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CUSTOMER: NT [REDACTED] C [REDACTED] T [REDACTED]
Technical Specification of 220 kV Double Circuit Transmission Line
Section-3: Project Details and General Specification
TB-316-369-031TL
REV.01

	above the mean ground level.	
g)	Category of terrain	Cat -2
h)	Risk Coefficient "K1"	1.06

3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	400 kV	220 kV
1	Highest system voltage	420 kV rms	245 kVrms
2	Lightning Impulse voltage	±1425kVp	± 1050kVp
3	Switching impulse voltage	±1050kVp	-
4	Power frequency withstand for 1 min (rms)	630 kV(rms)	460 kV(rms)
5	Max. fault level (1 sec.)	50 kA	40kA
6	Minimum creepage distance	10500 mm	6125mm

3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50 (+3% -5%)	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50 (+3% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.1.3 The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	2nd Level	3rd Level	Peak
220kV	6000mm	12000mm	17000mm	8500mm
400kV	8000mm	16000mm	23000mm	8500mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

The minimum height of intermediate gantry tower for 400kV wherever required shall be 25 m and the peak (s) shall be of 8.5 m.

3.1.4 The minimum clearances for 400kV & 220 kV switchyards shall be as given below:

	400kV	220kV
Phase to earth clearance	3500 mm	2100mm
Phase to phase clearance	4000 mm	2100mm
Section clearance	6500 mm	5000mm

3.2 INSTRUCTION TO BIDDERS:

The bidders shall submit the technical requirements, data and information.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such

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proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

The supplier is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956 (latest), and other local rules and regulations.

The equipment to be furnished under this specification shall conform to latest issue with all amendments of standards and/ or codes specified under respective section heads. The standards mentioned in the specification are not mutually exclusive or complete in them, but intended to complement each other. The supplier shall also note that list of standards presented in this specification is not complete. Whenever necessary the list standards shall be considered in conjunction with specific IS/IEC. When the specified requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards which ensure equivalent or better performance than specified in the standards referred under section shall also be acceptable.

In case governing standards for the equivalent for the equipment is different from IS/ IEC, the salient points of difference shall be clearly brought out in additional information schedule along with English language version of standard of relevant extract of the same. The equipment conforming to standards other than IS/ IEC shall be subject to Purchaser's approval.

The full names of the codes and standards mentioned in abbreviations under various equipment heads are as follows:

BS	British Standards
IEC/ CISPR	International Electro-technical Commission
IS	Bureau of Indian Standards

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During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

Burn In Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.

The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.13 ☐ QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (☒) mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

3.13.1 ☐ Typical contents of Quality Assurance Document are as below:-

- i) ☐ Quality Plan,
- ii) ☐ Material mill test reports on components as specified by the specification and approved Quality Plans.
- iii) ☐ Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

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and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager 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.

- 3.15.3 ☐ The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.
- 3.15.4 ☐ The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 3.15.5 ☐ When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 3.15.6 ☐ In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
- 3.15.7 ☐ The inspection by Project Manager / Inspector 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.
- 3.15.8 ☐ To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
- 3.15.9 ☐ All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

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- 3.19.7□ Suitable 240V, single phase, 50Hz ac heaters with thermostats controlled by switch and fuse shall be provided to maintain inside temperature 10deg. above the ambient.
- 3.19.8□ The size of enclosure and the layout of equipment inside shall provide generous clearances. Each cabinet/box/kiosk/panel shall be provided with a 15A, 240V ac, 2 pole, 3 pin industrial grade receptacle with switch. For incoming supply, MCB of suitable rating shall be provided. Illumination of each compartment shall be with door operated incandescent lamp. All control switches shall be of rotary switch type.
- 3.19.9□ Each cabinet/box/kiosk/panel shall be provided with two earthing pads to receive 75mmx12mm GS flat. The connection shall be bolted type with two bolts per pad. The hinged door shall be connected to body using flexible wire. The cabinets/boxes/kiosks/panels shall also be provided with danger plate, and internal wiring diagram pasted on inside of the door. The front label shall be on a 3mm thick plastic plate with white letters engraved on black background

