BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

Item	Transmission Line Pile Foundation
Applicability	BSPTCL Projects
Date of Issue	15.01.2016
Validity	Till next revision

FQP No.	002
REV.	00

S. No.	Description of Activity	Items to be Checked	Tests/Checks to be done	Ref. documents	Check/Testing		Counter Check/Test by BSPTCL	Accepting authority in BSPTCL
					Agency	Extent		
1.	Detailed Soil Investigation	a) Borelog	1. Depth of bore log 2. SPT Test 3. Collection of samples	As per BSPTCL Specification	Contractor	100% at Field	To witness 20% at Field	Site incharge
		b) Tests on samples	As per tech. Specs.	As per BSPTCL Specification	Contractor (Testing in Third Party Lab)	100% by testing lab (Reports to be signed by Testing person & Checking person)	Review of lab test results (All soil reports to have signature of BSPTCL official reviewing the report)	Site incharge based on the guide line issued by BSPTCL attached as Annex-7
2.	Pile Foundation							
		A. Materials 1. Cement	1. Brand approval	Cement of approved brands by BSPTCL may be procured.	Contractor	100%	Any new brand cement proposed by Contractor shall be assessed and approved by BSPTCL	BSPTCL-HQ

			2. Physical tests	As per document at Annexure-I of this FQP	Samples to be taken jointly with BSPTCL and tested at BSPTCL approved lab	Review of 100% MTC's and one sample for every Batch No. of Manufacturer.	100% review of lab test results and MTC Test results shall be sent by the Lab, by E mail directly to BSPTCL; further, hard Copy of Test Certificate shall also be sent by the Lab directly to BSPTCL by Postal Address.	Site Incharge

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					Agency	Extent		
			3. Chemical Tests Chemical composition of Cement	-do-	Contractor	**Review of all MTC's**	100% review of MTC test results	Site Incharge
		2. a) Reinforcement Steel	1. Source approval	**May be procured either from main producers directly or through the authorised dealers who can produce MTC from main producers with traceability.**	Contractor	**100%**	Material shall be supplied from Main producers / authorized dealers.	Site incharge.
			2. Physical and Chemical analysis test	As per annexure-2 of this FQP	Contractor to submit MTC	100% MTC One sample* / 500 MT / Manufacturer shall be jointly sealed by BSPTCL and tested at BSPTCL approved Lab. ***Note:** All sizes of 10mm and above shall be taken for testing in every 500MT.	100% review of MTC. Review of lab test results . **Test results shall be sent by the Lab, by E mail directly to BSPTCL; further, hard Copy of Test Certificate shall also be sent by the Lab directly to BSPTCL by Postal Address.**	Site Incharge

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

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REV.	00

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					Agency	Extent		
		2.b) MS Liner (before Fabrication)	1. Source approval	From main producers. (May be procured from any supplier which gives main producer MTC.)	Contractor	As proposed by Contractor	To review the proposal based on the documents.	Site In-charge.
			2. Physical and Chemical analysis test	As per annexure-6 of this FQP	Contractor to submit MTC	All MTC's	100% review of MTC	Site In-charge
		2.c) M.S. Liner (after fabrication)	a) Diameter	As per construction drawings.	Contractor	100%	100%	Site In-charge
			b) Painting	As per Specification	Contractor	100%	100%	Site In-charge
		3. Coarse Aggregates	1. Source approval	Source with materials meeting BSPTCL Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the test results of Joint samples tested in BSPTCL approved lab	To review the proposal based on the documents	Project In-charge. Once approved, the particular quarry shall be used for all the running Contracts under various Packages.

