APPENDIX-III

Standard Manufacturing Quality Plan

STANDARD MANUFACTURING QUALITY PLAN
FOR
TRANSMISSION LINE TOWER STRUCTURES / PARTS

(Doc No: CC/QA&I/MQP/Standard/Tower parts/Rev 05)

(Valid From : 01-09-2019 to As per MQP Approval Letter)

INSTRUCTIONS FOR CODE ALLOCATION

Code 1	**Indicates place where testing is planned to be performed i.e. Inspection location**	Code 2	**Indicates who has to perform the tests i.e. Testing Agency**
A	At Equipment Manufacturer's works (Fabricator)	J	The Equipment Manufacturer
B	At Component Manufacturer's works (Re-roller)	K	The Component Manufacturer
C	At Authorized Distributor's place	L	The Third Party
D	At Independent Lab	M	The Turnkey Contractor
E	At Turn Key Contractor's location		
F	Not specified		
Code 3	**Indicates who shall witness the tests i.e. Witnessing Agency**	**Code 4**	**Review of Test Reports/Certificates**
P	Component Manufacturer itself	W	By Equipment manufacturer during raw material / bought out component inspection
Q	Component Manufacturer and Equipment Manufacturer	X	By Contractor during product/process inspection
R	Component Manufacturer, Equipment Manufacturer and Contractor	Y	By POWERGRID during product/process inspection
S	Equipment Manufacturer itself	Z	By Contractor and/or POWERGRID during product/process inspection
T	Equipment Manufacturer and Contractor		
U	Equipment Manufacturer, Contractor and POWERGRID		
V	Third Party itself		
Code 5	**Whether specific approval of sub-vendor / Component make is envisaged?**	**Code 6**	**Whether test records required to be submitted after final inspection for issuance of CIP/MICC**
E	Envisaged	Y	Yes
N	Not Envisaged	N	No

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						Remarks
							1	2	3	4	5	6	
A. Raw Material Inspection (Indigenous)													
1.1	Structural Steel (Sections and Plates) - to be procured from POWERGRID approved Sources. If procured from re-rollers, specific vendor approval of POWERGRID needs to be ensured and CIP for every lot at re-roller's works.												
1.1.1	**Mechanical Properties**										E		
(a)		Test For Ultimate Tensile Strength	2 - Samples/cast/heat /Section for each vendor Or one sample per 20 MT / Section or Part Thereof for each vendor, subject to minimum of two samples, if cast/heat wise not maintained	IS: 2062:2011 Grade E250, POWERGRID Tech. Specn. IS: 2062:2011 Grade E350, POWERGRID Tech. Specn.	410 N/mm² (Min.) 490 N/mm² (Min)	Manufacturer's format of record (MFOR)	A	J	S	Z		N	The sampling Plan indicated is for material procured from POWERGRID approved source, where CIP is not required. Sampling plan for material which has been procured with CIP shall be as follows: 1 sample/section/lot for each vendor
(b)		Yield Stress		IS: 2062:2011 Grade E250, POWERGRID Tech. Specn. IS: 2062:2011 Grade E350, POWERGRID Tech. Specn.	i) <20mm thick: 250 N/mm² min ii) 20-40 mm thick: 240 N/mm² Min. iii) >40mm thick : 230 N/mm² min. i) <20mm thick : 350 N/mm² min ii) 20 - 40 mm thick : 330 N/mm² Min. iii) >40mm thick : 320 N/mm² min.	(MFOR)	A	J	S	Z		N	
(c)		Percentage Elongation at 5.65√Area		IS: 2062:2011 Grade E250, POWERGRID Tech. Specn. IS: 2062:2011 Grade E350, POWERGRID Tech. Specn.	23% Min. 22% Min.	(MFOR)	A	J	S	Z		N	
(d)		Bend Test	2 - Samples/cast/heat /Section for each vendor Or one sample per 20 MT / Section or Part Thereof for each vendor, subject to minimum of two samples, if cast/heat wise not maintained	IS: 2062:2011 Grade E250, POWERGRID Tech. Specn. IS: 2062:2011 Grade E350, POWERGRID Tech. Specn.	Piece at room temp. shall with stand bending through 180 degree to an internal dia i) not greater 2t for 25 mm, ii) 3t for > 25 mm, with both side parallel, without cracking. Piece at room temp. shall with stand bending through 180 degree to an internal dia i) not greater 2t	(MFOR)	A	J	S	Z		N	-do-

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						
							1	2	3	4	5	6	Remarks
(e)		Impact Test	1 - Sample per section per lot for each source	IS: 2062:2011 and IS 1757	IS: 2062:2011 and IS 1757	(MFOR)	A	J	S	Z		N	Applicable only if Material Grade E 250C /E 350 C/ E250 B0/E350 B0/E250Br/E350BR specified in Bill of Material /Drawing or TS
1.1.2	**Chemical Composition**	Chemical Analysis	1 - Sample per section per lot for each source	As per Chemistry enclosed at **Annexure-I** for each source	As per Chemistry enclosed at **Annexure-I** for each source	(MFOR)/TPL Reports	A/D	J /L	S/V	Z	-	N	
1.1.3	**Visual Inspection**	Visual	One sample for 50 MT / Section or Part Thereof	IS 2062:2011 POWERGRID Tech. Specn.	Material to be free from surface defects like laminations, rough/jagged and imperfect edges, cracks, rounded apex, deep roll marks, pipy and any harmful defects.	(MFOR)/TPL Reports	A	J	S	Z		N	
1.1.4	**Dimensional Inspection**	Measurement	One sample for 50 MT / Section or Part Thereof	IS 808/ IS 1730 / IS 1852 & POWERGRID Tech. Specn.		(MFOR)	A	J	S	Z		N	
(i)	**Angle section**												
a)	Tolerances For Leg Length of Angles Equal / Un Equal		One sample for 50 MT / Section or Part Thereof	IS 1852/ IS 808	Equal: (i) Up to 45 mm Leg Length : ± 1.5 mm (ii) > 45 to 100 mm Leg Length : ± 2.0 mm (iii) >100 mm Leg Length : ± 2.0 % of leg length Difference between Leg Length of Equal Angles shall be limited to 75 % of Total Tolerance (Plus & Minus) Unequal: tolerance as per IS	(MFOR)	A	J	S	Z		N	
b)	Out of Squareness	Measurement	One sample for 50 MT / Section or part thereof	IS 1852 POWERGRID Tech. Specn.	±1°	(MFOR)	A	J	S	Z		N	
c)	Camber	Measurement	One sample for 50 MT / Section or part thereof	IS 1851	(i) For Flange Less than 100 mm Reasonably Straight (ii) For Flange 100 mm & above Max 0.2% of length	(MFOR)	A	J	S	Z		N	

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						Remarks
							1	2	3	4	5	6	
d)	Root radius	Measurement	-do-	IS 808	IS 808	Test Report	A	J	S	W	-	N	
e)	Weight Tolerance For Angle Sections	Unit Weight Test	One sample for 50 MT / Section or part thereof	IS 1852 /IS 808	i) Up to 3 mm thick: ±5%, ii) > 3 mm thick :+ 5%, - 3 % over weights specified in IS 808	(MFOR)	A	J	S	Z		N	
(ii)	**Plate**												
a)	Weight Tolerances	Unit Weight Test	One sample for 50 MT / Section or part thereof	IS 1852 / IS 1730	+5%, -2.5% over weights specified in IS 1730	(MFOR)	A	J	S	Z	-	N	
b)	Thickness Tolerance	Measurement	One sample for 50 MT / Section or part thereof	IS 2062:2006 / IS 1730 / IS 1852	< 8 mm thick : + 12.5 %, - 5 %, 8 mm - 12 mm : + 7.5 %, - 5 %, over 12 mm ± 5 %	(MFOR)	A	J	S	Z	-	N	
1.2	**Zinc- To be procured from POWERGRID approved sources or Imported LME registered source**												
	Chemical Composition	Chemical Analysis	Every Consignment	IS 209/IS 13229	IS 209/IS 13229	Zinc Manufacturer TC	B	K	P	W	E	N	
			One sample for 100MT or Part thereof	IS 209/IS 13229	IS 209/IS 13229	TPL Reports	D	L	V	W	E	N	
			One sample of molten zinc taken from bath per quarter	IS 209/IS 13229	Min Zinc purity 98.5%	TPL Reports	D	L	V	W	E	N	
B) In-Process Inspection													
2	Fabrication of Tower Parts			IS 802 Part II/ IS 7215/ POWERGRID approved Drwg., Shop Sketches									
(a)	Straightening	Visual	100%										
(b)	Cropping (Cutting)	Dimensional	Ist Piece and every 50th Piece		Length Tolerance : ± 2 mm, The cut surface to be clean, reasonable square & free from distortion.	MFOR	A	J	S	Z	-	N	
(c)	Stamping	Visual	Ist Piece and every 50th Piece		Letter size as per POWERGRID Tech. Specn. / TPL norms	-do-	A	J	S	Z	-	N	

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						Remarks
							1	2	3	4	5	6	
(d)	Punching / Drilling	Dimensional	Ist Piece and every 50th Piece		Holes for bolts shall be drilled or punched with a jig but drilled holes shall be preferred. The punching may be adopted for thickness up to 12 mm. Tolerances regarding punch holes should be as follows: a)Holes must be perfectly circular and no tolerances in this respect are possible. b)The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8mm,i.e the allowable taper in a punched hole should not exceed 0.8mm on diameter. c)Holes must be square with the plates or angles and have their walls parallel.	-do-	A	J	S	Z	-	N	
(e)	Edge Security	Dimensional	Ist Piece and every 50th Piece	IS 802 Part II/ IS 7215/ POWERGRID approved Drwg., Shop Sketches		-do-	A	J	S	Z	-	N	
(i)	For 13.5 mm dia Hole				Sheared 20mm Min.								
					Rolled 16mm Min.								
(ii)	For 17.5 mm dia Hole				Sheared 23mm Min.								
					Rolled 20mm Min.								
(iii)	For 21.5 mm dia Hole				Sheared 28mm Min.								
					Rolled 25mm Min.								
(iv)	For 25 mm & 25.5 mm dia Hole				As per approved drawing								
(f)	Drilling & Punching Hole To Hole Distance		I[st] Piece and every 50th Piece		Tolerance cumulative and between consecutive hole shall be within ± 2 mm and ± 1mm respectively	-do-	A	J	S	Z	-	N	