3.20□ **TERMINAL BLOCKS**

- 3.20.1□ They shall be non-disconnecting stud type of extensible design equivalent to Elmex type CAT-M4.
- 3.20.2□ The terminal blocks shall be of 650 V grade, and rated to continuously carry maximum expected current. The conducting part shall be tinned or silver plated.
- 3.20.3□ They shall be of moulded, non-inflammable thermosetting plastic. The material shall not deteriorate with varied conditions of temperature and humidity. The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating plastic material. Insulating barriers shall be provided between the terminal blocks so that the barriers do not hinder the wiring operation without removing the barriers.
- 3.20.4□ The terminals shall be provided with marking tags for wiring identification.
- 3.20.5□ Unless otherwise required (expected current rating) or specified, terminal blocks shall be suitable for connecting the following conductors on each side:
 All CT & VT circuits - Min. four 2.5 sq.mm. copper flexible conductor
 AC & DC power supply -Two 16 sq.mm. Aluminium conductor
 Other control circuits - Min. two 2.5 sq.mm. copper flexible conductor.
- 3.20.6□ The terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall also be provided with short circuiting and earthing facilities.

3.21□ **Wiring**

- 3.21.1□ All wiring shall be carried out with 1100 V grade stranded copper wires. The minimum size of the stranded conductor used for internal wiring shall be as follows:
 - a) All circuits except CT circuits 2.5 sq.mm
 - b) CT circuits 4 sq. mm (minimum number of strands shall be 3 per conductor).
- 3.21.2□ All internal wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals and terminal blocks.
- 3.21.3□ Wire terminations shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with the wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires

CLAUSE NO.	<div style="text-align: center;"> TECHNICAL REQUIREMENTS  </div>		
1.0	<div style="text-align: right;">Annexure – A</div> CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST		
	General <p>Unless otherwise stipulated, all equipment together with its associated connectors where applicable shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and measurement of radio interference voltage (RIV).</p>		
2.0	Test Levels <p>The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.</p>		
3.0	Test Methods for RIV:		
3.1	RIV tests shall be made according to measuring circuit as per International Special – committee on Radio Interference (CISPR) Publication 16 -1 (1993) Part – I. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The result shall be in microvolts.		
3.2	Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein.		
3.3	In measurement of RIV temporary additional external corona shielding may be provided. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.		
3.4	Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85% , 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 420 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.		
3.5	The metering instruments shall be as per CISPR recommendations or equivalent device so long as it has been used by other testing authorities.		
3.6	The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to the voltage read by the noise meter.		
4.0	Test Methods for visible Corona <p>The purpose of this test is to determine the corona extinction voltage of the apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to</p>		
NORTH KARANPURA STPP (3 X 660 MW) EPC PACKAGE		TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-4410-001-2	SUB SECTION B-14 SWITCHYARD <div style="text-align: right;"> Page 6 of 102 </div>


CLAUSE NO.	<div data-bbox="632 226 1048 257">TECHNICAL REQUIREMENTS</div> <div data-bbox="1318 188 1474 262">  </div>		
	<p>130 % of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly until all visible corona disappears. The test procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which the visible corona (negative or positive polarity) disappears.</p>		
<p>NORTH KARANPURA STPP (3 X 660 MW) EPC PACKAGE</p>	<p>TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-4410-001-2</p>	<p>SUB SECTION B-14 SWITCHYARD</p>	<p>Page 7 of 102</p>

CLAUSE NO.	<div> <div>एनटीपीसी</div> <div>NTPC</div> </div> TECHNICAL REQUIREMENTS		
	<div>Annexure – B</div> <div> SEISMIC WITHSTAND TEST <p>The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.</p> <p>The bidder shall arrange to transport the structure from his contractor's premises / owner's sites for purpose of seismic withstand test only.</p> <p>The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and at any other point as agreed by the owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the purchaser.</p> </div>		
NORTH KARANPURA STPP (3 X 660 MW) EPC PACKAGE	TECHNICAL SPECIFICATIONS SECTION VI, PART-B BID DOC. NO.:CS-4410-001-2	SUB SECTION B-14 SWITCHYARD	Page 8 of 102

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT :
		ITEM :	QP NO.:	PACKAGE :
		SUB-SYSTEM:	REV.NO.:	CONTRACT NO. :
			DATE:	MAIN-SUPPLIER:
			PAGE: OF....	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N						M	C	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	**	10.		11.

