		INDICATIVE FIELD QUALITY PLAN									Annexure-II
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana			
				REV. NO .:		0	PACKAGE:				
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	**Activity and operation**	**Characteristics / instruments**		**Class of check**	**Type of Check**	**Quantum Of check**	**Reference Document**	**Acceptance Norms**	**Format of Record**		**Remarks**
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**D***	**10**
10.4	**Bituminous Surfacing - Open graded premix carpet and Seal coat**										
i		Quality of binder	Penetrometer with St. needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable	As per Technical Specifications/ BOQ /IRC/MORTH		SR	√	
ii		Aggregate Impact Value / Los angeles abrasion value	Aggregate Impact Value Test apparatus	A	Physical	One test per 50 cum of aggregate			SR	√	
iii		Flakiness Index and elongation index of aggregates	Flakiness test gauge	B	Physical	One test per 50 cum of aggregate			SR		
iv		Stripping value of aggregate (Immersion tray test)	As required / agreed	B	Physical	Initially one set of 3 representative specimen per source, and on every change of source			SR		
v		Water absorption test		A	Physical	Initially one set of 3 representative specimen			SR	√	
vi		Water sensitivity of mix	As required / agreed	A	Physical	Initially one set of 3 representative specimen			SR	√	
vii		Grading of aggregates	Set of Sieves	B	Physical	One test per 25 cum of aggregates	As per Technical Specifications/ BOQ /IRC/MORTH		SR		
viii		Soundness (Magnesium and Sodium Sulphate)	As required as per IS:2386	A	Physical	Once per source by each method and on every change of source			SR	√	
ix		Polished stone value	As required as per BS:812(Part 114)	B	Physical	As required			SR		
x		Temperature of binder at application	Thermometer	B	Physical	At regular close intervals			SR		
xi		Binder content	Bitumen extractor	A	Physical	One test per 500 cum& not less than two tests per day			SR	√	
xii		Rate of spread of materials	As required / agreed	B	Physical	One test per 500 cum and not less than 2 tests per day			SR		

		INDICATIVE FIELD QUALITY PLAN									Annexure-II
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana			
				REV. NO .:		0	PACKAGE:				
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	**Activity and operation**	**Characteristics / instruments**		**Class of check**	**Type of Check**	**Quantum Of check**	**Reference Document**	**Acceptance Norms**	**Format of Record**		**Remarks**
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**D***	**10**
xiii		Percentage of fractured faces	Bitumen extractor	A	Physical	When gravel is used one test per 50cum of aggregates			SR	√	
10.5	**Tack Coat/ Prime coat/ fog coat**										
i		Quality of binder	Penetrometer with Standard needle	A	Physical	No. of samples per Lot & tests as per IS:73, IS:217, IS:8887 as applicable			SR	√	
ii		Temperature of binder at application	Thermometer	B	Physical	At regular close intervals			SR		
iii		Rate of spread of binder	As required / agreed	B	Physical	One test per 500 cum and not less than 2 tests			SR		
10.6	**Alignment, Level, Surface regularity and rectification**										
		Horizontal alignment, Surface levels and Surface regularity	As required / agreed	B	Physical	As per section 900 of MORTH specification	As per Technical Specifications/ BOQ/ Referred Standards and construction		SR		
		Rectification	As required / agreed	B	Physical	Each rectification	As per Technical Specifications/ BOQ/		SR	√	
11.00	**False Ceiling**										
i		Materials (gypsum glass, glass fibre membrane, fibre board acoustical tiles etc)	As agreed / required	B	EIC Approved source and review of MTC/ test reports	For each lot received at site	Tech Specs and Const. Drawings		SR	√	Compare MTC with technical specification and requirement
ii		Installation finishing and acceptance	As agreed / required	B	Visual / physical	Random	Tech Specs and Const. Drawings		SR		
12.0	**GEOTECHNICAL INVESTIGATION WORK**										
i		Deployment of approved Geotechnical Investigation Agency - Equipments, Manpower etc.	As required / agreed	A	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes		SR	√	
ii		Execution of Geotechnical Investigation - locations, type etc. as per scheme	As required / agreed	B	Physical	Each Location	As per technical specifications and relevant IS Codes		SR	√	
iii		Collection of disturbed and undisturbed samples , their packing and storage	As required / agreed	B	Physical	each sampling	As per technical specifications and relevant IS Codes		SR		
iv		Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc.	As required / agreed	B	Physical	each field test	As per technical specifications and relevant IS Codes		SR		
v		Submission of Field Bore logs in approved format	As required / agreed	B	Review	Within 24 hours after completion of each BH	As per technical specifications and relevant IS Codes		SR	√	
vi		Submission of laboratory test schedule and selection of samples for laboratory testing	As required / agreed	A	Review and acceptance	as per consultation with engineer during dispatch of samples to approved laboratory	As per technical specifications and relevant IS Codes		SR	√	
vii		Submission of Final Geotechnical investigation report along with recommendations	As required / agreed	B	Physical	After completion of investigation work and review of draft reports	As per technical specifications and relevant IS Codes		-	√	
13.00	**STRUCTURAL STEEL MATERIAL (For Site Fabrication)**										
i	Procured by contractor	Structural steel procured from NTPC approved sources- Mechanical (YS, UTS, Elg, UT if specified),,and Chemical properties (CE as per IS)		A	Review	For each batch of each section delivered at site	Technical Specification and Construction Drawings, IS 2062		SR	√	Correlated MTC shall be verified.
13.1	**PRE-WELDING REQUIREMENTS**										