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						
							1	2	3	4	5	6	Remarks
(g)	Notching Flange Cut Corner Cut Bevel Cut		I[st] Piece and every 50th Piece		+ 5mm on specified length of cut, operationally shearing up to 12 mm thick & by gas cutting for material above 12 mm thick	-do-	A	J	S	Z	-	N	
(h)	Heel Cutting	Dimensional	I[st] Piece and every 50th Piece	POWERGRID Approved Drwgs./ Shop Sketches	for members > 12mm thick - gas cutting may be adopted followed By grinding/Machine cutting; Tolerance on heel cutting length: +10mm	-do-	A	J	S	Z	-	N	
(i)	Bending		100% Pieces	IS 802(Part II)/ IS 7215/ POWERGRID Approved Drawing / Shop Sketches	(1) HT Sections / Plates - All Sections & all plates to be hot bent. (2) MS Section- i) Cold – Section upto 75X75X6 - Angle Upto 10° ii) Cold – Section upto 100X100X8 – Angle Upto 5° iii) Hot - Section above 75X75X6 – Angle Above 10° iv) Hot - Section above 100X100X8 – Angle Above 5° (3) M. S. Plates i) Cold Upto 12 mm thick - Angle Upto 15° ii) Hot - Others	-do-	A	J	S	Z	-	N	
(j)	Welding	(a) WPS Approval (Welding procedure specification) (b) PQR/WQR Approval (Procedure /Welder qualification record)		As per Power Grid Technical specn./approved Drg./POWERGRID approved Welding procedure & Welder`s qualification		-do-	A	J	U	Y	-	N	WPS approval by POWERGRID CIP at black stage for welded members
	Welding	(1) DP Test (2)Dimensional & visual for welded tower parts	Random Basis	-- do ---		-do-	A	J	U	Z	-	N	CIP

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						Remarks
							1	2	3	4	5	6	
(k)	Final Inspection of Fabricated Parts		Random Basis	All parameters from (a) to (j) above are checked and record maintained before releasing the materials for galvanizing.		-do-	A	J	S	Z	-	N	
(l)	Foundation Bolts i) Cutting & Shearing ii) Chamfering iii) Threading	Physical	1st piece & every 50th piece	IS 802/POWERGRID technical spec./approved drawing		MFOR	A	J	S	Z		N	
3	**GLAVANIZING (Surface Preparation Procedure)**												
3.1	**Degreasing**	Chemical	One sample daily	IS 2629	Manufacturer's plant standard / IS	-do-	A	J	S	Z	-	N	
3.2	**Pickling**	Chemical	One sample daily	IS 2629	Manufacturer's plant standard/IS Iron contents 100 to 120 gram/litre. Max	-do-	A	J	S	Z	-	N	
3.3	**Rinsing**	Chemical	One sample daily	IS 2629	Manufacturer's plant standard / IS	-do-	A	J	S	Z	-	N	
3.4	**Pre Fluxing**	Chemical	One sample daily	IS 2629	IS 2629	-do-	A	J	S	Z	-	N	
3.5	**Pre-heating**	Measurement	One check daily	IS 2629	IS 2629	-do-	A	J	S	Z	-	N	
3.6	**Dipping** After drying is over the material is dipped in molten zinc. Following parameters are controlled					-do-	A	J	S	Z	-	N	
	a) Zinc bath temperature Recording is done by graphical manner OR sensors with digital display		Hourly check	IS 2629	450+/-10° C.	-do-	A	J	S	Z	-	N	

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						
							1	2	3	4	5	6	Remarks
	b) Immersion & Withdrawal time. Degree of immersion and withdrawal time is decided based on thickness and length of material.			IS 2629	IS 2629	-do-	A	J	S	Z	-	N	
3.7	**Quenching in Running Water:** After dipping the material is quenched in running water			IS 2629	IS 2629	-do-	A	J	S	Z	-	N	
3.8	**Dichromating :** After quenching, material is dipped in sodium dichromatic solution to avoid the white rust. (Proprietary Chemicals.)		One Sample	IS 2629	IS 2629	-do-	A	J	S	Z	-	N	
4	**Galvanizing Checking**												
(a)	Visual Checking	Visual	100%	IS 2629	Surface to be free from defects like bare / black spots, (except when small and suitable for patching) heavy ash & flux inclusions, lumps, pimples, runs etc.	-do-	A	J	S	Z	-	N	
(b)	Thickness of Zn Coating	Measurement	8 samples / shift	IS 4759	The minimum average zinc coating for all section shall be 87 microns for thickness $\geq$ 5 mm & 65 microns for thickness < 5mm and for plates	-do-	A	J	S	Z	-	N	*For marine mentioned in BPS, $\geq$5mm=127 micron, <5mm & plate=87 micron

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						
							1	2	3	4	5	6	Remarks
(c)	Weight of Zinc Coating	Measurement	3 samples / shift	IS 4759 / IS 6745	(a) For thickness below 5mm, but not less than 2 mm - Average Mass of Coating - 460gm/m² (b) For thickness 5mm & above – Average Mass of Coating - 610 gm/m²	-do-	A	J	S	Z	-	N	*For marine, ≥5mm=900gm/ m², <5mm & plate=610 gm/ m²
(d)	Uniformity of Zn Coating	Measurement	3 samples / shift	IS 2633	Material to withstand 4 dips of one minute each without showing signs of copper deposits	-do-	A	J	S	Z	-	N	
(e)	Adhesion Test of Zinc coating	Pivoted Hammer Test	3 samples / shift	IS 2629	No removal or lifting of coating in areas between hammer impressions	-do-	A	J	S	Z	-	N	
C. Final Inspection & Testing (Inspection Engineer to Check/ensure compliance to notes/General Requirements given on Notes of MQP.)													
(a)	VISUAL & DIMENSIONAL INSPECTION For Fabrication (as per approved dwg.) & Galvanizing	Visual & Measurement	One sample for Every 50 MT/ section/Lot or part thereof for each source/vendor	Please refer Sr. No 2(a) to 2(j) & Cl. No. 4.3 (a)	Please refer Sr. No 2(a) to 2(j) & Cl. No. 4.3 (a)	Test Report	A	J	U	Z		Y	CIP
(b)	MECHANICAL	(i) UTS Test (ii) Yield Stress Test (iii) % Elongation Test (iv) Bend Test (v) Impact Test, if applicable	One sample for Every 50 MT/ section/Lot or part thereof for each source/vendor	Please Refer (for test values) Sr. No. 1.1.1(a), (b) (c), (d) , (e)	Please Refer (for test values) Sr. No. 1.1.1(a), (b) (c), (d) , (e)	Test Report	A	J	U	Z	-	Y	CIP
(c)	Chemical Properties	Spectro Analysis	-do-	IS 2062:2012	Chemistry needs to be comparable with approved supplier TC	Test Report	A/ D	J/ L	U/V	Z		Y	CIP (Applicable for all except for black angle sections procured from POWERGRID approved Re-rollers with stage CIP. 10% samples shall be selected randomly for chemical testing from the Samples taken from material procured with CIP .)

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						
							1	2	3	4	5	6	Remarks
(d)	GALVANIZING TESTS	i) Thickness of Zinc Coating ii) Weight of Zinc Coating iii) Uniformity of Zinc Coating iv) Adhesion Test of Zinc Coating	One sample for Every 50 MT/ section/Lot or part thereof	IS 2629/IS 4759/IS 6745/IS 2633/	Please refer Cl. 4.0	Test Report	A	J	U	Z	-	Y	CIP
5	**For Foundation Bolt-**						A	J	U	Z	-	Y	CIP
	a) Dimensional test	Measurement	Sampling asper IS 1367/2500	POWERGRID Drawing	POWERGRID Drawing	Test Report							
	b) Mechanical Test UTS, Yield & Elongation	Mechanical	2 sample /heat/cast/lot of 100 MT	As per IS 2062/SAE 1018	As per IS 2062/SAE 1018								
	c) Chemical Test	Spectro Analysis	2 sample /heat/cast/lot or part thereof	As per IS 2062/SAE 1018	Chemistry needs to be comparable with raw material supplier TC	TPL Report							
6	Packing, Storing, Bundling and Handling	100%			IS802/POWERGRID specn./ Packing list to be submitted along with dispatch documents	Tower manufacturer's Log Book/Format No							Tower wise bundling shall be carried out. Pieces of light sections to be wire bundled and heavy sections to be supplied loose. Stacking to have proper ventilation and kept inclined. Damage to galvanization coating to be avoided while handling. to ensure sequential supplies and other details as per POWERGRID technical specification.

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						
							1	2	3	4	5	6	Remarks

NOTES / GENERAL REQUIREMENTS TO BE CHECKED/ENSURED

1 The manufacturer if purchasing the steel sections directly from the re-rollers, the POWERGRID approved re-roller MQP to be ensured.

2 Nuts/Bolts and Step Bolts / Nuts and other bought out items to be procured from POWERGRID approved sources and inspection at sub-vendor's works.

3 Welding procedure and Welder's performance qualification approval by POWERGRID is required in case welding is involved at any stage of fabrication of Tower parts.

4 All bent pieces shall be checked at the process of bending by a bend gauge made as per bend ratio/degree shown in the sketch of the item / mark no. On the stand, one piece is thoroughly checked with bend gauge and all other pieces are checked by comparison method and pieces are cleared for further process. If the holes are to be made near the bend line, the same shall be done after bending.

5 The sample pieces consumed in a testing shall be replenished by the manufacturer at the time of dispatch. If the offered material meets the quality requirements, CIP/MICC shall be issued for total quantity offered without deducting the weight of materials consumed in testing.

6 POWERGRID Specification means POWERGRID Technical Specification, Approved Drawing, Approved Technical data sheet and LOA provisions applicable for the specific contract.

7 **Grades of steel used and the standards to which the material conforms, shall be as approved by POWERGRID Engineering for the specific contract and same needs to be indicated in approved Drawings/ BOM & offer list.**

8 Steel plates below 6mm size used for packing plates/packing washers, produced as per IS: 1079 (Grade-0) are also acceptable. However, if below 6mm size plate are used as load bearing plates viz gusset plates , joint splices etc. the same shall conform to IS : 2062 or equivalent standard. Flats of equivalent grade meeting mechanical strength/ metallurgical properties may also be used in place of plates for packing plates/ packing washers.

9 The manufacturer shall maintain proper co-relation of test certificate with respect to the material from raw material stage to finished material stage (whether procured from POWERGRID approved sources on self- certification basis i.e. no stage CIP or POWERGRID approved re-rollers)

10 The manufacturer shall strip off galvanizing of rejected material before re-galvanizing in case rejection is due to galvanizing defects.

11 The manufacturer shall dispose off entire section rejected in physical testing by gas cutting or by machine cutting from any end of rejected mark number.

12 In case of any contradiction between Technical Specification / Approved Drawing and MQP, the details mentioned in the Technical Specification / Approved Drawing shall be final.

13 The manufacturer should progressively align their Quality System and sub-vendors Quality System to the requirements of ISO 9000 series Quality Standards and in due course of time should get their quality system certified to ISO 9001.

