

APPENDIX-II

FIELD QUALITY PLAN FOR TRANSMISSION LINES

REVISED STANDARD FIELD QUALITY PLAN FOR TRANSMISSION LINES
POWERGRID Document No. C/QA&I/SFQP/TL/030, Rev. 01

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-wrie)					

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 Cm ² /gm	
		ii) Compressive strength	168+/- 2 hour : Not less than 22 Mpa (22 N/mm ²) 672+/- 2 hour : Not less than 33 Mpa (33 N/mm ²)	
		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 (SO ₃), 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		
			F.A. Zone I	F.A. Zone II	F.A. Zone III
	a) Determination of particle size				
		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 represent 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) All materials should have Cat-A CIP before they are erected.
- 3) 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.
- 4) Project incharge means over all incharge of work. Line Incharge means incharge of the line. Section in-charge means incharge of the section.
- 5) 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.
- 6) 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.
- 7) 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.
- 8) All counter checks/tests by OWNER shall be carried out by OWNER's officials.