		INDICATIVE FIELD QUALITY PLAN									Annexure-II
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana			
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		REV. NO .:		0	PACKAGE:				
				DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	**Activity and operation**	**Characteristics / instruments**		**Class of check**	**Type of Check**	**Quantum Of check**	**Reference Document**	**Acceptance Norms**	**Format of Record**		**Remarks**
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**D***	**10**
i		Welding Procedure Specification * (WPS*)	-	A	Review	Each Welding Process	Technical Specification and Construction Drawings, ASME-IX/ AWS D 1.1		WPS	√	*To be approved by CQA
ii		PQR and Welder's Qualification	-	A	Physical	Each welder	PQR/ WQR, AWS-D1.1/ASME-IX, Technical Specifi- cation and Construction Drawings		TR	√	
iii		Welding consumables	-	B	Physical	Random in each shift	Approved WPS, Latest NTPC		SR	√	
13.2	**FIT-UP**										
i		Marking and Cutting	Tape, ruler etc.	B	Visual & Measurement	Each plate/ Section	Technical Specification and Construction Drawings/ Approved cutting plan		SR		
ii		Match markings for trial assembled components	-	B	Physical	Each fit-up	Technical Specification and Construction Drawings		SR		
iii		Weld Fit Up- Edge Preparation/ Gap/ Alignment	Tape, ruler etc.	B	Physical	Each fit-up	Technical Specification and Construction Drawings, IS 7215		SR	√	If required suitable stiffeners shall be provided to prevent deflection.
13.3	**PRE HEATING (wherever applicable)**										
i		Pre-Heating Temperature	Thermal chalk	B	Measurement	Each pre-heating	Technical Specification and Construction		SR	√	
ii		Post Weld Heat Treatment (PWHT), if required	Thermo couple with time temperature	A	Time & Temperature	Each PWHT	Technical Specification and Construction Drawings, Approved WPS		SR	√	

		INDICATIVE FIELD QUALITY PLAN									Annexure-II
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana			
				REV. NO .:		0	PACKAGE:				
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
13.4	WELDING REQUIREMENTS										
i		Sequence of welding	-	B	Physical	Random in each shift	Technical Specification and Construction Drawings, Agreed scheme		SR		
ii		Removal/ grinding of temporary	-	B	Measurement	All cleats/ attachments	Technical Specification and Construction		SR		
iii		Completeness after welding-Dimensions/ distortion	Weld gauge	B	Visual	Each structure component	Technical Specification and Construction Drawings, IS 822		SR	√	
iv		Completeness of welding (each butt & fillet weld)		B	Visual	Each structure component	Technical Specification and Construction Drawings, Approved Drg.		SR	√	
13.5	NON DESTRUCTIVE AND DESTRUCTIVE TESTING										
13.5.1	FILLET WELDS										
i		size and visual examination	As required/ agreed	B	Visual/ Measurement	100%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR		As per requirement of NTPC Engineer
ii		Dye Penetration Test	As required/ agreed	B	Physical	5% of Weld length with min. 300mm at each location	As per technical specifications and construction drawings, IS 822, AWS D 1.1		SR		
13.5.2	BUTT WELDS										
i		Visual examination	As required/ agreed	B	Visual	Random in each shift	As per technical specifications and		SR		As per requirement of NTPC Engineer
ii		DPT	As required/ agreed	B	Physical	100% on all butt welds after back gouging on root run and 10% on final weld	As per technical specifications and construction drawings, IS 822, AWS D 1.1		IR		All butt welds to be back gouged before DPT
iii		Radiography Test	As required/ agreed	A	Physical	10%	As per technical specifications and construction drawings, IS 822, AWS D 1.1		IR	√	Wherever RT is not feasible UT to be carried out. In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1.
13.6	FOUNDATION CHECKS										
i		Dimensions and levels- Shape, lines (including diagonal checks)	Theodolite, Tape etc.	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	√	
ii		Foundation Bolts and Embedment's- Verticality, Levels, pitch distance	Theodolite, Tape, Piano wires etc.	B	Physical/ Measurement	Each Foundation	Tech Specs and Const. Drawings		SR	√	
13.7	PAINTING SYSTEM										
i		Paining Materials and accessories	-	A	Review of MTC	Each batch of delivery	Tech Specs and Const. Drawings		SR/MTC	√	Mfr.'s T.C. shall be correlated with the consignment received.
ii		Submission of painting methodology	-	B	For Review of painting system	Before start of painting work	Tech Specs and Const. Drawings				
iii		Surface preparation	As agreed / required	B	Physical /visual	Each Erection Mark	Tech Specs and Const. Drawings,		SR	√	
iv		Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
v		DFT of paint	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR	√	
vi		Acceptance of painted surfaces	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings		SR		