14 The manufacturer to ensure that all measuring & testing equipments is having valid calibration certificate issued by NABL accredited testing agency or other approved accreditation agency operating in line with ISO/IEC 17011 and having full membership & MRA of ILAC/APLAC only.

15 Inspection of angle sections at black stage for galvanised tower structures/parts, irrespective of specific contract can be followed as detailed hereunder:

a. The manufacturer may raise inspection call for angle section at black stage at re-roller's work against any one of the ongoing Contract.

b. The manufacturer may fabricate the raw material, cleared under CAT –A CIP for a particular contractor, for any of its POWERGRID projects under execution.

c. The manufacturer will maintain a separate register indicating splitting and swapping of material between different projects awarded to same contractor, which can be reviewed by POWERGRID inspection engineer. Separate register for each Contractor is to be maintained if the manufacturer is executing jobs for different contractor.

Sr. No.	Components/ Operation & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						
							1	2	3	4	5	6	Remarks

d. The manufacturer as a contractor on whom POWERGRID has placed the contract, will only be allowed to split and swap material in black stage only, amongst its different ongoing contracts with POWERGRID, without any obligation to POWERGRID.

e. The final inspection after fabrication and galvanizing, however, will continue to be contract wise and CIPs will be issued for each contract only.

16 Pieces of light sections to be wire bundled & of heavy sections to be supplied loose. Stacking to have proper ventilation and kept inclined. Damage to galvanization coating to be avoided while handling. The fabricator to ensure sequential supplies and other details as per POWERGRID Technical Specification

17 Prior approval of POWERGRID is required to be taken for any activity or process that is out sourced.

18 In case tower part to be used at sub zero temperature, we may carry out Impact testing at -20° C during final inspection in line with IS/ POWERGRID TS.

19 All relevant IS standards shall be read along with the latest amendments.

20 Dispatch of the inspected towers shall be done with each tower / panel wise bundling in order to ensure availability of complete tower parts without missing of any member at site.

ANNEXURE-I

Agreed Chemical Composition of Billets / Blooms for POWERGRID Projects

	Rashtriya Ispat Nigam Ltd (RINL):			SAIL (IISCO)		SAIL (BSP)		SAIL (DSP)	
Grade	C18HMn-For HT (E350) with V	C18HMn-For HT (E350) with Ti	C20 MMn-For MS (E250)	SAIL Tower Grade VI For HT (E350)	C20 MMn-For MS (E250)	SAIL Tower Grade VI For HT (E350)	C20 MMn-For MS (E250)	SAIL Tower Grade VI For HT (E350)	C20 MMn-For MS (E250)
C	0.15-0.20	0.15-0.20	0.17-0.23	0.15-0.22	0.16-0.25	0.15-0.22	0.16-0.25	0.15-0.22	0.16-0.25
Mn	1.1-1.4	1.1-1.4	0.6-0.1	1.15-1.6	0.6-1.05	1.25-1.6 / 1.20-1.6*	0.6-1.05	1.25-1.6 / 1.20-1.6*	0.6-1.05
Si	0.1-0.35	0.1-0.35	0.1-0.35	0.10-0.35	0.15-0.30	0.15-0.30	0.1 (Max)	0.15-0.30	0.15-0.30
P (Max)	0.04	0.04	0.04	0.045	0.047	0.047	0.047	0.047	0.047
S (Max)	0.04	0.04	0.04	0.045	0.047	0.047	0.047	0.047	0.047
Cr (Max)	0.08	0.08	0.08	0.1	0.2	0.2	0.2	0.2	0.2
Ni (Max)	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05
Cu (Max)	0.03	0.03	0.03	0.07	0.1	0.1	0.1	0.1	0.1
Mo (Max)	0.005	0.005	0.005	0.05	0.05	0.05	0.05	0.05	0.05
V (Min)	0.03			0.025	As per test certificate	0.025 / 0.03*	As per test certificate	0.025 / 0.03*	As per test certificate
V (Max)	0.08	0.01	0.01						
Nb (Min)				0.015		0.015		0.015	
Nb (Max)									
Ti (Min)		0.028							
Ti (Max)	0.01	0.05	0.01						
Al (min)	0.015 for SMS -1 Heats			0.015					
Al (max)	0.04 for SMS -2 Heats								
CE (Min)			0.28		0.28	0.36	0.28	0.36*/0.38	0.28
CE (Max)	0.45	0.45	0.42	0.45	0.42	0.45	0.42	0.45	0.42
S+P (Max)				0.09	0.09	0.09	0.09	0.09	0.09
N (Max)									
B (Max)	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005
Sn (Max)									
Remarks	Variation in Min/Max Limit: C=0.02, Mn=0.03, P=0.005, S=0.005			Si - Traces - 0.35 for Al killed Steel, V=0.025 Min or Nb=0.015 (if added alone), V+Nb+Ti = 0.25 Max, Al=0.015 for Al Killed heats.		Mn 1.25 -1.60 for blooms size 350x150mm; V=0.025 Min for Billets and Blooms up to 150 mm and 0.03 for Blooms of 160 mm and above; Nb=0.015 (if added alone), Al=0.015 for Al Killed heats.		* 0.36 for 125x125 mm Billets Mn 1.25 -1.60 for blooms size 350x150mm; V=0.025 Min for Billets and Blooms up to 150 mm and 0.03 for Blooms of 160 mm and above; Nb=0.015 (if added alone), Al=0.015 for Al Killed heats.	

ANNEXURE-I

Agreed Chemical Composition of Billets / Blooms for POWERGRID Projects

	Tata Steel Ltd, Kalinganagar		Electrosteel Steels Ltd		Jindal Steel & Power Ltd (Raigarh & Angul)			JSW Steel Ltd		
Grade	C18 HMn-HT (E350)	C18 MMn-For MS (E250)	C18HMn-For HT (E350)	C20 MMn-For MS (E250)	C18 HMn-HT (E350)	C20 MMn-For MS (E250)	C18 MMn-For MS (E250)	C18 HMn-HT (E350)	C20 MMn-For MS (E250)	C18 MMn-For MS (E250)
C	0.12-0.18	0.12-0.18	0.15-0.22	0.17-0.25	0.15-0.20	0.17-0.23	0.15-0.21	0.15-0.21	0.17-0.23	0.15-0.21
Mn	1.05-1.45	0.6-0.95	1.20-1.50	0.6-1.00	1.20-1.50	0.60-1.00	060-1.00	1.20-1.50	0.60-1.00	0.60-1.00
Si	0.14-0.25	0.14-0.25	0.10-0.35	0.10-0.35	0.15-0.30	0.10-0.40	0.10-0.40	0.10-0.35	0.10-0.35	0.10-0.35
P (Max)	0.03	0.03	0.045	0.045	0.03	0.04	0.04	0.04	0.04	0.04
S (Max)	0.02	0.02	0.045	0.045	0.03	0.04	0.04	0.03	0.04	0.04
Cr (Max)	0.1	0.1	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07
Ni (Max)	0.1	0.1	0.03	0.03	0.07	0.07	0.07	0.07	0.07	0.07
Cu (Max)	0.1	0.1	0.03	0.03	0.1	0.1	0.1	0.1	0.1	0.1
Mo (Max)	0.1	0.1	0.005	0.005	0.07	0.07	0.07	0.07	0.07	0.07
V (Min)			0.03		0.03			0.025		
V (Max)			0.06	0.005						
Nb (Min)					0.015			0.015*		
Nb (Max)	0.15	0.15								
Ti (Min)										
Ti (Max)	0.1	0.1								
Al (min)	0.02	0.02			0.015	0.01	0.01	0.015	0.01	0.01
Al (max)								0.06		
CE (Min)			0.36	0.28						
CE (Max)	0.45	0.42	0.45	0.42	0.45	0.42	0.42	0.45	0.42	0.42
S+P (Max)										
N (Max)	0.012	0.012								
B (Max)	0.0005	0.0005	0.004	0.004						
Sn (Max)										
Remarks	Total Microalloying (Ti+Nb+V) = 0.025 (Min) and 0.25 (Max)				Variation in Min Limit: C=0.02, Mn=0.03, P=0.005, S=0.005, Nb when added alone V+Nb+Ti<=0.25			Total Microalloying (Ti+Nb+V) <= 0.20 * Nb=0.015 (Min) if aded alone		

ANNEXURE-I

Agreed Chemical Composition of Billets / Blooms for POWERGRID Projects

	Jayaswal Neco Industries Ltd			Visa Steel Limited			Usha Martin Ltd			Monnet Ispat & Energy Ltd		
Grade	C18 /C20 HMn-HT (E350)	C18 MMn MS (E250)	C20 MMn- MS (E250)	C18 / C20 HMn-HT (E350)	C18MMn-For MS (E250)	C20 MMn-For MS (E250)	C18HMn-For HT (E350)	C20 MMn-For MS (E250)	C18 MMn for MS (E250)	C18HMn-For HT (E350)	C20 MMn-For MS (E250)	C18 MMn for MS (E250)
C	0.15-0.20	0.15-0.20	0.17-0.23	0.15/0.17*-0.20	0.15-0.20	0.17-0.21	0.15-0.20	0.17-0.23	0.15-0.21	0.17-0.21	0.18-0.22	0.16-0.20
Mn	1.2-1.50	0.6-1.00	0.6-1.00	1.2-1.5	0.6-1.0	0.6-1.0	1.20-1.50	06-1.00	0.6-1.00	1.20-1.35	0.60-0.80	0.60-0.80
Si	0.15-0.35	0.15-0.35	0.15-0.35	0.15-0.35	0.15-0.30	0.15-0.30	0.15-0.30	0.10-0.40	0.10-0.40	0.15-0.30	0.15-0.30	0.15-0.30
P (Max)	0.035	0.035	0.035	0.035	0.035	0.035	0.03	0.04	0.04	0.03	0.04	0.04
S (Max)	0.035	0.035	0.035	0.035	0.035	0.035	0.03	0.04	0.04	0.03	0.04	0.04
Cr (Max)	0.05	0.05	0.05	0.05	0.05	0.05	0.07	0.07	0.07	0.05	0.05	0.05
Ni (Max)	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.07	0.07	0.05	0.05	0.05
Cu (Max)	0.1	0.1	0.1	0.05	0.05	0.05	0.1	0.1	0.1	0.05	0.05	0.05
Mo (Max)	0.05	0.05	0.05	0.05	0.05	0.05	0.01	0.01	0.01	0.05	0.05	0.05
V (Min)	0.03			0.03			0.03			0.025		
V (Max)												
Nb (Min)												
Nb (Max)												
Ti (Min)												
Ti (Max)				0.01	0.01	0.01						
Al (min)	0.015	0.01	0.01	0.02			0.015	0.002	0.002			
Al (max)	0.035	0.035	0.035		0.025	0.025						
CE (Min)	0.38											
CE (Max)	0.42	0.41	0.41	0.44	0.39	0.39	0.45	0.42	0.42	0.45	0.42	0.42
S+P (Max)												
N (Max)												
B (Max)												
Sn (Max)	0.1	0.1	0.1									
Remarks	Variation in Min/Max Limit: C=0.02, Mn=0.05			* : For C20 HMn Material Variation in Min/Max Limit: C=0.02, Mn=0.03, P=0.005, S=0.005, Si=0.03, V+Nb+Ti = 0.15(Max)			V+Nb+Ti=0.25			Al=0.02 (Min) for Al Killed heats. Ti+Nb+V <= 0.15		