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

Item	Transmission Line Pile Foundation
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FQP No.	002
REV.	00

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					Agency	Extent		
			2. Physical tests	As per document at Annexure-3 of this FQP	**Contractor**	**One sample per 200 cum or part thereof, Samples to be tested by Contractor in BSPTCL accepted lab.**	100% review of lab test results **Out of these 100% samples, BSPTCL shall witness at TPL, 5 samples selected at random, spread during the overall execution period of contract.**	Site In-charge
		4. Fine aggregate	1. Source approval	Source with materials meeting BSPTCL Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the results of Joint samples tested in BSPTCL approved lab.	To review the proposal based on the documents.	Project In-charge. . Once approved, the particular source shall be used for all the running contracts under various Packages .
			2. Physical test	As per Annexure-4 of this FQP	Contractor	**One sample per 200 cum or part thereof, Samples to be tested by Contractor in BSPTCL accepted lab.**	100% review of lab test results **Out of these 100% samples, BSPTCL shall witness at TPL, 5 samples selected at random, spread during the overall execution period of contract.**	Site In-charge

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

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FQP No.	002
REV.	00

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					Agency	Extent		
		5. Water	1. Cleanliness	BSPTCL Specification (Water shall be fresh and clean)	Contractor	100% visual check at Field	Verification at random	Site Engineer
			2. PH Value	- do -	Contractor	One sample per source	100% review of the test results Ph not less than 6	Site Engineer
		B) Before concreting of piles	1. Check for center line of each pile	Construction 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-

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

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Date of Issue	15.01.2016
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FQP No.	002
REV.	00

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					Agency	Extent		
			4 Diameter of borehole					
			5. Cut off & Founding level of each pile	-do-	-do-	-do-	-do-	-do-
			6 Sp. Gravity of bentonite slurry	As per Specification	-do-	-do-	-do-	-do-
			7. SPT	As per Specification	-do-	-do-	-do-	-do-
			8.Sp. Gravity of bentonite at founding level	As per Specification	-do-	-do-	-do-	-do-
			9. Placement of reinforcement steel and its cover.	Bar bending schedule of construction drawing	-do-	-do-	-do-	-do-
		C) Before concreting of pile caps & chimney						

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

Item	Transmission Line Pile Foundation
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FQP No.	002
REV.	00

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					Agency	Extent		
		a) Bottom of excavated earth	Depth of foundation	Construction. Drgs.	Pile Contractor/ TL tower contractor	100% at Field	100% check by BSPTCL	**Site Engineer**
		b) Stub/Anchor bolt setting	1) Centre Line	-do-	-do-	-do-	-do-	*-*-do-
			2) Diagonals	-do-	-do-	-do-	-do-	*-*-do-
			3) Level of stubs/Anchor plates	-do-	-do-	-do-	-do-	*-*-do-
		c) Reinforcement	Placement of reinforcement steel & its cover	Bar bending schedule of construction drawing	Contractor	-do-	-do-	-do- *-*At least 5% locations shall be cross verified by immediate Reporting officer/ Site In charge, at Random with respect to stub setting and reinforcement steel placement.
		D)During concreting a) Workability	Slump test	100 – 150 mm as per BSPTCL Specn.	Contractor	Every one hour for each pile	100% at field	Site Engr.

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

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Date of Issue	15.01.2016
Validity	Till next revision

FQP No.	002
REV.	00

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					Agency	**Extent**		
		b) Concrete strength	Cubes compressive strength	As per BSPTCL Specn. & Annexure-5	Contractor Casting of cubes at site. Cubes to be tested at BSPTCL appd. Lab /BSPTCL Lab/At site- if testing machine duly calibrated by NABL is installed at site for 28 days strength Cubes at **100%** location are to be taken in presence of BSPTCL officials	**Two set of cubes (3 Nos. cubes for each set) for each pile and tested one set for 7 days strength and one set for 28days strength. For the Pile caps, beams, Chimney, one set of 3 Nos. of cubes for every 20 Cu.m. or part thereof for each day of concreting and tested for 28days strength.**	**a)** 100% cubes for piles, Pile caps, beams, chimney etc. to be taken in presence of BSPTCL officials. **b)** 100% review of test results. **Normally testing shall be carried out at the Cube Testing Facility installed at BSPTCL premises, in the witness of BSPTCL. Alternatively, samples shall be tested at BSPTCL approved Labs.** **In this case, test results shall be sent by the Lab, by E mail directly to BSPTCL; Further, hard Copy of Test Certificate shall also be sent by the Lab directly to BSPTCL by Postal Address.** **Further, BSPTCL to witness testing on 20% samples and also to review 100% test results.**	Site Engr. 10% samples to be witnessed at TPL by BSPTCL Site Engineer and at least 5% samples at random, shall be witnessed by Site In-charge. In-case of Site/ BSPTCL Lab, 100% witnessed by BSPTCL representative