		INDICATIVE FIELD QUALITY PLAN									Annexure-II
		ITEM : CIVIL WORK		QP NO. :		1	PROJECT:	Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana			
				REV. NO .:		0	PACKAGE:				
		SUB-SYSTEM : CIVIL AND STRUCTURAL STEEL WORKS		DATE :			CONTRACT NO.				
				PAGE :			MAIN CONTRACTOR				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record		Remarks
1	2	3		4	5	6	7	8	9	D*	10
13.8	PRE-ASSEMBLY CHECKS										
i		Punch Erection marks and match marks	-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				Markings for -
ii		Pre-assembly as per match mark	-	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings				
iii		Camber, sweep and total length after trial assembly of structure.	Theodolite, Tape, plumb, piano wires etc.	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	√	
iv		Control assembly check at shop	Theodolite, Tape, plumb, piano wires etc.	B	Visual/ Physical	Every first and tenth set of identical structure	Tech Specs and Const. Drawings				
V		Completion of primer & intermediate coat of paint		B	Visual / Physical	Random	Tech Specs and Const. Drawings		SR		
13.9	ERECTION CHECKS										
i		Alignment, slopes, level, tolerances of erected member	Theodolite, Tape, plumb, piano wires etc.	B	Measurement	Each structural member	Tech Specs and Const. Drawings		SR	√	
ii		Tightening of bolts/ Torque including foundation bolts with lock nuts	Wrench/ Torque wrench if specified	B	Visual/ Physical	Each structural member	Tech Specs and Const. Drawings		SR	√	
iii		Completion of all erection fillet & butt welds		B	Visual	Each structural member	Tech Specs and Const. Drawings		SR	√	
iv		Acceptance of erected structure	Theodolite, Tape, plumb, piano wires etc.	B	Visual/ Physical	Each erected structure	Tech Specs and Const. Drawings, IS 7215 and IS 12843		SR	√	
13.10	PERMANENT BOLTS AND NUTS AND WASHERS										
i		Material- Permanent mild steel Bolts, mild steel Nuts, High strength structural Bolts, Washers-Dimensions, properties, Class, storage along with MTC	Screw gauge, Vernier, Tape etc.	A	Physical and MTC Review	Once for each lot of delivery	Tech Specs and Const. Drawings		SR/MTC	√	
ii		Contact surfaces before bolting	-	B	Physical	Random before assembly for bolting	Tech Specs and Const. Drawings, IS 4000		SR		
iii		Inspection of the assembled bolts	-	B	Physical	Randomly in each shift for assembled bolts	Tech Specs and Const. Drawings, IS 4000		SR		
iv		Tensioning	As agreed / required	B	Physical	Randomly during snug tight test and after full tensioning	Tech Specs and Const. Drawings, IS 4000		SR	√	
v		Acceptance of installed bolts	-	B	Physical	Each bolt	Tech Specs and Const. Drawings		SR		

Legend to be used: Class # : A = Critical, B=Major, C=Minor; SR = Site Register , TR= Test Report,MfrTC = Manufacturer's Test Certificate

Categorization Witnessing & Accepting (As per NTPC QA&I System)

Format No.: QS-01-QAI-P-09/F2-R1 **Engg. Div./QA&I**

	PROJECT: Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS				DATE	28.11.2018
	CONTRACT NO.:						

SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
1.	**CEMENT**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
2.	**CONSTRUCTION CHEMICALS - ADMIXTURES, PLASTISIZERS, RETARDERS WATER PROOFING COMPOUNDS GROUTS**	**III**	-	SIKA INDIA LTD	-	A	
				CICO TECHONOLOGIES LTD	-	A	
				FOSROC CHEMICALS (I) PVT LTD	-	A	
				BASF	-	A	
3.	**PAINT AND PAINTING SYSTEM**	**III**	-	BERGER	-	A	
				SHALIMAR PAINTS	-	A	
				JENSON AND NICHOLSON	-	A	
				KANSAI NEROLAC	-	A	
				AKZO NOBEL	-	A	
				ASIAN PAINTS	-	A	
4.	**GI PIPES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
5.	**BITUMEN ASPHALT**	**III**	-	ALL GOVERNMENT REFIINARIES	-		
6.	**PLASTIC/ PVC PIPES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
7.	**BITUMEN IMPREGNATED FIBER BOARD JOINT FILLER , BITUMEN SEALING COMPOUND**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
8.	**CERAMIC / VITRIFIED TILES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	

	PROJECT: Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS				DATE	28.11.2018
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
9.	**PARTICLE BOARDS, PLYWOOD, MDF**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
10.	**HIGH SOLID CONTENT LIQUID APPLIED URETHANE BASED ELASTOMERIC MEMBRANE FOR WATER PROOFING**	**III**	-	STP	-	A	
				IWL INDIA LTD	-	A	
				LLOYDS	-	A	
				CICO TECHONOLOGIES LTD	-	A	
				FOSROC CHEMICALS (I) PVT LTD	-	A	
11.	**POLYTHENE WATER STORAGE TANKS**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-		
12.	**MINERAL WOOL FOR THERMAL INSULATION**	**III**		ROCKWOOL INDIA LTD.	HYDERABAD	A	
				PUNJSTAR INSULATION FIBRE COMPANY	BHILAI	A	
				LAPINUS	MALANPUR (MP)	A	
				MINWOOL	RAJANANDGAON	A	
				LLOYD INSULATION	BHILAI	A	
				GOENKA ROCKWOOL (I) PVT LTD	RAIPUR	A	
				SHREERAM EQUITECH PVT LTD	DURG	A	
				U.P. TWIGA	BULENDSHAHAR	A	
13.	**CI PIPES**	**III**	-	BIS APPROVED SOURCES HAVING VALID BIS LICENCE			
14.	**MODULE MOUNTING STRUCTURES (MMS)**	**III**		MAIN CONTRACTOR'S APPROVED SOURCES			

	PROJECT: Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS				DATE	28.11.2018
	CONTRACT NO.:						

SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
15.	**GALAVANISED STEEL STRUCTURES FOR TRANSMISION LINE**	**I**		L&T	PITAMPUR	A	
				NAMPA STEEL	HOWRAH	A	
				UNITECH POWER TRANSMISSION LTD.	NAGPUR	A	
				L&T	PONDICHERRY	A	
				ASSOCIATED POWER STRUCTURES	VADODARA	A	
				GOOD LUCK STEEL TUBES	SIKANDRABAD	A	
				R.S. INFRAPROJECTS PVT. LTD	SURAJPUR	A	
				ADVANCE STEEL TUBE	SAHIBABAD	A	
				RICHARDSON & CRUDDAS (1972) LTD	NAGPUR	A	
16.	**GALVANISED STEEL STRUCTURE (LATTICE & PIPE)**	**I**		GOOD LUCK STEEL TUBES	SIKANDRABAD	A	
				RICHARDSON & CRUDDAS (1972) LTD	NAGPUR	A	
				L&T	PONDICHERY	A	
				L&T	PITAMPUR	A	
				R.S. INFRAPROJECTS PVT. LTD	SURAJPUR	A	
				VIJAY TRANSMIISION P. LTD	RAIPUR	A	
				UNIQUE STRUCTURES & TOWERS LTD.	RAIPUR	A	
				VATCO ELEC-POWER PVT. LTD.	NAVIMUMBAI	A*	*Galvanising at M/s Sigma Galvaniser, Navi Mumbai
				R.S. INFRAPROJECTS PVT. LTD	GHAZIABAD	A	
				ADVANCE STEEL TUBE ,	SAHIBABAD	A	
				SANGAM STRUCTURES LTD.	ALLAHABAD	A	