केन्द्रीय गुणवत्ता आश्वासन एवं निरीक्षण पावरग्रिड गुड़गाँव

ANNEXURE-I

Agreed Chemical Composition of Billets / Blooms for POWERGRID Projects

	Electrotherm India Pvt Ltd			Shreeyam Power Pvt Ltd	Bhushan Steel Ltd		Neelachal Ispat Nigam Ltd	Adhunik Metaliks	
Grade	C18 HMn-HT (E350)	C20 MMn-For MS (E250)	C18 MMn-For MS (E250)	C18 MMn-For MS (E250)	C18 HMn-HT (E350)	C20 MMn-For MS (E250)	C20 MMn-For MS (E250)	C18 HMn-HT (E350)	C20 MMn-For MS (E250)
C	0.15-0.21	0.17-0.23	0.15-0.21	0.15-0.21	0.15-0.21	0.17-0.23	0.15-0.23	0.15-0.20	0.17-0.23
Mn	1.20-1.50	0.60-1.00	0.60-1.00	0.60-1.00	1.20-1.60	0.60-1.00	0.6-1.0	1.2-1.5	0.6-1.0
Si	0.10-0.35	0.10-0.35	0.10-0.35	0.10-0.30	0.35	0.35	0.15-0.35	0.15-0.3	0.1-0.4
P (Max)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
S (Max)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Cr (Max)	0.1	0.1	0.1	0.07	0.12	0.12	0.01	0.06	0.06
Ni (Max)	0.07	0.07	0.07	0.07			0.05	0.08	0.08
Cu (Max)	0.1	0.07	0.07	0.07			0.01	0.07	0.07
Mo (Max)	0.07			0.07	0.07			0.03	0.03
V (Min)	0.025				0.03			0.03	
V (Max)	0.05						0.01		
Nb (Min)	0.015								
Nb (Max)									
Ti (Min)									
Ti (Max)								0.01	0.01
Al (min)	0.015	0.02	0.02	0.015	0.01	0.01	0.02*	0.02	
Al (max)									
CE (Min)									
CE (Max)	0.47	0.42	0.42	0.42	0.45	0.42	0.42	0.43	0.39
S+P (Max)									
N (Max)									
B (Max)									
Sn (Max)								0.015	0.015
Remarks	Nb = 0.015 Min if added alone Ti+Nb+V <= 0.20				Ti+Nb+V <= 0.20		(size 150x150 Sq.mm only) * In case Al killed steel only	Variation in Min/Max Limit: C=0.02, Mn=0.03, P=0.005, S=0.005, Si- 0.03	

केन्द्रीय गुणवत्ता आश्वासन एवं निरीक्षण
पावरग्रिड
गुड़गाँव

SECTION-II

GENERAL TECHNICAL CONDITIONS

TECHNICAL SPECIFICATIONS

SECTION-II

GENERAL TECHNICAL CONDITIONS

1.1 General Technical Conditions

1.1 **General**

The following provisions shall supplement all the detailed technical specifications and requirements brought out herein. The contractor's submission shall be based on the use of materials complying fully with the requirements specified herein.

1.2 **Drawings**

1.2.1 All relevant standard drawings for all the towers/ stubs and their extensions shall be furnished to the Contractor by the Employer which shall include structural drawings/erection drawings and/ or shop fabrication drawings, Bill of Materials for all the towers and their extensions.

1.2.2 The tower members can be directly fabricated from the structural/erection drawings wherever the required fabrication details are provided on the same or shop fabrication drawings. However, if the contractor is required to prepare shop fabrication drawings, of their own, in addition to the structural/ erection drawings with required fabrication details, they may prepare the same without any additional financial implication to Employer.

1.2.3 The work shall be performed by the Contractor strictly in accordance with the standard/approved drawings and no deviation shall be permitted without the written approval of the Employer, if so required.

1.2.4 All manufacturing, fabrication work under the scope of Contractor, prior to the approval of the drawings shall be at the Contractor's risk. The contractor may incorporate any changes in the design, which are necessary to conform to the provisions and intent of the contract and such changes will again be subject to approval by the Employer.

In no case the approval by the Employer of any document does imply compliance with all technical requirements or the absence of errors in such documents. If errors are discovered any time during the validity of the contract, then the Contractor shall be responsible for consequences.

1.2.5 All rights of the design/ drawing for all types of towers shall be strictly reserved with the Employer only and any designs/ drawings/ data sheets submitted by the contractor from time to time shall become the property of the Employer. Under no circumstances, the Contractor shall be allowed to user/ offer above designs/ drawings/ data sheets to any other authority without prior written permission of the Employer. Any deviation to above is not acceptable and may be a cause for rejection of the bid

1.3 **Design Improvements**

The Employer or the Contractor may propose changes in the specification and if the parties agree upon any such changes and the cost implication, the specification shall be modified accordingly.

1.4 Quality Assurance programme

To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Contractor's Works or at his Sub-Contractor's premises or at the Employer's site or at any other place of Work as applicable, are in accordance with the specifications, the Contractor shall ensure suitable quality assurance programme to control such activities at all points necessary. A quality assurance programme of the Contractor shall be in line with ISO requirements & shall generally cover the following:

a) The organisation structure for the management and implementation of the proposed quality assurance programme.
b) System for Document and Data Control.
c) Qualification and Experience data of Bidder's key personnel.
d) The procedure for purchases of materials, parts, components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
e) System for shop manufacturing and site erection controls including process controls, fabrication and assembly control.
f) System for Control of non-conforming products including deviation dispositioning, if any and system for corrective and preventive actions based on the feedback received from the Customers and also internally documented system for Customer complaints.
g) Inspection and test procedure both for manufacture and field activities.
h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.
~~i)~~ System for indication and appraisal of inspection status.
~~j)~~ System of Internal Quality Audits, Management review and initiation of corrective and Preventive actions based on the above.
k) System for authorising release of manufactured product to the Employer.
l) System for maintenance of records.
m) System for handling, storage and delivery.
n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics

relevant to each item of equipment furnished and /or service rendered.

o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records. In this regard, the Employer has already prepared Standard Field Quality Plan for transmission line/ substation equipments as applicable, Civil/ erection Works which is required to be followed for associated works.

The Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/ his vendor's quality management and control activities.

1.4.1 Quality Assurance Documents

The Contractor shall ensure availability of the following Quality Assurance Documents:

a) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.

b) Welder and welding operator qualification certificates.

c) Welder's identification list, welding operator's qualification procedure and welding identification symbols.

d) Raw Material test reports on components as specified by the specification and in the quality plan.

e) The Manufacturing Quality Plan (MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.

f) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.

g) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

1.4.2 **Employer's Supervision**

To eliminate delays and avoid disputes and litigation to the Contract, all matters and questions shall be resolved in accordance with the provisions of this document.

The manufacturing of the product shall be carried out in accordance with the specifications. The scope of the duties of the Employer, pursuant to the contract, will include but not be limited to the following:

a) Interpretation of all the terms and conditions of these Documents and Specifications.

b) Review and interpretation of all the Contractor's drawings, engineering data etc. if any

c) Witness or authorize his representative to witness tests at the manufacturer's works or at site, or at any place where work is performed under the contract.

d) Inspect, accept or reject any equipment, material and work under the Contract, in accordance with the Specifications.

e) Issue certificate of acceptance and/or progressive payment and final payment certificate.

f) Review and suggest modification and improvement in completion schedules from time to time, and

g) Supervise the Quality Assurance Programme implementation at all stages of the works.

1.5 Inspection, Testing & Inspection Certificate

1.5.1 Contractor shall procure bought out items from sub-vendors as per the list in “Compendium of Vendors” available on POWERGRID website www.powergrid.in after ensuring compliance to the requirements/ conditions mentioned therein. Contractor shall explore first the possibilities of procuring the bought-out items from POWERGRID approved existing vendors. In case of their unavailability/ non-response, Contractor may approach POWERGRID for additional sub-vendor approval. In that case, the assessment report of proposed sub vendor by Contractor along with the enclosures as per Annexure-I shall be submitted within 60 days of the award. The proposal shall be reviewed and approval will be accorded based on the verification of the document submitted and/or after the physical assessment of the works, as the case may be. The physical assessment conducted by POWERGRID, if required, shall be on chargeable basis. Charges shall be as per the POWERGRID norms prevailing at that time, which shall be intimated by POWERGRID separately. If proposal for sub-vendor is submitted after 60 days, the Contractor’s proposal normally will not be considered for current LOA. However, POWERGRID may process the case for developing more vendors for referred items, if found relevant. In all cases, it is the responsibility of

the Contractor that Project activities do not suffer on account of delay in approval/non-approval of a new sub-vendor.

The responsibility and the basis of inspection for various items & equipment is placed at Annexure-II along with the requirement of MQP (Manufacturing Quality Plan), ITP (Inspection & Test Plan), FAT (Factory Acceptance Test) which should be valid & POWERGRID approved and Level of inspection envisaged against each item.

Contractor shall ensure that order for items where MQP/ ITP/ FAT is required will be placed only on vendors having valid MQP/ITP/FAT and where the supplier's MQP/ITP/FAT is either not valid or has not been approved by POWERGRID, MQP shall be generally submitted as per POWERGRID format before placing order. A Copy of MQP format is placed at ***Annexure–III***.

Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/ technical Specifications/ POWERGRID approved data sheets/ POWERGRID approved drawings and relevant Indian/ International standards.

Inspection Levels: For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below:

Level–I: Contractor to raise all inspection calls and review the report of tests carried out by the manufacturer, on his own, as per applicable standards/ POWERGRID specification, and submit to concerned POWERGRID inspection office/Inspection Engineer. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates of manufacturers.

Level–II: Contractor to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/ specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Contractor and CIP/MICC will be issued by POWERGRID. Else, Contractor would submit their test reports/ certificates to POWERGRID. CIP/ MICC will be issued by POWERGRID based on review of test reports/ certificates.

Level-III: Contractor to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per

applicable standards/ specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Contractor and CIP will be issued by POWERGRID. Else, Contractor would submit the test reports/ certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports/ certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID.

Level-IV: Contractor to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/ specification and CIP/MICC will be issued by POWERGRID.

Contractor shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Contractor shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP).