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

Item	Transmission Line Pile Foundation
Applicability	BSPTCL Projects
Date of Issue	15.01.2016
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FQP No.	002
REV.	00

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					Agency	Extent		
		c) Consumption of Concrete Volume	Rate of concreting w.r.to length of built up pile	Theoretical Volume (Actual volume should be greater than theoretical volume)	Contractor.	Every Pile	100%	Site Engineer
		E) P.C.C (Grade, Thickness & Size)	completeness	IS:456 and BSPTCL approved foundation drawings & specification	CONTRACTOR	For all locations	Joint Inspection by BSPTCL and CONTRACTOR	Site Engr.
3.	Pile Integrity Test	Pile	Integrity of Pile	As per Specification	Contractor	100%	100%	Site Engr.
4	Chipping of Pile head	Pile head	a) Removal of loose Material	As per Specification & IS:2911	Contractor	100%	100%	Site Incharge.
			b) Exposure of reinforcement steel	As per Specification & IS:2911/Construction drawing	Contractor	100%	100%	Site Engr.
			c) Cut off Level of Pile	As per construction drawings	Contractor	100%	100%	Site Engr.

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

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Item	Transmission Line Pile Foundation
Applicability	BSPTCL Projects
Date of Issue	15.01.2016
Validity	Till next revision

FQP No.	002
REV.	00

Annex-1
(Sheet 1 of 3)

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 approved Lab
(i)	Fineness	Specific surface area shall not be less than 225 sq.m. per Kg. or 2250 Cm2/gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm2/gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm2/gm.	Blaine's air permeability method as per IS 4031 (Part-2) / Sieve analysis as per IS 4031 (part-3)
(ii)	Compressive strength	72 ± 1 hour : Not less than 16 Mpa (16 N/mm2) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm2) 672 ± 4 hour : Not less than 33 Mpa (33 N/mm2)	72 ± 1 hour : Not less than 23 Mpa (23 N/mm^2) 168 ± 2 hour : Not less than 33Mpa (33 N/mm^2) 672 ± 4 hour : Not less than 43 Mpa (43 N/mm^2)	72 ± 1 hour : Not less than 27Mpa (27 N/mm^2) 168 ± 1 hour : Not less than 37Mpa (37 N/mm^2) 672 ± 1 hour : Not less than 53 Mpa (53 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% by Autoclave test.	Unaerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% by Autoclave test	Unaerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% by 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 0.80 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. 2.00%	c) Insoluble residue, percentage by mass Max. 2.00%	
		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 sulpuric 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 sulpuric 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.	
		f) Total loss on ignition - Not more than 5 percent	f) Total loss on ignition - Not more than 5 percent	f) Total loss on ignition - Not more than 4 percent	

BIHAR STATE POWER TRANSMISSION COMPANY LIMITED

FIELD QUALITY PLAN

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FQP No.	002
REV.	00

Annex-1
(Sheet 3 of 3)

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	a) 72 ± 1 hour : Not less than 16 Mpa (16 N/mm^2) b) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm^2) c) 672 ± 4 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 **test and 0.8%** by 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 + 4 (100-x)/100 where x is the declared % of pozzolana in the PPC		-do-
		c) Total sulphur content calculated as sulpuric anhydride (SO_3), percentage by mass not more than 3.0		-do-
		d) Total loss on ignition - Not more than 5 percent		

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR REINFORCEMENT STEEL AS PER IS 1786-1985 Edition-4.3 (2004-12)

S. No.	Name of the test	Fe 415	Fe 500
i)	**Chemical analysis test**		
	Carbon	**0.30 Percent Maximum**	**0.30 Percent Maximum**
	Sulphur	**0.060 Percent Maximum**	**0.055 Percent Maximum**
	Phosphorus	**0.060 Percent Maximum**	**0.055 Percent Maximum**
	Sulphur & Phosphorus	**0.11 Percent Maximum**	**0.105 Percent Maximum**
ii)	**Physical tests**		
	a) Tensile Strength Minimum	10% more than actual 0.2% proof stress but not less than 485 N/Sq.mm.	8 % more than actual 0.2% proof stress but not less than 545 N/Sq.mm
	b) 0.2% of proof stress/Yield stress Minimum, N/mm^2	415	500
	c) Elongation percent , Minimum	14.5	12
iii)	**Bend & Rebend tests**	Pass	Pass