LEGEND: * RECORDS, IDENTIFIED WITH “TICK” (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
 ** M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC
 P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,
 CHP: NTPC SHALL IDENTIFY IN COLUM “N” AS ‘W’



FOR
NTPC
USE

DOC. NO.: REV..... CAT.....

REVIEWED BY	APPROVED BY	APPROVAL SEAL


FORMAT NO.: QS-01-QAI-P-09/F1-R1


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CLAUSE NO.	QUALITY ASSURANCE 			
SWITCHYARD SQE_20 <div> <div>Attributes / Characteristics</div> <div>Items/Components Sub Systems</div> </div>		Make, model, Type & Rating, Test Certificate	Routine & Acceptance Test as per IS / IEC	Functional requirements as per NTPC Specification
Circuit Breaker (IEC:62271-100)		Y	Y	Y
Interruptor & hollow insulator (IEC:233/ IS:5284)		Y	Y	Y
Isolator (IEC:62271-102)		Y	Y	Y
Current Transformer (IEC:60044/BS:3938/IS2705)		Y	Y	Y
Capacitor Voltage Transformer (IEC:186A / 358/IS3156/IEC60044)		Y	Y	Y
Bus Post Insulator (IEC:168 / 815 / IS:2544)		Y	Y	Y
Disc, Pin & String Insulator (IEC:383 / IS:731)		Y	Y	Y
Long Rod Insulator (IEC:433)		Y	Y	Y
Surge Arrestor (IEC:99-4/IS:3070)		Y	Y	Y
Hardware fittings for Insulator (IS:2486 / BS:3288)		Y	Y	Y
Spacer Clamps & Connector (IS:10162 / 5561)		Y	Y	Y
Aluminium Tube (IS:5082 / 2673 / 2678)		Y	Y	Y
Wave Trap (IEC:353 / IS:8792 / 8793)		Y	Y	Y
Conductor (IS:398-P-II)(V)		Y	Y	Y
Galvanised Steel Structures (IS:2062/2629/4759/6745)		Y	Y	Y
Vibration Damper (IS:9708)		Y	Y	Y
Sag Compensating Spring DIN:2089/2096 IS:3195 / 7906		Y	Y	Y
Control & Relay Panel		Y	Y	Y
SF6 Gas filling & evacuating plant		Y	Y	Y
SF6 Gas Leak Detector		Y	Y	Y
Leakage Current Analyser		Y	Y	Y
Nitrogen Gas Filling Device		Y	Y	Y
Protection Relays		Y	Y	Y
Event Logger		Y	Y	Y
Operation Analyser		Y	Y	Y
Disturbance Recorder		Y	Y	Y
Tariff Metering System		Y	Y	Y
Synchronising Trolley		Y	Y	Y
NORTH KARANPURA STPP (3 X 660 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-4410-001-2		SUB-SECTION-E-51 SWITCHYARD Page 1 of 2

CLAUSE NO.	QUALITY ASSURANCE			
<div>Attributes / Characteristics</div> <div>Items/Components Sub Systems</div>	Make, Type Rating, and Model, Test Certificates	Routine & Acceptance Test as per relevant IS/IEC	Functional requirements as per NTPC Specification	
	Relay Test Kit	Y	Y	Y
	LT Switchgear /LT Panels (IEC:947 / IS:13947)	Y	Y	Y
	Battery IS:1652	Y	Y	Y
	Lighting Panels	Y	Y	Y
	Surge Monitor	Y	Y	Y
	<div>Notes : 1) This is an indicative list of test/checks. The manufacture is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalisation for all items.</div> <div>2) All major Bought Out Items will be subject to NTPC approval.</div>			
NORTH KARANPURA STPP (3 X 660 MW) EPC PACKAGE		TECHNICAL SPECIFICATION SECTION-VI, PART-B BID DOC NO.:CS-4410-001-2	SUB-SECTION-E-51 SWITCHYARD	Page 2 of 2