The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Contractor's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices/ norms are adhered to, inspect and examine the materials & workmanship of the Works, to carry out Quality/ Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Contractor shall obtain for the Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. The item/ equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations.

Contractor shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Contractor with in 30 days of award of contract on submission of documents by Contractor. After raising the inspection calls, Contractor shall then proceed as per the message of that particular call which is available on the message board.

The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Contractor shall give the Employer/ Inspector Twenty-one (21) days written notice of any material being ready for testing for each stage of testing as identified in the approved quality plan as customer inspection point (CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty-five (45) days in advance. Such tests shall be to the Contractor's account except for the expenses of the Inspection Engineer. The Employer/ inspector, unless witnessing of the tests is waived by Employer, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector three copies of tests, duly certified. Contractor shall ensure, before giving notice for type test, that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. CIP/MICC will be issued only after review and approval of the test reports.

Contractor shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Contractor offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID, POWERGRID shall inspect the material and issue CIP only. However, in such an exceptional case, MICC shall be issued only as per provision of original/ revised approved supply schedule.

Contractor shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.

Contractor shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA /NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Contractor or their Sub-vendor before the material is offered for inspection.

Contractor shall ensure that material which has been cleared for dispatch after inspection will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch.

The Employer or IE shall give notice in writing to the Contractor, of any o bjection either to conformance to any drawings or to any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer/ Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract.

All Test Reports and documents to be submitted in English during final inspection of equipment by POWERGRID or as and when required for submission.

When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/ Inspection Engineer (IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Contractor/ manufacturer but if the tests are not witnessed by the Employer/ IE, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Employer/IE. Contractor shall, on completion of all tests, submit test reports within Ten (10) days to POWERGRID IE. Failure of the Employer/IE 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 certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

In all cases, where the Contract provides for tests whether at the premises or works of the Contractor or of any Sub- Contractor, the Contractor, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer/ Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/ Inspection Engineer or to his authorised representative to accomplish testing.

The inspection and acceptance by Employer and issue of Inspection Certificate thereon 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, or if such equipment is found to be defective at a later stage.

The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material complies with the specification.

The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.

Re-work/ Re-engineering, if any, on any item/ equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Contractor shall submit Joint Inspection Report of equipments under Re-Work/ Re-Engineering alongwith procedure for the same to POWERGRID for approval, before taking up the Re-Work/ Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.

Contractor shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.

The Employer reserves the right to increase or decrease their involvement in inspections at Contractor's Works or at his Sub-Contractor's premises or at the Employer's site or at any other place of Work based on performance of Contractor/ Sub Contractor.

Unless specified otherwise, inspection shall be made at the place of manufacture prior to dispatch and shall be concluded so as not to interfere unnecessarily with the operation of the work.

Should any item being supplied be found not to comply with the supplied design, it shall be liable to rejection. No item once rejected shall be resubmitted for inspection, except in cases where the Employer or his

authorised representative considers that the defects can be rectified. All rejected material shall be disposed-off/ destroyed under intimation to Employer QA&I representative as per laid down procedures.

The specified grade and quality of material from approved source shall be used by the Contractor. To ascertain the quality of material used, the inspector may at his discretion get the material tested at an approved laboratory.

1.5.2 **Tests**

The type, acceptance and routine tests and tests during manufacture shall be carried-out on the material and shall mean as follows:

Type Tests shall mean those tests which are to be carried out to prove the process of manufacture and general conformity of the material to this Specification. These tests shall be carried out on samples prior to commencement of commercial production against the order.

Acceptance Tests shall mean those tests which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.

Routine Tests shall mean those tests, which are to be carried out on the material to check requirements which are likely to vary during production.

Tests during Manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied.

The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the Employer.

The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this Specification, the norms and procedure of the test shall be as specified in ***Annexure-A*** or as mutually agreed to between the Contractor and the Employer in the Quality Assurance Programme.

For all type and acceptance tests, the acceptance values shall be the values specified in this Specification or guaranteed by the Bidder, as applicable.

In case of any failure or defect/ deficiency observed in material supplied Employer reserves the right to carry out any tests on the material supplied to site, if required to prove conformity of material to the specification for which testing charges shall be borne by contractor/ manufacturer.

1.6 **Standard Technical Particulars**

The Standard Technical Particulars of the various items are given in the relevant standard TS for this package., the bidder is required to comply with the same.

1.7 **Packing**

All the materials shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

The Contractor shall include and provide for securely protecting and packing the materials so as to avoid loss or damage during transport by air, sea, rail and road.

All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'up' and 'down' on the sides of boxes, and handling and unpacking instructions as considered necessary. Special precaution shall be taken to prevent rusting of steel and iron parts during transit by sea.

The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols, i.e. fragile, handle with care, use no hook etc. wherever applicable.

Each package shall be legibly marked by the Contractor at his expenses showing the details such as description and quantity of contents, the name of the consignee and address, the gross and net weights of the package, the name of the Contractor etc.

Angle section shall be wire bundled.

Cleat angles, gusset plates, brackets, fillet plate, hanger and similar loose pieces shall be tested and bolted together in multiples or securely wired through holes.

Bolts, nuts washers and other attachments shall be packed in double gunny bags accurately tagged in accordance with the contents.

The packing shall be properly done to avoid losses & damages during transit. Each bundle or package shall be appropriately marked.

1.8 Storage of Structural Steel for Tower Parts at supplier`s premise

The structural steer of different classification, sizes and lengths shall be stored separately. These shall be stored above ground level at least 150 mm upon platforms, skids or any other suitable supports to avoid any distortion of sections. Also, in order to prevent white rust formation sufficient care should be exercised while storing, handling and transporting galvanized products. The structural steel/ tower parts shall be stored in an adequately ventilated area. The article shall be stored with spacers in between them and kept at an inclination to facilitate easy drainage of any water collected on the structural steel/ tower parts.

2.0 Employer's Environment and Social Policy and its Implementation

(Whichever clauses relevant to the subject package are applicable.)

2.1

Development and growth of mankind through Industrialization and unwarranted use of natural resources has inflicted considerable impact on Environment and Society. As a result, Environmental and Social issues have emerged as the focal point of global debate.

Employer's activities by their inherent nature and flexibility have negligible impacts on environmental and social attributes. In order to address these issues and to match the rising expectations of a cleaner, safer and healthier environment, Employer has evolved its Environmental and Social Policy and Procedures (ESPP). The key principles of Employer's Environmental and Social Policy are: -

i) Avoidance of environmentally and socially sensitive areas while planning project activities.

ii) Minimisation of impacts when project activities occur in environmentally and socially sensitive areas.

iii) Mitigation of any unavoidable adverse impacts arising out of its projects.

2.2 Basic issues to be kept in mind while carrying out construction activities are to

i) Avoid socially sensitive areas with regard to human habitations and areas of cultural significance.

ii) Secure the interest of people affected by Employer's projects.

iii) Involve local people affected by transmission line projects as per requirement and suitability.

iv) Consult affected people in decisions having implication to them if considered necessary.

v) Apply, efficient and safe technology/ practices.

vi) Keep abreast of all potential dangers to people's health, occupational safety and safety of environment and the respective mitigatory measures.

vii) Establish preventive mechanisms to guarantee safety.

viii) Mitigation measures in case of accidents.

ix) Avoid unwarranted cutting of trees in forest area.

2.3 While constructing the lines through forest stretches the contractor will provide alternate fuel to its employee e.g. working labours/ supervisors etc. in order to avoid cutting of forest woods.

2.4 Contractor will ensure safety to the wild life, during working/ camping near to the National park.

2.5 Contractor during construction of lines in agricultural fields will ensure minimum damages to the crops, trees, bunds, irrigation etc. If the same is un-avoidable, the decision of Engineer- in-charge shall be final.

2.6 The waste/ excess material/ debris should be removed from the construction site including agricultural field, forest stretches, river etc. immediately after construction work.

2.7 The Contractor will ensure least disturbance to the hill slope and natural drainage so as to avoid soil erosion. Natural drainage in plain area if disturbed is to be trained to the satisfaction of Engineer- in-charge.

2.8 As far as possible existing path/ kutchha road/ approach shall be used for the construction.

2.9 The Contractor will ensure supply of stone chips/sand from authorised/ approved quarry areas.

2.10 Proper documentation of above, if any.

2.11 The Environment & Social Policy and Procedures (ESPP) evolved by POWERGRID is available at the POWERGRID's website, www.powergrid.in, which shall be referred by the Bidder for further information.

Annexure-I
Page 1 of 1

Assessment report from Contractor for proposed sub-vendor along with following enclosures (to the extent available):

1. Registration / License of the works
2. Organization chart with name and qualification of key persons
3. List of Plant and Machinery.
4. List of testing equipment with their calibration status.
5. List of Raw material, bought out items with sourcing details
6. List of out-sourced services with sourcing details.
7. List of supply in last three years.
8. Third party approval, if any (viz. ISO, BIS),
9. Pollution clearance wherever applicable
10. Energy Conservation & Efficiency report (Applicable to industries having contract load more than 100 KVA)
11. Formats for RM, in process and acceptance testing
12. Type test approvals conducted in last 5 years, if applicable
13. Performance Certificates from customers
14. Photographs of factory, plant and machinery & testing facilities

Annexure-II

MQP & INSPECTION LEVEL REQUIREMENT

Sl. No.	Item / Equipment	Requirement of MQP/ITP/FAT	Inspection Level
N.28	Fibre Optic Cable	MQP	III
N.29	Hardware Fittings for Fibre Optic Cable	MQP	III
O.01	Re-rollers of MS/ HT Angle Section and galvanized tower parts	MQP	IV
O.02	Conductor	MQP	IV
O.03	Hardware Fittings and Accessories for Conductor and Earthwire	MQP	IV
O.04	Earthwire	MQP	IV
O.05	Insulator	MQP	IV
O.06	Bolts & Nuts of Grade 8.8/8	MQP	IV
O.07	Mono Pole	POWERGRID TS	IV
O.08	Foundation Bolts & Anchor Bolts	MQP	III
O.09	D-Shackle/ Hanger/ Links and associated Special bolts & Nuts	MQP	III
O.10	Span Marker, Obstruction Light and Wind Measuring Equipment	POWERGRID TS	III
O.11	MS Rod rolled by Approved Re-Roller of POWERGRID	MQP	III
O.12	MS Rod rolled by Approved steel producers of POWERGRID	POWERGRID TS	I
O.13	Spring Washers & Pack Washers	POWERGRID TS	II
O.14	Bolts & Nuts Grade upto 5.6/5	POWERGRID TS	II
O.15	ACD & barbed wire of ACD/ Bird Guard	POWERGRID TS	II
O.16	Danger Plate/ Phase Plate/ Number Plate/ Circuit plate	POWERGRID TS	I
O.17	Sub-station Structure (Lattice/pipe type)	MQP	III
O.18	Clamps & Connecters (including equipment connectors)	MQP	III
O.19	MS/ GI F/at, rod type, pipe type and other earthing material	POWERGRID TS	II
O.20	Aluminium Tube & Busbar materials	POWERGRID TS	II
O.21	Pipe Type & Counter Poise Earthing	POWERGRID TS	II

Note: For Equipment where requirement of MQP is envisaged, ITP/FAT will be followed If sourced from off shore. For items required in S/S or T/L or TELECOM/LD&C , same inspection level as specified shall be followed for all the cases. (Only items for this procurement out of above may be considered).

