the event of any failure of structural steel members to meet an inspection or test requirement, contractor shall inform BHEL and must obtain permission from the BHEL before repair is undertaken. The quality control procedures to be allowed to ensure satisfactory repair shall be subject to approval by BHEL.

2.5 PACKING TRANSPORTATION AND DELIVERY

After completion of final inspection and marking, the fabricated galvanized structural items shall be packed and loaded for transportation.

Packing must be adequate to protect items against bending and any mechanical injuries and damage to galvanized film during loading and unloading. As far as possible, like member should be bundled together and tied.

Proper lifting devices shall be used for loading at shop and unloading at site in order to protect items against bending, mechanical injuries and damage to galvanized film.

Loading, transporting and unloading shall be done in compliance with transportation rules.

Slender and projected parts shall be braced properly with additional spacer steel bars, spacer wood etc, before loading for transportation, to protect against bending or any other damages during transportation.

If certain parts cannot be transported in the lengths stipulated in the design drawing, the position and type of additional splice joints shall be got approved from BHEL.

Items must be carefully loaded and tied up properly to prevent bending, falling etc. during transportation.

The small parts such as plates, gussets, cleats etc. shall be securely tied with the wire, and packed in double gunny bags and cased as per the actual requirements..

As far as possible the delivery of fabricated galvanized structural steel shall be as per the order stipulated by BHEL and to suit the erection sequence.

Contractor shall make good/ replace at his own cost any damage occurred during loading, transporting, unloading and stacking of fabricated galvanized steel structures as directed by BHEL. No extra payment on this account shall be entertained under any circumstances.

2.6 APPLICABLE STANDARDS

Unless otherwise specified, materials, and workmanship shall conform to the following standards.

1. IS : 209 - 1992 - Zinc Ingot.
2. IS : 228 - 1959 - Method of chemical analysis of pig

			iron, cast iron, plain carbon and low alloy steel.
3.	IS : 406 - 1964	-	Methods of analysis of zinc (Spelter).
4.	IS : 800 - 1984	-	Code of practice for general construction.
5.	IS : 802 - Part1 - 1977 - Part1/Sec.2/1992 - Part2 - 1978 - Part3 – 1978	-	Code of Practice for use of structural in over head Transmission line towers.
6.	IS : 806 - 1968	-	Code of practice for use of steel tubes in general building construction.
7.	IS : 808 - 1989	-	Dimensions for hot rolled steel beam, column, channel and angle sections.
8.	IS : 814 - 1991	-	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
9.	IS : 816 - 1969	-	Code of Practice for use of metal arc welding for general construction in mild steel.
10.	IS : 817 - 1966	-	Code of practice for training & testing of Metal Arc welders.
11.	IS : 1161 - 1979	-	Steel tubes for structural purposes.
12.	IS : 1599 - 1985	-	Method of bend test
13.	IS : 1608 - 1972	-	Method of tensile testing of steel products.
14.	IS : 1852 - 1985	-	Rolling and cutting tolerances for hot rolled steel products.
15.	IS : 1978 - 1982	-	Line pipe
16.	IS : 2062 - 1992	-	Steel for general structural purposes.
17.	IS : 2074 - 1992	-	Ready Mixed Paint, air drying red oxide zinc, chrome, priming.

18.	IS : 2629 - 1985	-	Recommended practice for hot dipped galvanising on Iron & Steel.
19	IS : 2633 - 1986	-	Methods for testing uniformity of coating on zinc coated articles.
20.	IS : 3502 - 1981	-	Steel chequered plates.
21.	IS : 4759 - 1984	-	Hot dip zinc coating on structural steel and other allied products.
22.	IS : 6745 - 1972	-	Method for determination of mass of zinc coating on zinc coated iron and steel articles.

SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections and is not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 QUALIFYING REQUIREMENT

The contractor shall have adequate galvanizing facilities to galvanize the longest single steel member of 6.5m length in one dip.

All structural assembly drawings shall be prepared in Auto Cad (Release 12 or better).

3.2 SITE INFORMATION

SL.NO.	DESCRIPTION	
3.2.1	**PROJECT INFORMATION**	
	a) Customer	
	b) Project	
	c) Project location	
	d) Transport facilities Nearest Railway Station/Gauge Distance from Railway Station	
	e) Access roads	

3.3 STANDARDS

All materials shall comply in all respect with the requirement of the latest edition of the relevant codes as listed in Section2.

3.4 UNIT

Metric (System International) units of measurements shall be used in all drawings.

3.5 DRAWINGS, BILL OF MATERIALS AND CDs

At each stage following set of fabrication drawings/Bill of materials shall be submitted.

i) Fabrication Drawings : 4 sets
ii) Bill of Materials : 4 sets

After final approval of proto –type assembly of structures, the drawings shall be updated as per proto and marked "PROTO CORRECTED". The following sets of fabrication drawings/shop drawings/bill of materials/CDs shall be submitted for distribution:

i)	Fabrication Drawings	: 1 set
ii)	Shop Drawings	: 1 set
ii)	Bill Of Materials	: 1 set
iii)	CDs	: 2 sets

3.6 CATEGORIES OF APPROVAL

CATEGORY I — This means that the documents/drawings is approved.

CATEGORY II — This means that the document/drawing is approved with comments i.e, some corrections are required but the contractor can go ahead with the manufacture after incorporating comments.

CATEGORY III — This means that the document/drawing is not approved i.e major revisions are required and the contractor can not proceed with the manufacture.

3.7 ERRORS

Any error in fabrication work preventing proper assembly and fitting up of parts in the field, shall be classified as defective workmanship. All changes incurred by BHEL either directly or indirectly because of this shall be deducted from the amount due to the contractor.

3.8 PURCHASE ORDER NUMBER

The P.O No. shall be mentioned on all documents and drawings.

SECTION – 5

MANUFACTURING QUALITY PLAN

5.1 The minimum inspection and test requirements for lattice & pipe type structures shall be as per attached quality plans.

SECTION-6

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER

RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:
BIDDER:OFFER REFERENCE:

6.1 Deviations Tick [YES] [NO]

If yes,

S.No.	Deviation	Clause No.
1		
2		
3		
4		

(Signature & Seal of Bidder)