**TENTATIVE
FIELD QUALITY PLAN FOR
TRANSMISSION LINES**

TENTATIVE FIELD QUALITY PLAN FOR TRANSMISSION LINES

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
1.	Detailed Survey on rerouted portion	a. Route alignment	Optimisation of route length	a. Preliminary survey. b. Topographical map c. Tower spotting datas given by Engg.	Contractor	100% at Field	100% based on record documents	Project incharge
		b. Route profiling & tower spotting.	1. Ground clearance. 2. Cold wt. Span 3. Hot wt. Span 4. Sum of Adj. Span (wind span) 5. Angle of Devn.	a. Sag template b. Tower Spotting data c. Route alignment	Contractor -do- -do- -do- -do-	100% at Field -do- -do- -do- -do-	100% based on record documents -do- -do- -do-	Line incharge
2.	Check Survey	Tower Location & Final Length	i) Alignment ii) Final Length	a. Route alignment b. Tower Schedule c. Profile	Contractor -do-	100% at Field -do-	i) All angle towers in plains and 50% in hilly terrains. ii) Final length to be checked on 100% basis based on records/documents	Section Incharge
3.	Detailed Soil Investigation	a. Borelog	1. Depth of bore log 2. SPT Test 3. Collection of samples	As per OWNER Specification	Contractor	100% at Field	To witness 20% at Field	Section incharge

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
		b. Tests on samples	As per tech. Specs.	As per OWNER Specification	Lab appd. By OWNER	100% by testing lab	Review of lab test results	Line incharge based on the report review by CC Engg.
4.	Tower Foundation							
		A. Materials 1. Cement	1. Source approval	Source meeting OWNER Specification/Approved vendor	Contractor	As proposed by Contractor	To verify the proposal based on the supply made and factory test results.	Line incharge
			2. Physical tests	As per document at Annexure-I of this FQP at Pg. 12, 13 & 14.	Samples to be taken jointly with OWNER and tested at OWNER approved lab	Review of all MTC's and one sample for every 500 MT	100% review of lab test results	Line incharge
			3. Chemical Tests Chemical composition of Cement	-do-	Contractor to submit MTC	100%% review of MTC by Contractor	100% review of MTC	Line Incharge
		2. Reinforcement Steel	1. Source approval	To be procured from main producers only.	Contractor	As proposed by Contractor	To review the proposal based on the documents.	Line incharge.
			2. Physical and Chemical analysis test	As per annexure-2 of this FQP at pg. 15	Contractor to submit MTC	All MTC's	100% review of MTC	Line Incharge

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
		3. Coarse Aggregates	1. Source approval	Source meeting OWNER Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the test results of Joint samples tested in OWNER approved lab	To review the proposal based on the documents	Line Incharge
			2. Physical tests	As per document at Annexure-3 of this FQP at page 16	Samples to be taken jointly and tested in OWNER approved lab	One sample per lot of 200 cum or part thereof	100% review of lab test results	Line Incharge
		4. Fine aggregate	1. Source approval	Source meeting OWNER Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the results of Joint samples tested in OWNER approved lab.	To review the proposal based on the documents.	Line Incharge
			2. Physical test	As per Annexure-4 of this FQP at page 17	Samples to be taken jointly and tested in OWNER approved lab	One sample per lot of 200 cum or part thereof	100% review of lab test results	Line Incharge
		5. Water	1. Cleaniness (Water shall be fresh and clean)	OWNER Specification	Contractor	100% visual check at Field	Verification at random	Site Engineer

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
			2. Suitability of water for concreting	OWNER Specification	Contractor	100% Visual Check at Field	Verification at random	Site Engineer
		B. Classification	1. Visual observation of soil strata 2. Ground water level 3. History of water table in adj. Area/surface water 4. Soil Investigation wherever required	OWNER Specification	Contractor	100% at Field	100% at Field	a. Section incharge b. In case of WBC/SFR/FS acceptance by Line Incharge c. For Spl. Fdns./pile fdns. Acceptance by Project In-charge
		C. Concrete Works a. Before concreting						
		1. Bottom of excavated earth 2. Stub setting 3. Reinforcement steel	Depth of foundation 1) Centre Line 2) Diagonals 3) Level of stubs Placement	Appd. Drgs. -do- Bar bending schedule	Contractor -do- -do-	100% at Field -do- -do-	100% check by OWNER -do- -do-	Jr. Engr./Engr. -do- -do-
		b. During concreting						