MANUFACTURING QUALITY PLAN

	Manufacturers Details (Name, Works Address etc.)	Customer POWERGRID	Vendor's Code:	Item:	Q.P. No. Rev. No. Date:	Valid From: Valid Upto:

Sr. No.	Components / Operations & Description of Test	Type of check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						Remarks
							1	2	3	4	5	6	
A. Section: RAW MATERIAL INSPECTION													
B. Section : IN PROCESS INSPECTION													
C. Section: FINAL TESTING													
D. Section: PACKING & DISPATCH													

Code 1	Indicates place **where testing is planned** to be performed i.e. Inspection location	**Code 2**	Indicates **who has to perform the tests** i.e. Testing Agency
A	At Equipment Manufacturer's works	J	The Equipment Manufacturer
B	At Component Manufacturer's works	K	The Component Manufacturer
C	At Authorised Distributor's place	L	The Third Party
D	At Independent Lab	M	The Turnkey Contractor
E	At Turn Key Contractor's location		
F	Not specified		

Code 3	Indicates **who shall witness** the tests i.e. Witnessing Agency	**Code 4**	Review of Test Reports/ Certificates
P	Component Manufacturer itself	W	By Equipment manufacturer during raw material/bought out component Inspection.
Q	Component Manufacturer and Equipment Manufacturer	X	By Contractor during product/process inspection
R	Component Manufacturer, Equipment Manufacturer and Contractor	Y	By POWERGRID during product/process inspection
S	Equipment Manufacturer itself	Z	By Contractor and/or POWERGRID during product/process inspection
T	Equipment Manufacturer and Contractor		
U	Equipment Manufacturer, Contractor and POWERGRID		
V	Third Party itself		

Code 5	Whether specific approval of sub-vendor / Component make is envisaged?	**Code 6**	Whether test records required to be submitted after final inspection for issuance of CIP/MICC
E	Envisaged	Y	Yes
	Not Envisaged	N	No

SECTION-IVC

TOWER: MATERIALS &FABRICATION

TECHNICAL SPECIFICATIONS

SECTION-IV C

TOWER: MATERIALS & SFABRICATION

CONTENTS

Clause No.	Description	Page No.
1.0	Transmission Tower Materials	1
2.0	Inspection & Tests	16
3.0	Manufacturing Quality Plan	17

TECHNICAL SPECIFICATIONS

SECTION- IV C

TOWER: MATERIALS, FABRICATION, ERECTION & STRINGING

1.1 Transmission Tower Materials

1.1.1 Tower Steel Sections

For Non-Snow Regions, IS Steel Sections of any tested quality A, B0 or BR in conformity with IS 2062:2011 corresponding to grade E250 (Designated Yield Strength 250 MPa) and/ or grade E350 (Designated Yield Strength 350 MPa) may be used in towers, extensions, stubs and stub setting templates. For Snow Regions, IS Steel Sections of tested quality C in conformity with IS 2062:2011 corresponding to grade E250 and/or E350 shall be used. The Contractor can use other equivalent grade of structural steel angle sections and plates conforming to latest International Standards viz BSEN 10025. However, use of steel grade having designated yield strength more than that of EN 10025 grade S355 JR/JO (designated yield strength 355 MPa) is not permitted, unless otherwise indicated in this specification.

Steel plates below 6mm size exclusively used for packing plates/ packing washers produced as per IS 1079 (Grade-0) are also acceptable. However, if below 6mm size plate are used as load bearing plates viz gusset plates, joint splices etc. the same shall conform to IS 2062 or equivalent standard meeting mechanical strength/ metallurgical properties corresponding to grade E250 or above grade (designated yield strength not more than 355MPa), depending upon the type of grade incorporated into design. Flats of equivalent grade meeting mechanical strength/ metallurgical properties may also be used in place of plates for packing plates/ packing washers. The chequered plates shall conform to IS 3502. SAILMA 350HI grade plate can also be accepted in place of HT plates (EN 10025 grade S355 JR/ JO/ IS 2062:2011– grade E350, as applicable) provided SAILMA 350HI grade plate meet all the mechanical properties of plate as per EN 10025 grade S355 JR/JO (designated yield strength 355 MPa)/ IS 2062:2011–grade E350. While selecting equivalent grade, requirement of IS 2062 for particular grade has to be fully complied. Further, material shall be imported from the manufacturers having valid BIS license.

During execution of the project, if any particular section is not available, the same shall be substituted by higher section/ Grade. Any cost on account of the same shall be borne by the Contractor. However, design approval for such substitution shall be obtained from the Employer before any substitution and records of such substitutions shall be maintained by the Contractor.

1.1.2 Fasteners: Bolts, Nuts and Washers

1.1.2.1 All tower members shall be joined together with Hexagonal Bolts and nuts. All hexagonal bolts and nuts shall conform to IS 12427. They shall have hexagonal head and nuts, the heads being forged out of the solid, truly concentric, and square with the shank, which must be perfectly straight.

All bolts and nuts shall be galvanized as per IS 1367 (Part-13)/IS 2629.

1.1.2.2 The bolt shall be of 16/ 24 mm diameter and of property class 5.6 as specified in IS 1367 (Part-III) and matching nut of property class 5.0 as specified in IS 1367 (Part-VI). Alternatively, contractor may use 12mm diameter of property class 6.8 in place of 16 mm diameter bolts. However use of both 12 mm and 16 mm diameter bolts simultaneously in the same package is not permitted. Matching Nut for 12 mm diameter bolts shall be property class 6 as specified in IS 1367 (Part-VI).

1.1.2.3 Bolts up to M16 and having length up to 10 times the diameter of the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolts for 5.6 grade should be 310 MPa minimum as per IS 12427. The shear strength of bolts for 6.8 grade should be minimum 372 MPa. Bolts should be provided with washer face in accordance with IS 1363 (Part-I) to ensure proper bearing.

1.1.2.4 Nuts for hexagonal bolts should be double chamfered as per the requirement of IS 1363 Part-III. It should be ensured by the manufacturer that nuts should not be over tapped beyond 0.4mm oversize on effective diameter for size up to M16.

1.1.2.5 Fully threaded bolts shall not be used. The length of bolts shall be such that the threaded portion will not extend into the place of contact of the members.

1.1.2.6 All bolts shall be threaded to take the full depth of the nuts and threaded for enough to permit firm gripping of the members, but not further. It shall be ensured that the threaded portion of each bolt protrudes not less than 3mm and not more than 8mm when fully tightened. All nuts shall fit tight to the point where the shank of the bolt connects to the head.

1.1.2.7 Flat and tapered washers shall be provided wherever necessary. Spring washers shall be provided for insertion under all nuts. These washers shall be steel electrogalvanised, positive lock type and 2.5 mm in thickness for 12mm dia bolt ,3.5mm in thickness for 16mm dia bolt and 4.5mm for 24 mm bolt.

1.1.2.8 To avoid bending stress in bolts or to reduce it to minimum, no bolt shall connect aggregate thickness of members more than three (3) times its diameter.

1.1.2.9 The bolt positions in assembled towers shall be as per structural drawing.

1.1.2.10 Bolts at the joints shall be so staggered that nuts shall be tightened with spanners without fouling.

1.2.1.3 To ensure effective in-process Quality control it is desirable that the manufacturer should have in house testing facility for all tests like weight of zinc coating, shear strength and other tests etc. The manufacturer should also have proper Quality Assurance System which should be in line with the requirement of this specification and IS 9001 series Quality System Standard.

1.2 Design and Drawings

1.2.1. In case of Employer design tower: -

1.2.1.1 The relevant drawings for all the towers and their extensions shall be furnished to the Contractor by the Employer which shall include structural drawings/ erection drawings and/ or shop fabrication drawings, Bill of Materials for all the towers and their extensions as well as construction drawings for foundations.

1.2.1.2 The tower members can be directly fabricated from the structural/ erection drawings wherever the required fabrication details are provided on the same or shop fabrication drawings. However, if the contractor is required to prepare shop fabrication drawings, of their own, in addition to the structural/ erection drawings with required fabrication details, they may prepare the same without any additional financial implication to Employer.

1.2.2 Proto Assembly:

i) Contractors, who have not done the proto-assembly of the towers/ tower extensions or have not supplied the same towers/ tower extensions against any earlier POWERGRID's project, shall before taking up mass fabrication, the Contractor shall arrange for one number proto assembly for each type of towers and extensions. POWERGRID reserves the right to get the same witnessed by their representative. After proto-assembly, the contractors, shall incorporate revisions in the drawings/ documents if any on account of proto corrections, and make necessary endorsement with reference to the respective packages/ Letter of Awards. The revised drawing/ documents shall be submitted for final approval by the Employer.

ii) The contractors who have already done the proto-assembly of the towers/ tower extensions or have supplied the same towers/ tower extensions against any earlier POWERGRID's project need not do the proto assembly. They shall submit documentary evidence viz. proto-inspection reports, supply records etc. in its support. However, they may do the proto-assembly for their verification and satisfaction. Further, they shall submit the structural drawings and BOM of tower/ tower extensions after endorsing the projects name for further distribution by Employer.

Alternatively, in place of physical proto assembly (as specified in (i) and (ii) above), contractor may also carry out proto assembly using any suitable software/3D modelling software.

No payment shall be made to the Contractor on the account of proto-assembly in either of the cases mentioned at (i) or (ii).

In any case, the onus of correct fabrication / fitment of tower parts shall lie with contractor. Any defect, if found during erection at site, the same has to be rectified by the contractor without any additional financial implication to POWERGRID.

1.2.3 All the drawings shall have a proper name plate clearly displaying the name of Employer on right hand bottom corner. The approval for exact format of the nameplate shall be provided to the successful bidder for incorporation of the same on all the drawings.

1.2.4 The mass fabrication shall be taken up from the shop drawings. The overall responsibility of fabricating tower members correctly lies with the Contractor only and the Contractor shall ensure that all the tower members can be assembled/ fitted while erecting without any undue strain on them.

1.3 **Tower Accessories**

Arrangement shall be provided for fixing of all tower accessories to the tower at a height between 2.5 meters and 3.5 meters above the ground level.

