

NTPC Limited

(A Government of India Enterprise)



TECHNICAL SPECIFICATION

FOR

DEMONSTRATION OF METHANOL FIRING IN RAJIV GANDHI COMBINED CYCLE POWER PLANT, KAYAMKULAM

SECTION - VI

BIDDING DOCUMENT NO.: CS-0011-130A-9

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TABLE OF CONTENTS

PART - A	
SUB-SECTION-I	INTENT OF SPECIFICATION
SUB-SECTION-II	PROJECT INFORMATION
SUB-SECTION-III	SCOPE OF SUPPLY & SERVICES
SUB-SECTION-IV	FUNCTIONAL GUARANTEES & LIQUIDATED DAMAGES
PART - B	DETAILED TECHNICAL SPECIFICATION
SUB-SECTION-A-01	MECHANICAL SYSTEM
SUB-SECTION-B-01	ELECTRICAL SYSTEM
SUB-SECTION-C-01	CONTROL & INSTRUMENTATION SYSTEM
SUB-SECTION-D-01	CIVIL WORKS
SUB-SECTION-E-01	QUALITY ASSURANCE
PART - C	NOT USED
PART - D	NOT USED
PART - E	TENDER DRAWINGS

SUBSECTION-D-01

CIVIL WORKS

<p>1.00.00</p> <p>1.01.00</p> <p>1.01.01</p> <p>1.01.02</p> <p>1.01.03</p>	<p>Technical Requirements—Civil</p> <p>Material Specification</p> <p>Cement, Aggregates, Bricks, Water etc.:</p> <p>Ordinary Portland Cement with C3A content from 5 to 8 percent conforming to IS 269/ Portland slag cement conforming to IS 455 shall be used for all areas. Coarse aggregate shall meet the requirements of IS 383. Fine aggregate in concrete shall conform to IS 383. For plaster, it shall conform to IS 1542 and for masonry work to IS 2116. Fly ash bricks shall preferably be used in all construction. Potable water shall generally be considered satisfactory for all masonry and concrete works, including curing. All materials brought for incorporation in works shall be as per IS unless specified otherwise.</p> <p>Reinforcement Steel</p> <p>Reinforcement steel shall be of corrosion resistant grade high strength deformed TMT steel bars of grade Fe-415/ Fe-500/ Fe500D/ Fe550D and shall conform to IS 1786 and IS 13920. However, minimum elongation shall be 14.5%.</p> <p>Structural Steel</p> <p>Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects. Structural steel shall comprise of mild steel, medium strength steel and high tensile steel as specified below.</p> <p>Mild Steel</p> <p>Rolled sections shall be of grade designation E250, Quality A/BR, Semi-killed/ killed conforming to IS 2062. All steel plates shall be of Grade designation E250, Quality BR (fully killed), conforming to IS 2062 and shall be tested for impact resistance at room temperature. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p> <p>Medium and High Tensile Steel</p> <p>Rolled Sections and plates shall be of grade designation E350 or higher, Quality B0 (Fully killed), conforming to IS: 2062. Plates beyond 12mm thickness and up to 40mm thickness shall be normalized rolled. Plates beyond 40mm thickness shall be vacuum degassed & furnace normalised and shall also be 100% ultrasonically tested as per ASTM –A578 level B-S2.</p>
<p>DEMONSTRATION OF METHANOL FIRING IN RAJIV GANDHI COMBINED CYCLE POWER PLANT, KAYAMKULAM</p>	<p>TECHNICAL SPECIFICATION PART-B</p> <p>SUB SECTION D01 CIVIL WORKS</p> <p>PAGE 14 OF 42</p>