	PROJECT: Development of 100 MW Floating Solar PV Project at NTPC Ramagundam in Telanagana	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL				NTPC DOC NO	
	PACKAGE: SOLAR					REV. NO.	0
	MAIN SUPPLIER:	SUB SYSTEM: CIVIL WORKS				DATE	28.11.2018
	CONTRACT NO.:						
SR. NO.	ITEM	QAP / INSP. CAT	QAP NO.	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
				NEW MODERN TECHNOMECH	MAYURBHANJ (OR)	A	
				UNITECH POWER TRANSMISSION LTD.	NAGPUR	A	
				ASSOCIATED POWER STRUCTURES	VADODARA	A	
				RELIABLE SPONGE PVT LTD,	KALUNGA, ODISHA	A	
17	**FOUNDATION BOLT**	**III**		MAIN CONTRACTOR'S APPROVED SOURCES			

LEGENDS:
1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)
A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter "A" in the list along with the condition of approval, if any.
DR – For these items "Details required" for NTPC review. To be identified with letter "DR" in the list.

2. QP/INSPN CATEGORY:
CAT-I : For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.
CAT-II : For these items the Quality Plans approved by NTPC. However no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved quality plan.
CAT-III : For these items Main Supplier approves the Quality Plans.
UNITS/ WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

NOTE 1: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of MTC / certificate of conformance in line with Indicative FQP / Technical Specifications.
NOTE 2: Clearance from NTPC Engineering required wherever the Proveness / Sub-QR criteria mentioned against that particular BOIs or Sub-Suppliers in the Technical specifications.

Specification of auxiliary transformer 30 KVA, 380V/433V, dYN11

1.0 Technical parameters and specifications:

#	**Technical parameter**	**Specification**
1	Transformer type	Dry type
2	IP class	The transformers shall be housed in an enclosure (Corrosion resistant) having degree of protection of IP-54 or higher.
3	Type of cooling	AN
4	Governing Standard	IS: 2026, IS:11171 or equivalent to any other international standard, Indian Electricity Act 2003, BEE Guideline & CEA notifications.
5	Rating in KVA	30 KVA
6	No. of phases	3
7	Frequency	50 Hz, +/- 3%
8	HV winding	433V, 3-Ph with **Star**t Connection
9	LV windings	380V, 3-Ph, with **Delta** connection
10	Winding material	Electrolytic grade copper for both HV and LV windings
11	Winding Insulation	Class F or better
12	Neutral on LV side	Neutral terminal shall be brought out separately to facilitate earthing connections.
13	Vector Group	dYN11
14	Short circuit withstand time (thermal)	2 sec.
15	% Impedance	As per IS: 1180
16	Termination HV/LV/Orientation	Air insulated cable box with disconnecting chamber, for both HV and LV sides. Cable box / Cable box / 180^0.
17	Cable entry on HV side	Bottom entry of cables. **Cable supply in bidder scope.**
18	Cable entry on LV side	Bottom entry of cables. **Cable supply in bidder scope.**
19	Cables and accessories	Cables, Cable glands cable lugs (Dowell/Comet/3D make) and connecting hardware shall be in bidder scope of supply.
20	Tapping on HV winding	Off circuit tap changer (OCTC) switch with five tap positions: +5%, +2.5%, 0, -2.5%, -5%.
21	Loading Capability	Continuous operation at rated KVA on any tap with voltage variation of +/-10%. Transformer shall be capable of being loaded in accordance with IS: 6600 / IEC 60076-7.
22	Ambient temperature	Max 50 deg C
23	Temperature rise	90 deg C. (class F) 115 deg C. (class H)

	24	Flux density	Not to exceed 1.9 Wb/sq.m at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over-fluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating b) 125% for at least one minute c) 140% for at least five seconds Bidder shall furnish over-fluxing characteristics up to 150%
	25	Air Clearance	As per CBIP
	26	Load loss principal tap at 75^0C, with IS tolerance	This shall be provided by bidder.
	27	No Load loss at rated voltage on principal tapping and at rated frequency, with IS tolerance	This shall be provided by bidder.
	28	No load current at rated voltage and rated frequency	This shall be provided by bidder. To be indicated as percentage.
	29	Efficiency at 75^0C, UPF	As per IS 1180 and CBIP
	30	Regulation at full load, 75 ^{o}C	< 2 % for UPF For 0.8 PF lagging, to be indicated by bidder.
	31	Harmonics	Shall be designed to suppress harmonics especially 3^{rd}& 5^{th}.
	32	Vibration & noise	Noise level shall be according to NEMA TR-1 standard
	33	Highest system voltage	LV side: 1.1 kV HV side: 1.1 kV
	34	Bushing rating, Insulation class (Winding & bushing)	As per relevant IS/IEC Creepage distance : 35 mm/kV
	35	Overall dimensions in mm Length x Breadth x Height	This shall be provided by bidder.
	37	Weight of transformer in Kg	This shall be provided by bidder.
	38	Painting	The inside of enclosure and accessories (except M. Box) shall be painted with two coats of fully glossy white colour with total DFT of 25 to 60 microns. The external paint colour of transformer & accessories shall be blue corresponding to **RAL 5012**. The external surface of transformer & accessories shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of polyurethane finish paint with total DFT of 80 to 150 microns. The internal surface of Marshalling