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
		1. Workability	Slump test	Range 25 mm to 55 mm refer document at Annexure-5 of this FQP at Pg. 18	Contractor	100% at field	20% check at random	Jr. Engr../Engr.
		2. Concrete Strength	Cubes Comp Strength	CPWD SPEC as referred in document at annexure-5 of this page at 18	Casting of cubes at site. Cubes to be tested at OWNER appd. Lab for 28 days strength	One sample of 3 cubes in each tower locations	100% review of lab test results. Cubes at 20% location are to be taken in presence of OWNER officials	Section Incharge
5.	Pile foundations	1. All materials like cement, steel Coarse/fine aggregate, water	To be tested as per procedure enumerated in the respective columns above					
		2. Before concreting	1. Check for center line of each pile	Appd. Drawings	Contractor	100%	100%	Site Engr.
			2. Check for dia/verticality of each pile	-do-	-do-	-do-	-do-	-do-
			3. Check for depth of each pile	-do-	-do-	-do-	-do-	-do-
		3. During Concreting						
		a. Workability	1. Slump test	100-150 mm as per OWNER Specn.	Contractor	Every one hour. For each pile	100% at field	Site Engr.

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
		b. Concrete strength	2. Cubes compressive strength	As per OWNER Specn.	Contractor. One set of cubes (Min. 6 nos.) to be taken and tested for 7&28 days strength at OWNER appd. Lab.	One set for each pile. For Pile caps, beams, Chimney, one sample for every 20 Cu.m. or part thereof for each day of concreting.	100% cubes for piles, 20% Pile caps, beams, chimney etc. to be taken in presence of OWNER officials. 100% review of test results.	Section Incharge.
6.	Tower Erection	1. Materials a. Tower member/bolts & nuts/washers/accessories	Visual checking for 1. Stacking 2. Cleanliness 3. Galvanizing 4. Damages	Appd. Drgs./BOM	Contractor	100% at stores	100% verification of records	Site Engineer
		2. Erection of Super-structure	1. Sequence of erection	As per Appd. Drgs./OWNER specification	Contractor	100% at field	100% check	Site Engineer
			2. Check for completeness	-do-	-do-	-do-	-do-	-do-
			3. Tightening of nuts and bolts	-do-	-do-	-do-	-do-	-do-
			4. Check for verticality	-do-	-do-	-do-	-do-	-do-

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
			5. Tack welding for bolts & nuts	OWNER Specification	Contractor	100% at Field	100% Check	Site Engineer
		3. Tower footing resistance (TFR)	TFR at locations before and after earthing.	OWNER Specification	Contractor	100% at Field	20% locations to be verified	Line Incharge
7.	Stringing	1. Materials						
		a. Insulators	1. Visual check for cleanliness/glazing/ cracks/and white spots.	OWNER Specification	Contractor	100% at Field	100% verification of records and to carry random checks 10%	Site Engineer
			2. IR Value	(min. 50M Ohms)	-do-	One test per sample size of 20 for every lot of 10,000	To verify Contractor's records 100% and joint check 20% of total tests	-do-
			3. E&M test	-	Insulator supplier	a. 20 per 10,000 for discs b. 3 per 1500 for long rod	Collection of samples, sealing them and handing over by OWNER to Insulator supplier	Tests to be witnessed/ Appd. by QA&I at Manufacturer's works
			4. Traceability (Make/batch No./Locations where installed)	Packing list/CIP	Contractor	100% at field	100% Review of records	Site Engineer