1.01.04	<p>Colour coated and other sheeting work</p> <p>a) Wall Cladding & Roofing Material</p> <p>Troughed permanently colour coated sheet of approved shade and colour shall be:-</p> <ol style="list-style-type: none"> Either of steel with minimum 0.6mm bare metal thickness (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y250 as per IS 15961 / grade G250 as per AS1397 / grade SS255 as per ASTM A653M / grade S250GD as per EN 10326 with zinc coating to class Z350 / aluminium-zinc alloy coating to class AZ200 Or of minimum 0.5mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y350 as per IS15961/ grade G350 as per AS1397 / grade SS340 class 4 as per ASTM A792M / grade S350GD as per EN 10326 with zinc coating to class Z350 / aluminium-zinc alloy coating to class AZ200. Or of steel of minimum 0.4mm BMT (i.e. excluding the thickness of galvanizing/aluminium-zinc coating and painting) of grade Y550 as per IS 15961/ grade G550 as per AS1397 / grade SS550 as per ASTM A792M / grade S550GD as per EN 10326 with zinc coating to class Z350 / aluminium-zinc alloy coating to class AZ200 <p>Alternatively aluminium feed material of minimum bare metal thickness of 0.7 mm of aluminium alloy of Series 31000 and above as per IS 737 and IS 1254.</p>
1.02.00	<p>Concrete work shall be carried out as per IS 456. The minimum grade of concrete shall be as follows in accordance with IS 456:</p> <p>a) Piling, Reinforced Cement Concrete for Tank Foundations, Shed Foundation, Paving Slab or any other RCC work: M30 grade</p> <p>(Minimum cement content for such structures shall not be as per “severe” exposure condition, but shall be as per design mix subject to minimum cement content as per IS 456)</p> <p>b) Mud Mat PCC: M10 grade</p>
1.03.00	<p>The minimum concrete clear cover to Reinforcement bars in all RCC structures shall meet durability requirements of severe exposure conditions as per IS 456.</p>

1.04.00	Painting of Steel Structures			
	CORROSSIVITY CATEGORY (as per ISO 12944-2)	PRIMER COAT	INTERMEDIATE COAT	FINAL COAT
	C5	All steel surfaces shall be provided with two component moisture curing zinc (ethyl) silicate primer coat (having minimum 80% of metallic Zinc content in dry film, solid by volume minimum 60% $\pm 2\%$) of minimum 70 micron DFT to be applied over blast cleaned surface conforming to Sa 2 ½ finish of ISO 8501-1 with surface profile 40-60 Micron. The primer coat shall be applied in shop immediately after blast	Primer coat shall be followed with the application of Intermediate coat of two component polyamide cured epoxy with MIO Content (containing lamellar MIO minimum 30% on pigment, solid by volume minimum 80% $\pm 2\%$) of minimum 180 micron DFT. This coat shall be applied in shop after an interval of minimum 24 hours (from the application of primer coat) by airless spray technique.	Intermediate coat shall be followed with the application of finish coat of two-pack aliphatic Isocyanate cured acrylic finish paint (solid by volume minimum 55% $\pm 2\%$) with Gloss retention (SSPC Paint Spec No 36, ASTM D 4587, D 2244, D 523) of Level 2 (after minimum 1000 hours exposure, Gloss loss less than 30 and colour change less than 2.0 ΔE) and minimum 70 micron DFT. This coat shall be applied shop after an interval of minimum 10
DEMONSTRATION OF METHANOL FIRING IN RAJIV GANDHI COMBINED CYCLE POWER PLANT, KAYAMKULAM		TECHNICAL SPECIFICATION PART-B		SUB SECTION D01 CIVIL WORKS
PAGE 16 OF 42				

		cleaning by airless spray technique. Zinc dust composition and properties shall be Type-II as per ASTM D520-00.		hours and within six (6) months (from the completion of Intermediate coat), Colour and shade of the coat shall be as approved by the Employer.
1.05.00	GENERAL CIVIL WORK SPECIFICATION Foundation, Building Works The foundation work to be carried out with M30 grade concrete. Building and its associated works (i.e finishing, plumbing, etc) shall be carried out using the materials as per IS code/CPWD specifications. Peripheral drains shall be provided all around the buildings, and flow of the drain shall be discharged into owners drain. All the debris and excavated soil shall be suitably disposed of as per direction of engineer in charge. Bidder shall submit all the Civil/ Structural/ Architectural drawings before taking up the construction work. Design and drawings shall comply to BIS and statutory requirements. Work shall be executed as per instruction on Engineer in charge.			
1.06.00	Bidder shall conduct soil investigation as per requirement of work. Foundation system and geotechnical criteria chapter is attached as Annexure-A.			
1.07.00	Seismic loads shall be considered as Annexure-B.			
1.08.00	Wind loads shall be considered as per IS 875 part 3.			
DEMONSTRATION OF METHANOL FIRING IN RAJIV GANDHI COMBINED CYCLE POWER PLANT, KAYAMKULAM		TECHNICAL SPECIFICATION PART-B	SUB SECTION D01 CIVIL WORKS	PAGE 17 OF 42