		Box shall have two coats of chemical resistant epoxy zinc phosphate primer and two coats of chemical & thermal resistant epoxy enamel white paint with total DFT of 80 to 150 microns.
39	Constructional features	As per relevant clause of this specification
40	Fittings and accessories	As per relevant clause of this specification

2.0 Tests on auxiliary transformer

2.1

Sl.No.	ROUTINE TESTS
1	All routine test shall be carried out in accordance with IEC 60076.
2	Measurement of Voltage Ratio & phase displacement
3	Measurement of winding resistance on all the taps (as per IEC 60076-1)
4	Vector group and Polarity Check
5	Magnetic Balance and Magnetising Current Test
6	Measurement of no load current with 415 V, 50 Hz AC supply
7	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage
8	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps
9	IR measurement (As per IEC 60076-1)
10	Separate Source Voltage Withstand Test /Applied voltage test.
11	Induced overvoltage test/Induced voltage withstand (IVW) test .
12	Repeat no load current/loss & IR after completion of all electrical test
13	Oil leakage test on completely assembled transformer along with radiators (as per relevant clause of this sub section)
14	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.
15	IR measurement on wiring of Marshalling Box.

2.2 Type Tests

Sl.No.	TYPE TESTS
1.	Temperature Rise test at a tap corresponding to maximum losses as per IS 2026.
2.	Short Circuit test as per IEC (if applicable)
3.	Noise Level Measurement

3.0 Constructional features and details of transformer components

3.0	Dry Type Transformer shall be constructed in accordance to IS: 2026, IS: 11171 or equivalent to any other international standard, Indian Electricity Act 2003, BEE Guideline & CEA notifications. Transformer rating and all related technical parameters including tap changer (if applicable) shall be as per system requirement/SLD and relevant standards. Transformer shall be suitable for

	continuous indoor duty application. Transformer shall be complete & functional in all respect. The other important construction particulars shall be as below. All materials / components used shall be of best quality and class most suitable for working under the conditions specified. These shall withstand the variations of temperature and atmospheric conditions, overload, over-excitation, short-circuits as per specified standards without distortion or deterioration, without development of stresses in any part and also without affecting the strength and suitability of the various parts for the work that they have to perform.

3.1 Core

3.2.1	The core shall be constructed from non-ageing, cold rolled, super grain oriented silicon steel laminations equivalent to M4 grade steels or better.
3.2.2	The insulation structure of the core to clamp plates shall be such that it withstands a voltage of 2kV (rms) for one minute in air.
3.2.3	Adequate lifting lugs will be provided to enable the core & windings to be lifted.

3.2 Windings

3.3.1	Windings shall be of electrolytic grade copper free from scales and burrs.
3.3.2	Windings shall be subjected to a shrinking and seasoning process so that no further shrinkage occurs during service.
3.3.3	Windings shall have uniform insulation.
3.3.4	Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.
3.3.5	The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with oil after the drying process to ensure elimination of air and moisture within the insulation.
3.3.6	Windings shall be made in dust proof and conditioned atmosphere. Bidder shall indicate those details of facilities (as available at the winding works) that will ensure meeting this requirement.

3.4 Internal earthing

3.4.1	The frame work and clamping arrangements of core and coil shall be securely earthed inside the tank by copper strip connection to the tank.

3.5 Bushings

3.5.1	a) Bushing below 52 kV shall be oil communicating type with porcelain insulator. b) No arcing horns to be provided on the bushings.

3.6 Bushing CTs

1.Shall be of adequate rating for protection as required, WTI (WTI CTM applicable for transformer above 50 KVA) etc.
2. All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

3.7 Cable boxes & disconnecting chamber (Disconnecting chamber applicable 3.3 kV and above)

(a) HV Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination. Phase segregation shall be achieved by insulating barriers (for 3.3 kV and above side)

(b) Cable boxes shall have bus bars / suitable terminal connectors of adequate size & bolt holes to receive cable lugs.

(c) A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box

(d) The support from base for the cable box (for 3.3 kV and above side) shall be of galvanized iron.

(e) The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat.

(f) The minimum length provided for terminating 33 kV, 11KV & 3.3 KV XLPE cable shall be 1000 mm (for 33 kV) 650 mm (for 3.3 kV and 11 kV) from cable gland plate to the cable lug) for the cable boxes, for 433V side suitable length shall be provided (shall be discussed during

detail engineering). The final cable size, number & length of terminating XLPE cable shall be furnished during detailed engineering.

(g) Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports (as applicable).

(h) Cable boxes shall have removable top cover (for transformer above100 KVA) & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.

3.8 Fittings and accessories

Following fittings per transformer shall be provided. Bidder shall indicate compliance (Yes / No) for each line item. In case of non-compliance or deviation, bidder shall indicate and provide comments.

a	Winding temperature indicator (WTI)	Shall be Platinum resistance type temperature detector in each limb. Single Indicating meter may be provided for display of temperature of all limbs. Accuracy class of Indicating meter shall be +/- 1% or better and it shall have least count of 0.1 °C or better. 1 no. 4-20 mA signal shall be provided for remote monitoring of winding Temperature.
b	RTD/Thermistors	1 No. PT-RTD shall be embedded in each limb with alarm and trip contacts for remote annunciation. Additional 1 No. thermistor/RTD shall be embedded in each limb.
c	Bi-directional wheel/skids, M.Box, OCTC, Bushing CTs (as applicable), Cooling equipment.	
d	Cover lifting eyes, transformer lifting lugs, towing holes and core and winding lifting lugs, inspection cover, Bilingual R&D Plate, Terminal marking plates, two nos. earthing terminals etc.	
e	Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.	
The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformers are deemed to be included.		