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
		b. Conductor	On receipt, 1. Visual check of drum.	Packing list	Contractor	100% at stores	20% check	Site Engineer
			2. Check for seals at both ends, and OWNER sticker on outer end	-do-	-do-	-do-	-do-	-do-
			3. Check depth from top of flange to the top of the outer most layer	-do-	-do-	-do-	-do-	-do-
		c. Earthwire	Check for seals at both ends	Packing list	Contractor	100% at stores	20% check	-do-
		2. Field activity						
		a. Before Stringing	Readiness for stringing	Stringing procedures as per OWNER specification	Contractor	Readiness certificate to be submitted by the Contractor	Review of Certificate	Line Incharge
		b. During stringing	(Conductor/Earth-wire)					

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
			1. Scratch/cut check (Visual)	Appd. Drawings/ OWNER Specn.	Contractor	100% at Field	100% record & Field check 20%	Site Engineer
			2. Repair sleeve	-do-	-do-	-do-	-do-	-do-
			3. Mid span Joints	-do-	-do-	-do-	-do-	-do-
			4. Guying (in case of towers not designed for one side stringing)	Appd. Guying arrangement/OWNER specn.	-do-	-do-	100%	Section Incharge
		c. After stringing	Check for,					
			1. Sag/Tension	Sag tension chart/tower Spotting data	-do-	-do-	100% record & Field check 20%	Site Engr.
			2. Electrical clearances	As per appd. Drgs./OWNER specifications	-do-	-do-	-do-	-do-
			i) Ground clearance	-do-	-do-	-do-	-do-	-do-
			ii) Live metal clearance etc.	-do-	-do-	-do-	-do-	-do-
			3. Jumpering	-do-	-do-	-do-	-do-	-do-

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
			4. Copper bond	As per Appd. Drgns./OWNER Specification	Contractor	100% at Field	100% record & Field Check 20%	Site Engineer
			5. Placement of spacer/damper	As per Specn./drgs/ placement chart	-do-	-do-	-do-	-do-
8.	Final Testing							
	a. Pre-commissioning of lines	a. Readiness of lines for pre-commissioning	1. Completeness of line. 2. Meggar test of line	OWNER latest pre-commissioning procedures (Doc. No. D-2-01-70-01-00)	Contractor	100%	100% joint checking	Project Incharge
	b. Commissioning of line	Readiness of lines for commissioning	2. Digital photograph of each tower to ascertain the completeness of tower.	a. OWNER latest pre-commissioning procedures (Doc. No. D-2-01-70-01-00) b. Pre-commissioning Report c. CEA clearance	-do-	-do-	-do-	-do-

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by OWNER	Accepting authority in OWNER
					Agency	Extent		
			3. Electrical Inspectors clearance from CEA.		-do-	-do-	-do-	-do-

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CEMENT

ORDINARY PORTLAND CEMENT					
S. No.	Name of the test	Ordinary Portland Cement 33 grade as per IS 269	Ordinary Portland Cement 43 grade as per IS 8112	Ordinary Portland Cement 53 grade as per IS 12269	Remarks
a)	Physical tests				To be conducted in apprd. Lab
(i)	Fineness	Specific surface area shall not be less than 225 sq.m. per Kg. or 2250 Cm ² /gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm ² /gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm ² /gm.	Blaine's air permeability method as per IS 4031 (Part-2)
(ii)	Compressive strength	72+/- 1 hour : Not less than 16 Mpa (16 N/mm ²) 168+/-2 hour : Not less than 22 Mpa (22 N/mm ²) 672+/-4 hour : Not less than 33 Mpa (33 N/mm ²)	72+/- 1 hour : Not less than 27 Mpa (27 N/mm ²) 168+/-2 hour : Not less than 37 Mpa (37 N/mm ²) 672+/-4 hour : Not less than 53 Mpa (53 N/mm ²)	72+/- 1 hour : Not less than 23 Mpa (23 n/mm ²) 168+/-1 hour : Not less than 33 Mpa (33 N/mm ²) 672+/-1 hour : Not less than 43 Mpa (43 N/mm ²)	As per IS 4031 (Part-6)
(iii)	Initial & Final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	As per IS 4031 (Part-5) -do-
(iv)	Soundness	Unaerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% Autoclave test.	Unaerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% Autoclave test	Unaerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% Autoclave test.	Le chatlier and Autoclave test as per IS 4031 (Part-3)