1.3.1 **Step Bolts & Ladders**

Each tower shall be provided with step bolts as per drawing enclosed in the section of drawing. The step bolts conforming to IS 10238 of not less than 16mm diameter and 175 mm long, spaced not more than 450 mm apart and extending from 2.5 meters above the ground level to the top of the tower. However, the head diameter shall be 35mm as indicated in the enclosed drawing. The step bolt shall be fixed on two diagonally opposite legs up to top of the towers for single, double and multi circuit towers. Each step bolt shall be provided with two nuts on one end to fasten the bolt securely to the tower and button head at the other end to prevent the feet from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1.5 KN. For special river crossing towers, ladders alongwith protection rings as per the Employer approved design shall be provided in continuation of the step bolts on one face of the tower from 30 meters above ground level to the top of the special structure. From 2.5m to 30m height of super structure step bolts shall be fixed on two diagonally opposite legs. Suitable platform using 6mm thick perforated chequered plates alongwith suitable railing for access from step bolts to the ladder and from the ladder to each cross-arm tip and the ground wire support shall also to be provided. The platform shall be fixed on tower by using counter-sunk bolts.

1.3.2 **Insulator Strings and Earth wire Clamps Attachments**

a) For the attachment of suspension Insulator string, if required a suitable dimensioned swinging hanger on the tower shall be provided so as to obtain specified clearances under respective swinging condition of the strings. The hanger, extensions links, D-shackles etc. as required shall be of same rating/ strength as that of corresponding rating/ Ultimate tensile Strength of Insulator string. The design and supply of hanger, D-shackles, strain plate, extension link etc. are also in the scope of Contractor.

b) At tension towers, strain plates of suitable dimensions under each cross-arm tip, shall be provided for taking the hooks or D-shackles of the tension insulator strings. Full details of the attachments shall be provided to the contractor. To achieve requisite clearances, if the design calls for providing extra D-shackles, link plate etc. before connecting the insulator string the same shall be supplied by the Contractor. These items shall be same rating/strength as that of as that of corresponding rating/ Ultimate tensile Strength of Insulator string.

c) D shackles, if required for attachment of Insulator strings, shall be supplied by the contractor from the identified and approved sub-vendor/ supplier of Hardware fittings.

1.3.3 Earth wire Clamps Attachments

For Suspension and tension clamp for attachment of earthwire, wherever required, the Contractor shall supply U–Bolts, D–Shackles etc. for attachment of clamp to the tower. Full details of the attachments shall be provided to the contractor. These items shall be same rating/ strength as that of corresponding rating/ Ultimate tensile Strength of earthwire suspension/tension clamp.

1.4 Tower Fabrication

The fabrication of towers shall be in conformity with the following:

1.4.1 Except where hereinafter modified, details of fabrication shall conform to IS 802 (Part-II) or the relevant international standards.

1.4.2 The tower structures shall be accurately fabricated to connect together easily at site without any undue strain on the bolts.

1.4.3 No angle member shall have the two leg flanges brought together by closing the angle.

1.4.4 The diameter of the hole shall be equal to the diameter of bolt plus 1.5 mm.

1.4.5 The structure shall be such that all parts are accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets of depression are likely to hold water.

1.4.6 All steel sections before any work is done on them, shall be carefully leveled, straightened and made true to detailed drawings by methods which will not injure the materials so that when assembled, the adjacent matching surfaces are in close contact throughout. No rough edges shall be permitted in the entire structure.

1.4.7 Drilling and Punching

1.4.7.1 Before any cutting work is started, all steel sections shall be carefully straightened and trued by pressure and not by hammering. They shall again be trued after being punched and drilled.

1.4.7.2 Holes for bolts shall be drilled or punched with a jig but drilled holes shall be preferred. The punching may be adopted for thickness up to 12 mm. Tolerances regarding punch holes are as follows: -

a) Holes must be perfectly circular and no tolerances in this respect are permissible.

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

c) Holes must be square with the plates or angles and have their walls parallel.

1.4.7.3 All burns left by drills or punch shall be removed completely. When the tower members are in position the holes shall be truly concentric/ matching to each other. Drilling or reaming to enlarge holes shall not be permitted.

1.4.8 Erection mark

1.4.8.1 Each individual member shall have erection mark conforming to the component number given to it in the fabrication drawings. The mark numbers shall be marked with marking dies of 16mm size before galvanising and shall be legible after galvanizing.

1.4.8.2 Erection Mark shall be A-BB-CC-DDD

A = Employer's code assigned to the Contractors- Alphabet

BB = Contractor's Mark-Numerical

CC = Tower Type Alphabet.

DDD = Number mark to be assigned by Contractor - Numerical.

Erection mark for high tensile steel members shall be prefixed by the letter "H"

1.5 Quantities and weights

1.5.1 The quantities of the following items have been envisaged in Metric Tonne (MT) in case of Employer design towers and in 'Nos.' in case of Contractor design towers, in the relevant price Schedules for various types of towers: -

i) Basic Body

ii) Body Extensions, wherever required

iii) Leg Extension

iv) Stubs & Cleats

v) Bolts & Nuts including spring washers and step bolts etc. for above items

During detailed engineering, requisite drawings if any shall be released by POWERGRID for fabrication and manufacturing as per the Technical Specification to the Contractor. The contractor shall carry out proto-assembly after fabrication from the Employer's drawing for his verification/ satisfaction prior to mass production of the tower.

The manufacturing of the above items shall be taken up in such a manner that the Equipment/ Material offered for inspection to POWERGRID are on completed tower basis for each type of tower, completed Stubs & Cleats set basis so as to facilitate availability of erectable tower of each type and erectable stubs & cleats set for casting of foundation. After inspection of the offered Equipment/ Material by POWERGRID representative(s), CIP shall be issued by POWERGRID for the material meeting the Technical Specification. However, MICC shall be issued only on Completed Tower Basis for each type of tower (comprising the required Basic Body, body extensions wherever required, four (4) equal or defined unequal Leg Extension, Bolts & Nuts along with D-shackles, Hangers, Packing and Spring Washers) and on completed Stubs & Cleats set basis for each type of tower foundations (comprising a set of stubs & Cleats, required Bolts and Nuts along with Spring Washers).

Towers to be supplied by the Contractors/ Tower Manufacturers shall be dispatched Panel wise as per mutually agreed procedure with Employer Quality Assurance & Inspection Department.

Accordingly, the payment shall be released on completed Tower Basis for each type of tower (comprising the Basic Body, body extensions, wherever applicable, bolts & nuts along with spring washer and step bolts, four (4) equal or defined unequal leg extensions wherever applicable for a completed tower) and on completed Stubs and Cleats set basis for each type of foundation (comprising a set of stubs & cleats, required Bolts and nuts along with Spring Washers) based

on the weight of the tower parts as calculated as per Clause 1.5.3 and fasteners based on the unit rates incorporated in the contract.

1.5.2 The provisional quantities required (including provisional spare tower quantity) are mentioned in the respective Schedules of BPS. Final quantities shall be determined after completion and approval of the detailed route survey. The final quantities of tower including spare towers shall be confirmed by the Employer/ Site -in-charge based on the requirement of quantities of various towers furnished by the Contractor after completion of detailed survey. Hence it will be responsibility of the Contractor to intimate the exact requirement of all towers and various line materials required for line immediately after the survey.

The Employer reserves the right to order the final quantities including required quantities of spares for which the rates quoted in the Bid shall be valid. Regarding quantity variation the provisions of relevant clauses of SCC shall apply.

1.5.3 The estimated total weight of tower/ tower parts as well as bolts & nuts along with spring washers and step bolts to be supplied by the Contractor under various packages have been envisaged in the relevant Price Schedule. Though fully galvanised tower parts are to be supplied, the weight of tower shall mean the weight of tower calculated by using the black sectional (i.e. ungalvanised) weight of steel members of the size indicated in the approved fabrication drawings and bill of materials, without taking into consideration the reduction in weights due to holes, notches and bevel cuts etc. but taking into consideration the weight of the D shackles, hangers, strain plates, pack plates, gusset plates, extension link/plates and pack washers etc. The weight of stub and cleats also shall be calculated in similar manner. The weight of strain plates, pack plates, extension link and gusset plates shall mean the weight of its circumscribing rectangle, without taking into considerations the reductions in weight due to holes, notches etc. The weight of D-shackles, hangers and pack washers shall be net actual weight taking into consideration reduction due to holes. For bolts and nuts along with spring washers and step bolts, the weight per tower shall be calculated from the bolt schedule applicable to each type of towers and body extensions as approved by the Employer. The rate quoted by the bidder for tower/tower parts supply, is deemed to be inclusive of galvanising charges including the cost of zinc.

1.5.4 The contractor is permitted to get inspected and supply upto 2.5% extra fasteners to take care of losses during erection. No payment shall be admissible for these extra supplies.

1.6 Galvanising

Fabricated Tower Parts & Stubs

1.6.1

The tower parts, stubs and pack washers shall be hot dip galvanized. The galvanization shall be done as per requirements of IS 4759 after all fabrication

work is completed. The contractor shall also take guidelines from the recommended practices for hot dip galvanizing laid down in IS 2629 while deciding and implementing galvanizing procedure. The mandatory requirements however, are specified herein.

The subject towers for this procurement are envisaged to use in coastal region.

Towers for coastal areas or creek regions or aggressive soil areas or under marine environment, as specifically mentioned in BPS the fabricated tower parts a nd stubs shall have a minimum overall zinc coating of 900 gm/ sqm of surface area except for plates and sections below 5mm which shall have a minimum overall zinc coating of 610 gm/sqm of surface area. The average zinc coating for all sections and plates 5mm and above shall be maintained as 127 microns and that for plates and sections below 5mm shall be maintained as 87 microns.

The zinc coating shall be adherent, reasonably uniform, smooth, continuous and free from imperfections such as black/ bare spots, ash rust strains, bulky white deposits/ wet storage strains and blisters.

The surface preparation for fabricated tower parts and stubs for hot dip galvanizing shall be carried out as indicated herein below:

(i) Degreasing & Cleaning of Surface: Degreasing and cleaning of surface, wherever required, shall be carried out in accordance with clause 4.1 of IS 2629. After degreasing the article shall be thoroughly rinsed. However, if acidic degreasers are used rinsing is not required.

(ii) Pickling: Pickling shall be done using either hydrochloric or sulphuric acid as recommended at clause 4.3 of IS 2629. The actual concentration of the acids and the time duration of immersion shall be determined by the Contractor depending on the nature of material to be pickled. Suitable inhibitors also shall be used with the acids to avoid over pickling. The acid concentration, inhibitors used, and maximum allowable iron content shall form part of plant standard to be formulated and submitted to employer along with Quality Assurance Program.