4.0 Inspection and testing of transformers at bidder works

4.0	Bidder shall provide inspection call to BHEL for the type and routine tests. Prior to the call, bidder shall submit the routine test results as per Manufacturing Quality Plan (MQP) for scrutiny of BHEL/NTPC.

5.0 Documents to be submitted after receipt of purchase order

5.1	Following documents shall be submitted for BHEL approval within seven days from date of purchase order. (1) GA drawings including foundation details (2) GTP (3) MQP (4) Valid type test report as above

6.0 Documents to be submitted along with consignment

6.1	Following documents shall be submitted to BHEL at the time of delivery of the consignment: (1) As built drawings of transformer (2) Routine test reports on transformer (3) Type test reports on transformer (4) Test certificate for transformer oil (5) Operations and maintenance manual of transformer

1.0 Introduction

This technical specification provides BHEL requirements for LT Switchgear system for the solar photovoltaic project.

1.1 Technical specification

The scope of work under this specification covers the design, manufacture, assembly, testing at manufacturer's works, transportation, transit insurance, delivery at site, storage, installation, testing, and commissioning of indoor type following 415V LT Switchgear complete with all accessories and spares.

The Scope shall include supply of 415 V (3 phase, 1 neutral and single phase for lighting etc.) power distribution line for the entire area from the LT switchgear with necessary breaker, switch fuse unit as and when required, Boards as above along with gland plates for all power and control cables, base frames, special tools i.e. operating handles, trolley necessary for removing the circuit breakers for maintenance etc. Isolators should be provided in the line to connect or isolate the connection from both the station auxiliary transformer.

The scope shall include all associated devices, components, relays, contactors, switches etc. required for satisfactory operation of the switch boards as per the proposed logic control scheme. The scope of supply shall also include necessary spares required for operation & maintenance of switchgear equipments for a period of 5 (five) years & special tools & plants required for erection & maintenance.

Corresponding parts of all the equipments & spares shall be of the same material & dimensions, workmanship & finish and shall be interchangeable. All the material & workmanship shall be of suitable commercial quality as have proven successful in their respective uses in similar services & under similar condition.

1.2 STANDARDS

The equipments covered under this chapter shall comply with the requirement of latest edition of following IS/BS/IEC specifications as amended up to date except where specified otherwise.

Sl. No.	Standards	Description
1	IEC 60947/IS13947	Specification for Low-Voltage Switchgear and Control gear.
2	IS: 10118 (Part 1 to 4)	Code of practice for selection, installation and maintenance of switchgear & control gear.
3	IS 3043	Code of practice for earthing.
4	IS 3072	Code of practice for installation and maintenance of Switchgear
5	IS: 2705	Current Transformers
6	IS: 3156	Voltage Transformers
7	IS: 3231	Electrical Relays for Power System Protection
8	IEC 60255	Electrical Relays
9	IS 3202	Code of practice for climate proofing of electrical equipment.
10	IS: 8828	Circuit breakers for over current protection for household and similar installations
11	IS: 13703 / IEC 60269	HRC Cartridge fuses
12	IS: 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals.

2.0 TECHNICAL PARAMETERS		
A. POWER SUPPLY (AC SYSTEM)		
(i)	Voltage	415V + 10%, 3 Phase, 4 wire,Neutral Solidly Earthed
(ii)	Frequency	50 Hz +/- 5%
(iii)	Minimum system fault level	As per system fault current (for 1 sec)
(iv)	Short time rating for bus bars,ckt.breakers,current transformers and swgr. Assembly.	As per system fault current (for 1 sec)
(v)	Maximum ambient air Temperature	50 deg. C
BUS BARS		
(vi)	Continuous current rating at 50ºC ambient:	As Per Requirement

(vii)	Temperature Rise allowed above ambient	40^0C for plain joints 55^0C for Silver plated joints
B. MCCB		
(i)	Rated voltage	415V
(ii)	Rated Insulation Level	690V
(iii)	Rated ultimate and service SC breaking capacity(As per system requirement)	As per system fault current (for 1 sec)
(iv)	Rated making capacity	2.1 times of System fault current
(v)	Utilization category	A
C. DIGITAL MFM		
(i)	Accuracy class	0.5
(ii)	MFM shall be provided at LT incomer feeder. MFM shall have suitable communication port for integration with SCADA system.	
D. CURRENT TRANSFORMERS		
(i)	Type	Cast Resin Bar Primary
(ii)	Voltage class and frequency	650V, 50HZ
(iii)	CT Secondary Current	1 A
(iv)	Class of insulation	E or better
(v)	Accuracy class & burden	
	a) For Protection	5P20, 5VA
	b) For Metering	Class 1.0, 5VA (min)
(vi)	Instrument Security Factor for metering CT	5
E. VOLTAGE TRANSFORMERS		
(i)	Type	Cast Resin
(ii)	Voltage Ratio	415 / 110V for line PT
		415/√3 / 110/√3V for Bus PT
(iii)	Neutral Solidly Earthed	Vee Vee
(iv)	Accuracy Class	0.5
(v)	Rated Voltage factor	1.1 continuous, 1.5 for 30 sec.
(vi)	Class of insulation	E or better
(vii)	One minute power frequency withstand voltage	2.5 KV
F. HRC FUSES		
(i)	Voltage Class	650 Volts

(ii)	Rupturing capacity	80kA (RMS) for AC circuits
G. CONTACTORS		
(i)	Type	Air break electro magnetic
(ii)	Utilising Category	AC3 of IS/IEC 60947 for nonreversible AC4 of IS/IEC 60947 for reversible drives
H. SWGR. CUBICLE CONSTRUCTIONAL REQUIREMENTS		
(i)	Colour finish	
	Exterior	RAL9002 (Main body) RAL 5012 (Extreme end covers) ,The paint thickness shall not be less than 50 microns
	Cable entry	
(ii)	Power Cables	Bottom
	Control Cables	Bottom

3.0 DETAILS OF INDOOR DISTRIBUTION BOARDS

Applicable for Auxiliary Power Supply system.