Annex-3

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 55	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 deletrious material		Total presence of deleterious materials not to exceed 5%								
	e. Hardness		Abrasion value not more than 40%, Impact value not more than 30%								

	f. Soundness test (for concrete work subject to frost action)	12% when tested with sodium sulphate and 18% when tested with magnesium sulphate

Annex-4

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	15-34	35-59	60-79
		300 microns	5 to 20	8 to 30	12 to 40
		150 microns	0-10	0-10	**0-10**
	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 between 100 - 150 mm.
		b) Compressive strength	**As per IS:456**

Notes:

1) For design concrete mixes of grade M25, 28 days compressive strength for concrete shall be as per IS:456. The minimum cement content should be 400kg/cum of concrete. In case of piles subsequently exposed to free water or in case of piles where concreting is done under water or drilling mud using methods other than the tremie , 10% extra cement over that required for the design grade of concrete at the specified slump shall be used subject to minimum quantity of cement specified above

2) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR DESIGN MIX CONCRETE: AS PER Table-11 of IS;456 as given below:

Specified Grade	Mean of the Group of 4 Non-Overlapping consecutive test results in N/sq mm	Individual Test Results in N/sq mm
M 20 or above	Shall greater than or equal to fck+0.825 x established standard deviation (rounded off to nearest 0.5 N/sq mm)* Or Fck + 3 N/sq mm, whichever is greater	≥ fck – 3 N/sq mm

* Established value of standard deviation shall be determined based on Note of Table-11 of IS:456

3) 53 Grade cement shall be used after obtaining specific approval of the Engineer in charge.

4) Portland slag cement conforming to IS: 455 may be used as per Technical Specification.

Annex-6

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR MILD STEEL LINER

S. No.	Name of the test	Mild steel as per IS 2062 **(Fe410WA grade)**
i)	Chemical analysis test	Carbon(For 6mm thick) 0.23% Max. Manganese 1.50%
		Sulphur 0.05%
		Phosphorus 0.05%
		Silicon 0.4%
		Carbon Equivalent = 0.42% for semi killed or killed
ii)	Physical tests	a) Ultimate Tensile stress = 410 N/Sq.mm. (min.)
		b) Yield stress 250 N/Sq.mm. (min.) c) Percentage of elongation 23%
iii)	Bend & Rebend tests	Pass

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FQP No.	002
REV.	00

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 under supply contract should have D.I. before they are erected.

3) Contractor shall be responsible for implementing/documenting the FQP. Documents shall be handed over by the contractor to BSPTCL after the completion of the work.

4) Project incharge means over all incharge of work. Site In-charge means in-charge of the line. Section in-charge means incharge of the section.

   Site Engineer's responsibility may be allocated to Site JE, with the approval of Regional Head, only in such cases where, Site Engineer is not in position.

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 BSPTCL 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 BSPTCL shall be carried out by BSPTCL's officials atleast at the level of Line Engr.

9) The authorized dealer means the dealer whose names are listed in the main producer's web site or certified by the main producers.

10) Accepting Authority for testing Laboratory shall be Regional Head.

11) Mobile Testing Labs owned by the contractor may also be acceptable if their facilities meet the testing requirements and the testing equipments are properly calibrated at Third Party Labs where testing/calibration is to be carried out should be accredited by NABL or an agency operating in line with ISO/IEC 17011 and having full membership & MRA of ILAC/APLAC, subject to approval of project In-charge**.**

12) **READYMIX CONCRETE (RMC) IS ACCEPTABLE FOR USE. HOWEVER, SITE INCHARGE SHALL APPROVE THE SOURCE OF MATERIALS TO BE USED FOR RMC .The documentation to be maintained shall be as per IS 4926:2003 i.e i) Information to be supplied by the purchaser (clause 7)**

ii) Information to be supplied by the producer (clause 8)

iii) Sampling for concrete strength should be one set of 3 nos of cubes for every 50 cu.m or part thereof for each day of concreting and 28 days compressive strength shall be tested in line with IS:456.