1.00.01	FOUNDATION SYSTEM AND GEOTECHNICAL DATA
1.01.0	Geotechnical data and foundation system for the proposed tank areas are enclosed at Annexure-I . The corresponding bore logs of vicinity are enclosed at Annexure-II .
1.02.0	Available geotech data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed geotech investigation for facilities under this package and shall be as per the scheme approved by owner. The scheme for geotechnical investigation shall be as given at Clause 1.12.02 and shall be approved by owner before execution. If required, contractor may carry out Geotechnical investigation work. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The report shall be submitted for Owner's approval prior to commencement of design of foundation.
1.03.0	The furnished borelog details are specific to the co-ordinates where the boreholes have been carried out and are provided for bidder's information only. Soil profile in the proposed area may vary with respect to the borelogs enclosed for bidder's information. Bidder has to consider all such variations in his estimation, over the extent of the work to be carried out. The Bidder should note that nothing extra whatsoever on account of variation between soil data collected by Owner and that found by the Bidder during geotechnical investigation by him or during execution of works, shall be payable.
1.04.0	Foundation System The requirements for the foundation system to be adopted are as given in subsequent clauses.
1.05.0	General Requirements <ul style="list-style-type: none"> a) All structures/equipment shall be supported on pile foundation. b) The roads, ground floor slabs, trenches, pipe pedestals, channels/drains and staircase foundation with foundation loading intensity less than 4 T / M2 may be supported on open / shallow foundations resting on virgin / controlled compacted filled up soil. c) No other foundation (other than as mentioned in (b) above and (j) below) shall rest on the filled up ground / soil. d) No foundation shall rest on the black cotton soil.

- e) Before execution of work the bidder shall ensure that there is no obstruction to underground/overground facilities like sewer lines, pipe lines etc. Any such damage and remedial/ rectification measures shall be at the contractors cost.

For underground facilities survey, Ground Penetration Radar (GPR) may be used.

- f) Bidder shall also ensure that there is no damage to existing nearby foundations and the foundations pertaining to this package are not placed at shallower depth than the nearby foundations. If required depth of foundation is deeper than the existing foundations, proper protection shall be provided to existing foundations.
- g) **Bidder shall also ensure that there is no damage to existing nearby foundations/facilities due to vibration during installation of piles.**
- h) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.
- i) The water table for design purpose shall be considered at Finished Ground Level.
- j) Foundation for miscellaneous equipment's on ground floor.

For equipment of static weight upto 0.5 T, the equipment may be supported on the ground floor slab by locally thickening the slab. Thickening of the ground floor slab shall be done upto an extent of about 0.6 m beyond the plan area of the equipment on all the sides. Further, the load intensity below the equipment shall be limited to 2T/m². Other requirements of floor slab and compaction below the floor slab shall be adhered, as specified elsewhere in the specifications.

For equipment of static weight more than 0.5 T, the equipment foundation shall be supported on pile foundation. The pedestal of equipment foundation or the foundation Block shall be isolated from the adjoining floor slab by providing bitumen impregnated fiber board of minimum 50 mm thick, conforming to IS: 1838 all around the equipment pedestal for the full depth of the floor slab.

1.06.0

Open Foundations (Not Applicable)

In case open foundations are adopted, following shall be adhered to.

- a) The minimum width of foundation shall be 1.0 m.
- b) Minimum depth of foundation shall be 1.0m below Ground Level.

- c) It shall be ensured that all foundations of a particular structure/ buildings/ facility shall rest on one bearing stratum.
- d) Wherever the intended bearing sub-strata is virgin soil stratum but the actual stratum encountered during foundation excavation consists of filled up soil at founding level, under such cases either the foundation shall be lowered completely into the virgin stratum or the filled up soil upto the virgin layers shall be removed and built up through PCC (1:4:8) up to designed foundation level.

1.07.0

Pile Foundation

- i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.

Based upon the available soil data, soil up to a depth of 10m (below existing ground level) is loose soil. In view of this, temporary/permanent MS liner upto loose strata may be provided for piling.