3.1 Switchboards shall be of metal enclosed, indoor, wall mounted type.

3.2 All switchboard frames and load bearing members shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. The gland plate thickness shall be 3.0 mm for hot / cold-rolled sheet steel and 4.0 mm for non-magnetic material.

3.3 All panel edges and cover / door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. The top covers of the panels should be designed such that they do not permanently bulge/ bend by the weight of maintenance personnel working on it.

3.4 The switchboards shall be of bolted design. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut outs shall be true in shape and devoid of sharp edges.

3.5 All switchboards shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP: 5X as per IS/IEC 60947. All cutouts shall be provided with EPDM / Neoprene gaskets. Feeder Pillar with IP 55 enclosure protection meeting the technical requirement is also acceptable.

3.6 All switchboards shall be of uniform height not exceeding 2450 mm.

3.7 Switchboards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding down the base frame to the foundation / steel insert plates.

3.8 All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. Replacement /Maintenance of individual equipment/ component shall be possible without switching off or isolating the other equipments/components.

3.9 Each switchboard shall be provided with undrilled, removable type gland plate. For all single core cables, gland plate shall be of non-magnetic material. The gland plate shall be provided with gasket to ensure enclosure protection.

3.10 The minimum clearance in air between phases and between phases and earth for the entire busbars shall be 25mm. For all other components, the clearance between "two live parts", "a live part and an earthed part", shall be at least ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for busbars the clearances specified above should be maintained even when the busbars are sleeved or insulated. All connections from the busbars up to switch / fuses/MCCB shall be fully insulated and securely bolted to minimize the risk of phase to phase and phase to earth short circuits. All busbars and jumper connections shall be of high conductivity aluminium alloy / copper of adequate size.

3.11 All switchboards shall be provided with three phase and neutral busbars. Entire busbar system shall be insulated with PVC sleeves. Busbar sleeves shall be compliant to UL224 (Extruded insulating tubing), CE/UL certified, having fire retardant properties and working temperature of 105°C.

3.12 The cross-section of the busbars shall be uniform throughout the length of switchboard section and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. Neutral busbar short circuit strength shall be same as main busbars.

3.13 All busbars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet molded compound or equivalent type polyester fiber glass molded insulator. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided, anti-tracking barriers shall be provided between the supports. Insulator and barriers of inflammable material such as Hylam shall not be accepted. The busbar insulators shall be supported on the main structure.

3.14 All busbar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts, so as to ensure good contacts at the joints. Non-

silver plated busbar joints shall be thoroughly cleaned at the jointed locations and suitable contact grease shall be applied just before making a joint. All bolts shall be tightened by torque spanner to the recommended value. The overlap of the busbars at each joint surface shall be such that the length of overlap shall be equal to or greater than the width of the busbar. All copper to aluminium joints shall be provided with suitable bimetallic washers.

3.15 All busbars shall be colour coded as per IS: 375.

3.16 Wherever the busbars are painted with black Matt paint, the same should be suitable for temperature encountered in the switchboard under normal operating conditions.

3.17 The Bidder shall furnish calculations establishing the adequacy of bus bar sizes for specified current ratings.

3.18 Panel space heaters shall be provided and the supply for this shall be tapped from incomer, before the isolating switch/circuit breaker. Incoming circuit to space-heater shall have an isolating switch, HRC fuse and neutral link of suitable rating. Panel illumination and plug-socket shall also be tapped from the space heater supply.

3.19 A galvanized steel / Copper / Aluminium earth bus shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded / bolted to the framework of each panel and breaker earthing contact bar. Vertical earth bus shall be provided in each vertical section which shall in turn be bolted / welded to main horizontal earth bus.

3.20 The earth bus shall have sufficient cross section to carry the momentary short circuit and short time fault current to earth without exceeding the allowable temperature rise.

3.21 All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosure framework and truck shall be maintained even after painting.

3.22 All metallic cases of relays, instruments and other panel-mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. All the equipment mounted on the door shall be earthed through flexible wire/braids. Insulation color code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors, soldering is not acceptable. Looping of earth connections, which would result in loss of earth connections to other devices, when a device is

removed, is not acceptable. However, looping of earth connections between equipment to provide alternative paths to earth bus is acceptable.

3.23 VT and CT secondary neutral point earthing shall be at one place only, i.e. on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

3.24 All hinged doors having potential carrying equipment mounted on it shall be earthed by flexible wire/ braid. For doors not having potential carrying equipment mounted on it, earth continuity through scraping hinges/ hinge pins of proven design may also acceptable. The Contractor shall establish earth continuity at site also.

3.25 All switchboards shall be supplied completely wired internally upto the terminals, ready to receive external cables.

3.26 All auxiliary wiring shall be carried out with 650V grade, single core stranded copper conductor, colour coded, PVC insulated wires. Conductor size shall be 1.5 mm2 (min.) for control circuit wiring and 2.5 mm2 (min) for CT and space heater circuits.

3.27 Extra flexible wires shall be used for wiring to devices mounted on moving parts such as hinged doors. The wire bunches from the panel inside to the doors shall be properly sleeved or taped.

3.28 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminal blocks.

3.29 All internal wiring terminations shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor or an equally secure method. Similar lugs shall also be provided at both ends of component to component wiring. Insulating sleeves shall be provided over the exposed parts of lugs to the extent possible. Screw-less (spring loaded) / cage clamp type terminal shall also be provided with lugs.

3.30 Printed single tube ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire identification marking shall be in accordance with IS: 375. Red Ferrules should be provided on trip circuit wiring.