(iii) Rinsing: After pickling, the material shall be rinsed, preferably in running water to remove acid traces, iron particles or any other impurities from the surface. Two rinse tanks are preferable, with water cascading from the second tank to the first to ensure thorough cleaning. Wherever single tank

is employed, the water shall be periodically changed to avoid acid contamination, and removal of other residue from the tank.

(iv) Fluxing: The rinsed article shall be dipped in a solution of Zinc ammonium chloride. The concentration and temperature of the flux solution shall be standardized by the contractor depending on the article to be galvanized and individual circumstances. These shall form part of plant standard to be formulated and submitted to Employer along with Quality Assurance Program. The specific gravity of the flux solution shall be periodically monitored and controlled by adding required quantity of flux crystals to compensate for drag-out losses. Free acid content of the flux solution also shall be periodically checked and when it is more than two (2) grams of free acid per litre of the solution, it shall be neutralized. Alternatively, Ph value should be monitored periodically and maintained between 5.0 to 5.5.

(v) Drying: When dry galvanizing is adopted the article shall be thoroughly dried after fluxing. For the purpose of drying, the contractor may use hot plate, air oven or any other proven method ensuring complete drying of the article after fluxing and prior to dipping in the molten zinc bath. The drying process shall be such that the article shall not attain a temperature at which the flux shall get decomposed. The article thus dried shall be galvanized before the flux coating picks up moisture from the atmosphere or the flux layer gets damaged or removed from the surface. The drying procedure, time duration, temperature limits, time lag between fluxing, drying, galvanizing etc. shall form part of plant standard to be formulated and submitted to employer along with Quality Assurance Program.

(vi) Quality of Zinc: Any one or combination of the grades of zinc specified in IS 209 or IS 13229/ Prime Western (PW grade) (Zn 98.65%) or other comparable international standard shall be used for galvanizing. The contractor shall declare the grade(s) of zinc proposed to be used by them for galvanizing. The molten metal in the zinc bath shall contain minimum 98.5 % zinc by mass. It shall be periodically measured and recorded. Zinc aluminum alloy shall be added as per IS 2629.

(vii) Dipping Process: The temperature of the galvanizing bath shall be continuously monitored and controlled. The working temperature of the galvanizing bath shall be maintained at 450+/-10^0 C. The article should be immersed in the bath as rapidly as possible without compromising on safety aspects. The galvanizing bath temperature, immersion angle & time, time duration of immersion, rate of withdrawal etc. shall be monitored and controlled depending upon the size, shape, thickness and chemical composition of the article such that the mass of zinc coating and its

uniformity meets the specified requirements and the galvanized surface is free from imperfections and galvanizing defects.

(viii) Post Treatment: The article shall be quenched in water. The quench water is to be changed/ drained periodically to prevent corrosive salts from accumulating in it. If water quenching is not done then necessary cooling arrangements should be made. The galvanized articles shall be dipped in chromating solution containing sodium dichromate and sulphuric acid or chromic acid base additive at a predetermined concentration and kept at room temperature to retard white rust attack. The temperature of the chromate solution shall not exceed 65^0 C. The articles shall not be stacked immediately after quenching and dichromating. It shall be ensured that the articles are dry before any further handling operation.

(ix) Storing, Packing and Handling: In order to prevent white rust formation sufficient care should be exercised while storing handling and transporting galvanized products. The articles shall be stored in an adequately ventilated area. The articles shall be stored with spacers in between them and kept at an inclination to facilitate easy drainage of any water collected on the articles. Similar care is to be taken while transporting and storing the articles at site.

The Contractor shall prepare a detailed galvanizing procedure including Flow Chart with control parameters and all plant standards as required above and submit to POWERGRID for approval as part of Quality Assurance Plan.

1.6.2 Fasteners

For fasteners, the galvanizing shall conform to IS 1367 (Part-13). The galvanizing shall be done with centrifuging arrangement after all mechanical operations are completed. The nuts, may however be tapped (threaded) or rerun after galvanizing and the threads oiled. The threads of bolts & nuts shall have a neat fit a nd shall be such that they can be turned with finger throughout the length of the t hreads of bolts and they shall be capable of developing full strength of bolts. Spring washers shall be electro galvanized as per Grade-IV of IS 1573.The subject t owers for this procurement are envisaged to use in coastal region and the galvaniz ation shall be as per coastal consideration.

1.7 Standards

1.7.1 The design, manufacturing, fabrication, galvanising, testing, erection procedure and materials used for manufacture and erection of towers, design and construction of foundations shall conform to the following Indian Standards (IS)/ International Standards which shall mean latest revisions, with amendments/ changes adopted and published, unless specifically stated otherwise in the Specification. In the event of supply of material conforming to Standards other than specified, the Bidder shall confirm in his bid that these Standards are equivalent to those specified. In case of award, salient features of comparison between the Standards proposed by the Bidder and those specified in this document will be provided by the Contractor to establish their equivalence.

1.7.2 The material and services covered under the:se specifications shall be performed as per requirements of the relevant latest standard code referred hereinafter against each set of equipment and services

Sl. No.	Indian Standard	Title
1	IS 209	Zinc INGOT - Specification
2	IS 278	Galvanized steel barbed wire for fencing-Specification
3	IS 800	General construction in steel - Code of practice
4(a)	IS 802(Part 1) Sec 1-2015 Sec 2-2016	Use of structural steel in overhead transmission line towers - code of practice part 1 materials, loads and design strengths Section-1: Materials and loads Section-2: Design Strengths.

Sl. No.	Indian Standard	Title
4(b)	IS 802(Part 2)	Code of Practice for use of structural steel in Overhead Transmission Line Towers: Part-2 Fabrication, Galvanising, inspection & Packing
4(c)	IS:802(Part 3)	Code of Practice for use of structural steel in Overload Transmission Line: Part-3 Tower testing
5	IS 808	Dimensions for Hot Rolled Steel Beam, Column, Channel and Angle Sections.
6(a)	IS 875 Part-1, 2, 4, 5	Code of Practice for Design Loads (other than Earthquakes) for Buildings and Structures.
6(b)	IS 875 Part-3	Design Loads (other than Earthquakes) for Buildings and Structures- Code of Practice
7	IS 1363 Part-1, 2, 3	Hexagon head bolts, Screws and Nuts of product Grade `C'
8	IS 1367, Part 1 to 20	Technical Supply Conditions for Threaded Steel Fasteners
9	IS 1477	Code of practice for Painting of Ferrous Metals in Buildings: Part-I: Pre-treatment Part-II: Painting.
10	IS 1573	Electro-Plated Coatings of Zinc on iron and Steel
11	IS 1852	Rolling and Cutting Tolerances of Hot Rolled Steel Products
12	IS1893 Part 1 Part 2 Part 3 Part 4	Criteria for Earthquake Resistant Design of Structures
13	IS 2016	Specification for Plain Washers
14	IS 2062	Hot Rolled medium and High tensile Structural Steel
15	IS 2074 & IS 2074 (Part-1)	Ready Mixed Paint. Air Drying, Red Oxide Zinc Chrome, Priming Specification.
16	IS 2551	Danger Notice Plates

Sl. No.	Indian Standard	Title
17	IS 2629	Recommended Practice for Hot Dip Galvanizing of iron and steel.
18	IS 2633	Method of Testing Uniformity of Coating of Zinc Coated Articles
19	IS 3043	Code of Practice for Earthing
20	IS:3063	Fasteners-Single coil Rectangular Section Spring Lock Washers
21	IS 3757	Specification for High Strength Structural Bolts
22	IS 4759	Specification for Hot-dip zinc coatings on structural steel and other Allied products
23	IS 5369	General Requirements for Plain Washers and Lock Washers
24 a)	IS 5613 (Part 1)	Code of Practice for Design installation and Maintenance of Overhead Power Lines: Lines up to and including 11 KV Section-1: Design, Section-2: Installation and Maintenance
24 b)	IS 5613 (Part 2)	Code of Practice for Design installation and Maintenance of Overhead Power Lines: Lines above 11 KV and upto and including 220 KV Section-1: Design, Section-2: Installation and Maintenance
24 c)	IS 5613 (Part 2)	Code of Practice for Design installation and Maintenance of Overhead Power Lines: 400kV Lines Section-1: Design, Section-2: Installation and Maintenance
25	IS 6610	Specification for Heavy Washers for Steel Structures
26	IS 6623	High Strength Structural Nuts
27	IS 6639	Hexagon Bolts for Steel Structure.
28	IS 6745	Method for Determination of Mass of Zinc coating on zinc coated iron and Steel Articles.
29	IS 10238	Fasteners - Threaded Steel Fasteners - Step Bolts for Steel Structures
30	IS 12427	Fasteners - Threaded Steel Fasteners - Hexagon Head Transmission Tower Bolts
31	Publication No. 19(N)/700	Regulation for Electrical Crossing of Railway Tracks

The standards mentioned above are available from

Reference Abbreviation	Name and Address
BIS/IS	Bureau Of Indian Standards. Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi - 110001 INDIA
ISO	International Organisation for Standardization. ISO Central Secretariat BIBC II Chemin de Blandonnet 8 CP 401 1214 Vernier, Geneva Switzerland

2.0 Inspection and Tests

2.1 General

All standard tests, including quality control tests, in accordance with appropriate Indian/ International Standard, shall be carried out unless otherwise specified herein.

2.1.1 Inspection

In addition to the provision of GCC and Cl. 1.7.3 of Section II of this Specification, the following shall also apply:

a) The Contractor shall keep the Employer informed in advance about the time of starting and of the progress of manufacture and fabrication of various tower parts at various stages, so that arrangements could be made for inspection.

b) The acceptance of any part of items shall in no way relieve the Contractor of any part of his responsibility for meeting all the requirements of the Specification.

2.1.2 The Employer or his representative shall have free access at all reasonable times to those parts of the Contractor's works which are concerned with the fabrication of the Employer's material for satisfying himself that the fabrication is being done in accordance with the provisions of the Specification.

2.1.3 Unless specified otherwise, inspection shall be made at the place of manufacture prior to dispatch and shall be concluded so as not to interfere unnecessarily with the operation of the work.

2.1.4 Should any member of the structure be found not to comply with the supplied design, it shall be liable to rejection. No member once rejected shall be resubmitted for inspection, except in cases where the Purchaser or his authorized representative considers that the defects can be rectified.

2.1.5 Defect which may appear during fabrication shall be made good with the consent of the Employer according to the procedure proposed by the Contractor and its approval.

2.1.6 All gauges and templates necessary to satisfy the Employer shall be supplied by the Contractor.

2.1.7 The specified grade and quality of steel shall be used by the Contractor. To ascertain the quality of steel used, the inspector may at his discretion get the material tested at an approved laboratory.

3.0 Manufacturing Quality Plan

Tower manufacturing shall be carried out in accordance with Standardized Manufacturing Quality plan as given in ***Appendix-III*** to this section of the Specification.