S. No.	Name of the test	Ordinary Portland Cement 33 grade as per IS 269	Ordinary Portland Cement 43 grade as per IS 8112	Ordinary Portland Cement 53 grade as per IS 12269	Remarks
b)	Chemical composition tests				Review of MTCC only
		a) Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.66 to 1.02	a) Ratio of percentage of lime to percentage of silica, alumina % iron oxide 0.66 to 1.02	a) Ratio of percentage of lime to percentage of silica, alumina % iron oxide 0.66 to 1.02%	
		b) Ratio of percentage of alumina to that of iron oxide Minimum 0.66%	a) Ratio of percentage of alumina to that of iron oxide Minimum 0.66	a) Ratio of percentage of alumina to that of iron oxide Minimum 0.66%	
		c) Insoluble residue, percentage by mass Max. 4.00%	c) Insoluble residue, percentage by mass Max. 4.00%	c) Insoluble residue, percentage by mass Max. 4.00%	
		d) Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	
		e) Total sulphur content calculated as sulphuric anhydride (SO ₃), percentage by mass Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.	e) Total sulphur content calculated as sulphuric anhydride (SO ₃), percentage by mass Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.	e) Total sulphur content calculated as sulphuric anhydride (SO ₃), percentage by mass Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.	
c)	Total loss on Ignition	Not more than 5 percent	Not more than 5 percent	Not more than 5 percent	

S. No.	Name of the test				Remarks
2.	POZZOLANA PORTLAND CEMENT AS PER IS 1489				
a)	Physical tests	i) Fineness	Specific surface area shall not be less than 300 sq.m. per Kg. or 3000 Cm2/gm		
		ii) Compressive strength	168+/- 2 hour : Not less than 22 Mpa (22 N/mm2) 672+/- 2 hour : Not less than 33 Mpa (33 N/mm2)		
		iii) Initial & Final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes		
		iv) Soundness	Unaerated cement shall not have an expansion of more than 10mm		Le chatlier and Autoclave test as per IS 4031 (Part-3)
b)	Chemical composition tests				
		a) Magnesia percentage by mass Max. 6%			Review of MTCC only
		b) Insoluble material, percentage by mass $x + 2 (100-x)/100$ where x is the declared % of pozzolana in the PPC			-do-
		c) Total sulphur content calculated as sulphuric anhydride (SO3), percentage by mass Not more than 2.75 and 3.0 when tri-calcium aluminate percent by mass is 7 or less and greater than 7 respectively.			-do-
c)	Total loss on Ignition	Not more than 5 percent			

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR REINFORCEMENT STEEL

S. No.	Name of the test	Mild and medium tensile steel as per IS 432	Cold twisted Deformed bars Fe 415 as per IS 1786	Remarks
i)	Chemical analysis test	Carbon (For 20 mm dia and below) 0.23% Max. Carbon (For over 20 mm dia) 0.25%	Carbon 0.30% Max	
		Sulphur 0.055%	Sulphur 0.060%	
		Phosphorus 0.055%	Phosphorus 0.060%	
			Sulphur & Phosphorus 0.11%	
ii)	Physical tests	a) Ultimate Tensile stress For all dia bars 410 N/Sq.mm. (min.)	a) Ultimate Tensile stress 10% more than actual 0.2% proof stress but not less than 485 N/Sq.mm.)	Testing in approved lab
		b) Yield stress (N/Sq.mm) min. For bars upto 20 mm dia 250 For bars above 20 mm dia 240 c) Percentage of elongation 23%	b) 0.2% of proof stress/Yield stress (N/Sq.mm) min. For bars upto 20 mm dia 415 c) Percentage of elongation 14.5% (min.)	Testing in approved lab
iii)	Bend & Rebend tests	Pass	Pass	Testing in approved lab

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR COARSE AGGREGATES AS PER IS 383