3.31 Cable termination arrangement for power cables shall be suitable for heavy duty, 1.1 kV grade, stranded aluminium conductor, PVC/ XLPE insulated, armoured / unarmoured and PVC sheathed cables. All necessary cable terminating accessories such as supporting clamps and brackets, hardware etc., shall be provided by the contractor, to suit the final cable sizes.

3.32 All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type conforming to IS: 8309. All lugs shall be insulated/ sleeved.

3.33 All Switchgears, MCCs, Distribution Boards, Fuse boards, all feeders, local push-button stations etc. shall be provided with prominent, engraved identification plates.

3.34 All name plates shall be of non-rusting metal or 3-ply Lamicoid, with white engraved lettering on black background. Inscription & lettering sizes shall be subject to Employer's approval.

3.35 Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.

3.36 The gaskets, wherever specified, shall be of good quality EPDM / neoprene with good ageing, compression and oil resistance characteristics suitable for panel applications.

3.37 The bidder shall, ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per indian standards / specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.

3.38 ON/OFF status and protection trip status of incomers and bus coupler (if available) be provided for SCADA system.

3.39 Suitable changeover and interlocking arrangement shall be provided for incomers and bus coupler.

3.40 It shall be the responsibility of the contractor to fully coordinate the overload and short circuit breakers/fuses with the upstream and downstream circuit breakers / fuses, to provide satisfactory discrimination. Further the various equipment supplied shall meet the requirements of type ii class of co-ordination as per IS: 8544.

3.41 All sheet steel work shall be pretreated, in tanks, in accordance with is: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-c" as specified in is: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, electrostatic powder coating shall be used. Powder should meet

requirements of is 13871 (powder costing specification). Finishing paint shade for complete panels excluding end covers shall be RAL9002 & RAL5012 for extreme end covers of all boards, unless required otherwise by the employer. The paint thickness shall not be less than 50 microns.

4.0 MCCB

a. MCCB shall be fixed type module, air break type, having trip free mechanism with quick make and quick break type contacts. MCCB shall have current limiting feature. MCCB of identical ratings shall be physically and electrically interchangeable. MCCB shall be provided with 1 NO and 1NC auxiliary contacts.

b. MCCB shall have inbuilt front adjustable releases (overload & short circuit) and shall have adjustable earth fault protection unit also. The protection settings shall have suitable range to achieve the required time & current settings. LED indications shall also be provided for faults, MCCB status (on/off etc).

C. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit rating. Extended cable terminal arrangement for higher size cable may also be offered. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door can not be opened unless the MCCB is in OFF position. Means shall be provided for defeating this interlock at any time. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked. The MCCBs being offered shall have common/interchangeable accessories for all ratings like aux. switch, shunt trip, alarm switch etc. The MCCBs shall have the current discrimination up to full short circuit capacity and shall be selected as per manufacturer's discrimination table.

5.0 FUSES

5.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC circuits shall be rated for 80kA rms (prospective) breaking capacity at 415V AC and for DC circuits, 20kA rms breaking capacity at 240V DC.

5.2 Fuse shall have visible operation indicators. Insulating barriers shall be provided between individual power fuses.

5.3 Fuse shall be mounted on insulated fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchboard.

5.4 The Neutral links shall be mounted on fuse carriers which shall be mounted on fuse bases.

6.0 DERATING OF COMPONENTS

The Bidder shall, ensure that the equipment offered will carry the required load current at site ambient conditions specified and perform the operating duties without exceeding the permissible temperature as per Indian Standards / Specification. Continuous current rating at 50 deg C ambient in no case shall be less than 90% of the normal rating specified.

The Bidder shall indicate clearly the derating factors if any employed for each component and furnish the basis for arriving at these derating factors duly considering the specified current ratings and amb. Temperature of 50 deg C

SAFETY PLAN

PROJECT- 100 MW Floating Solar Project ,NTPC, Ramagundam

Doc ref. No. :BHE:NTPC RDM:HSE:01_Rev00 dated 25.11.2019
Rev01 dated 15.01.2020

Prepared : N RABINDRABABU SAFETY OFFICER/QUEST

Checked : P S V SAMPATH KUMAR AGM/BHEL-EDN

Approved : M SREENATH AGM/BHEL-EDN

HSE POLICY

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

Atul Sobti
Chairman & Managing Director

June 5, 2018

Creating BHEL of tomorrow

BHARAT HEAVY ELECTRICALS LIMITED

CONTENTS

11	WASTE MANAGEMENT
12	WARNINGS & SIGNS
13	EMERGENCY PREPAREDNESS
14	FIRE SAFETY PROCEDURE
15	CONTROL OF DOCUMENTS
16	SAFETY INSPECTION
17	MONTHLY SAFETY REVIEW MEETING
18	TYPICAL DETAILS OF FLOATING SOLAR POWER PLANT
19	ANNEXURES 1. Formats to be used at site 2. JSA (HIRAs) for PV floating system work, Tree felling and clearance work

1.0 INTRODUCTION

The purpose of this Safety Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during execution of the 100 MW Floating Solar Project.

This document shall be followed by Client's Sub-Contractors at all installation and servicing sites. In case customer specific documents are to be referred, the same will be followed in conjunction with this document.

2.0 APPLICATION

The document is applicable for execution of the 100 MW Floating Solar Project and it is expected that Client and Sub-contractor are committed to the following guidelines:

- Ensure that the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment at the worksite.
- Ensure compliance at all times with the relevant statutory and contractual Safety requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including contractors in respects of Safety.
- Establish effective communication on SAFETY matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps. Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent authority.
- Ensure timely provision of resources to facilitate effective implementation of SAFETY requirements.
- Ensure continual improvements in SAFETY performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.