13) Epoxy coating on reinforcement steel wherever required shall be done as per IS 13620.

14) Cement is to be used in the order it is delivered (ie. First in First Out). Cement bought to works shall not be more than 6 weeks old from the date of manufacture. In case the cement remains in storage for more than 3 months, the cement shall be retested before use and shall be rejected, if it fails to conform to any of the requirements given in the relevant Indian Standard. Cement shall be packed in bags and stored in accordance with the provisions in IS -4082.

15) If e-mail facility is not available in BSPTCL approved Lab, report may be collected directly by BSPTCL / Speed Post / Registered Post / UPC.

16) In case any Laboratory refuses to allow BSPTCL representative for witnessing the test, same shall be taken in writing and approved by BSPTCL-HQ.

17) Bidders should thoroughly go through the QAP, MQP & FQP prior to submission of proposal of bids. No extra claim on account of implementation of this QAP, MQP & FQP under any circumstances shall be entertained. All destructive tests, wherever required in compliance of the MQP & FQP shall be done by the contractor without extra cost implications. These MQP & FQP shall be applicable for all the contracts. However the BSPTCL reserves the rights to waive off any testing at its discretion in the interest of the progress of the projects.

Annex-7

ENGINEERING GUIDE LINE FOR CHECKING / ACCEPTING SOIL INVESTIGATION REPORT:

Following are the guide line for checking and accepting the soil investigation report:

The soil investigation shall be carried out in line with the Technical Specification. The detailed soil Investigation Report should be signed by the soil investigating agency, Line Contractor and BSPTCL's Site Engineer and following points should be checked in the soil investigation report :

1) Normal Locations :

a) Soil investigation report should contain the bore Log sheet indicating the variation of different soil strata.

b) The Bearing capacity, Bulk density (γ) , Submerged Density(γ_{Sub}) , angle of repose (δ) in dry as well as wet condition and Angle of internal friction (ϕ) for different soil layers including at 3m depth shall be indicated in the Soil investigation report.

c) Present water table and history of variation of water table at the tower location shall be indicated in the soil investigation report.

d) Classification of foundation should be indicated based on the water table , Bearing capacity, Swelling Index, Soil type and the value of angle of repose (δ) in line with parameters indicated in the standard foundation drawings.

2) River Crossing /Special Locations:

a) A sketch indicating profile of river crossing locations with borehole positions shall be indicated in the soil investigation report.

b) Maximum discharge, Maximum velocity and Highest Flood Level (HFL) data (authenticated) of the river shall be enclosed in the Soil Investigation Report.

c) Comprehensive Bore log Sheet indicating the depth of different Strata, Soil type , SPT value & water table for each bore hole is to be indicated in the soil investigation report.

d) Natural Ground Level (GL) for all the locations are to be indicated***. Note that the GL & HFL should be with respect to same reference. For example if HFL is given in RL, the ground level should be in terms of RL only. Mixing of level with respect to MSL (Mean Sea level) & RL should be avoided.***

e) Whether the river is navigable or not is to be indicated in the soil investigation report.

f) Silt factor calculation based on the laboratory test results of weighted mean diameter (d_m) of soil for different layers of the soil shall be furnished in the soil investigation report.

g) Bulk density **(γ)**, Submerged Density **(γ_{Sub})**, Value of Cohesion (**C**) and Angle of internal friction (ϕ) for different soil layers based on laboratory test results shall be indicated in the soil investigation report.

h) If Rock is encountered prior to termination of bore hole (40m below existing Ground Level) , core drilling should be done. The details of core recovery (Run wise) and calculation of Rock Quality Designation (RQD) together with the photograph of core sample properly placed in a core Box are to be enclosed in the soil investigation report.

i) If the refusal is not obtained or the type of soil encountered at 40m depth below existing ground level is very poor (like loose clay, organic deposit etc.) further boring should be continued upto a depth of 50m below Ground Level or refusal whichever is earlier and all relevant data upto termination depth of bore holes shall be furnished in the Soil Investigation Report as detailed above.

j) Liquefaction Potential Analysis should be included in the report (for seismic zone-3 and above only) and recommendation of possible remedial measures shall be provided.