3.	Coarse Aggregates										
i)	Physical Tests										
	a) Determination of particles size	a. IS Sieve Designation	%age passing for Single-Sized Aggregate of nominal size					Percentage Passing for grades Aggregate of nominal size			
			40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
		63 mm	100	-	-	-	-	-	-	-	-
		40 mm	85 to 100	100	-	-	-	95 to 100	100	-	-
		20 mm	0 to 20	85 to 100	100	-	-	30 to 70	95 to 100	100	100
		16 mm	-	-	85 to 100	100	-	-	-	90-100	-
		12.5 mm	-	-	-	85 to 100	100	-	-	-	90 to 100
		10 mm	0 to 5	0 to 20	0 to 30	0 to 45	85 to 100	10 to 35	25 to 35	30 to 70	40 to 85
		4.75 mm	-	0 to 5	0 to 5	0 to 10	0 to 20	0 to 5	0 to 10	0 to 10	0 to 10
		2.36 mm	-	-	-	-	0 to 5	-	-	-	-
	b. Flakiness index	Not to exceed 25%									
	c. Crushing Value	Not to exceed 45%									
	d. Presence of deleterious material	Total presence of deleterious materials not to exceed 5%									
	e. Soundness test (for concrete work subject to frost action)	12% when tested with sodium sulphate and 18% when tested with magnesium sulphate									

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FINE AGGREGATES AS PER IS 383

4.	Fine aggregates				
i)	Physical Tests	IS Sieve Designation	Percentage passing for graded aggregate of nominal size		
	a) Determination of particle size		F.A. Zone I	F.A. Zone II	F.A. Zone III
		10 mm	100	100	100
		4.75 mm	90-100	90-100	90-100
		2.36 mm	60-95	75-100	85-100
		1.18 mm	30-70	55-90	75-100
		600 microns 12.5 mm	15-34	35-59	60-79
		300 microns	5 to 20	8 to 30	12 to 40
		150 microns	0-10	0-10	01-0
	b) Silt content		Not to exceed 8%	Not to exceed 8%	Not to exceed 8%
	c) Presence of deleterious material	Total presence of deleterious materials shall not exceed 5%			
	d) Soundness Applicable to concrete work subject to frost action	12% when tested with sodium sulphate and 15% when tested with magnesium sulphate			

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CONCRETE WORK

1)	Concrete	a) Workability	Slump shall be recorded by slump cone method and it shall be between 25-55 mm.
		b) Compressive strength	Three samples of 15 cm cube for 28 days compressive strength for all concrete works except pile foundation work shall be taken. For pile foundation works, six cubes, three for 7 days testing and balance three for 28 days testing shall be taken.

Notes :

- 1) For nominal (volumetric) concrete mixes, compressive strength for 1:1.5:3 (Sand : Fine aggregates : Coarse aggregates) concrete shall be 265 kg/Sq.cm. for 28 days and for 1:2:4 nominal mix, it shall be 210 kg/Sq.cm.
- 2) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR NOMINAL MIX CONCRETE :
 - a) the average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.
 - b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the Engineer-in-charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of the specified strength, it will be restricted to 30% only for computation of strength.
 - c) If the actual average strength of accepted sample is equal to or higher than specified upto 30%, the strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.
 - d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-charge.
 - e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to

retain the structure shall taken at the risk and cost of contractor. If, however, the Engineer-in-charge so desires, he may order additional tests to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the Contractor.

General Notes :

- 1) This standard Field Quality Plan is not to limit the supervisory checks which are otherwise required to be carried out during execution of work as per drawings/Technical specifications etc.
- 2) Contractor shall be responsible for implementing/documenting the SFQP. Documents shall be handed over by the contractor to OWNER after the completion of the work.
- 3) Project incharge means over all incharge of work. Line Incharge means incharge of the line. Section in-charge means incharge of the section.
- 4) In case of deviation the approving authority will be one step above the officer designated for acceptance in this quality plan subject to minimum level of Line incharge.
- 5) Acceptance criteria and permissible limits for tests are indicated in the Annexures. However for further details/tests OWNER specification and relevant Indian standards shall be referred.
- 6) Tests as mentioned in this FQP shall generally be followed. However E.I.C. reserves the right to order additional tests wherever required necessary at the cost of the agency.
- 7) All counter checks/tests by OWNER shall be carried out by OWNER's officials.