- ii) The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report, pile capacity achieved in pile load tests and the values furnished in annexure-I.

- iii) Only straight shaft piles shall be used. Minimum cast length of pile above cutoff level shall be 1.0 m.

- iv) The contractor shall furnish design of piles (in terms of rated capacity, length, diameter, termination criteria to locate the founding level for construction of pile in terms of measurable parameter, reinforcement for job as well as test piles, pile load test arrangement, locations of initial test piles etc.) for Engineer's approval.

- v) The piling work shall be carried out in accordance with IS:2911 (Relevant part) and accepted construction methodology. The construction methodology shall be submitted by the Contractor for Engineer's approval.

- vi) Number of initial load tests to be performed for each diameter and rated capacity of pile shall be subject to minimum as under.

Vertical

Lateral

Uplift

Minimum of 1 nos in each mode

- vii) The initial pile load test shall be conducted with test load three times the pile capacity mentioned in Annexure-I. In case of vertical compression test (initial test) the method of loading shall be cyclic as per IS:2911 (relevant part).
- viii) Load test shall be conducted at pile Cut-off Level (COL). If the water table is above the COL the test pit shall be kept dry throughout the test period by suitable de-watering methods. Alternatively the vertical load test may be conducted at a level higher than COL. In such a case, an annular space shall be created to remove the effect of skin friction above COL by providing an outer casing of suitable diameter larger than the pile diameter.
- ix) Number of routine pile load tests to be performed for each diameter/allowable capacity of pile shall be as under :
- Vertical : 0.5% of the total number of piles provided
- Lateral : 0.5% of the total number of piles provided
- x) The routine tests on piles shall be conducted upto test load of one and half times the allowable pile capacity. Piles for routine load tests shall be approved by the Employer.
- xi) In case, routine pile load test shows that the pile has not achieved the desired capacity or pile(s) have been rejected due to any other reason, then the Contractor shall install additional pile(s) as required and the pile cap design shall accordingly be reviewed and modified, if required.
- xii) Testing of piles and interpretation of pile load test results shall be carried out as per IS:2911 (Part-4). Contractor shall ensure that all the measuring equipment and instruments are properly calibrated at a reputed laboratory / institute prior to their use. Settlement / movement of the pile top shall be made by Linear Variable Differential Transducers (LVDT) having a least count of 0.01mm.
- xiii) The test load on initial test piles shall be applied means of reaction from anchor piles / rock anchors alone or kentledge with concrete blocks alone or combination of anchor piles / rock anchors and kentledge with concrete blocks.
- xiv) Low Strain Pile Integrity test shall be conducted on all test piles and job piles. This test shall be used to identify the routine load test and not intended to replace the use of static load test. This test is limited to assess the imperfection of the pile shaft and shall be undertaken by an independent specialist agency to be approved by Engineering department of Owner. The test equipment shall be of TNO or PDI make or equivalent. The process shall confirm to ASTM.

High Strain Dynamic Load Test may be carried out for routine load testing of working piles. However, at least two numbers of static routine vertical load tests shall be carried out on pile on which high strain dynamic load test has already been carried out for establishing the correlation between the two tests. In case of discrepancy if any between dynamic and static vertical load tests, then additional static routine vertical load tests shall be conducted as decided by the Engineer and the results of static routine vertical load shall prevail. Number of routine vertical pile load tests as per clause 1.07.0 (ix) shall be total of static routine vertical load test and high strain dynamic load tests.

The procedure to carry out the test shall be submitted to the Engineer. The test and equipment shall conform to ASTM D4945-00. The test shall be conducted by an experienced independent test agency approved by the owner. Field data shall be submitted to the site engineer and shall include force velocity curves, pile capacity, simulated static load test curve, net and total pile displacement, pile integrity. A (Case pile wave analysis) CAPWAP or equivalent software analysis shall be conducted on the field data for correct capacity estimation and to evaluate end bearing and skin friction components of the pile.

xv) From load considerations, single pile may be used under a column/tower. In that case, pile shall be connected with tie beams at pile cut off level in both directions.

xvi) Contribution of frictional resistance of filled up soil if any, shall not be considered for computation of frictional resistance of piles.

xvii) Reinforcement for job piles shall be designed as following:

a) Compression + bending piles: For these piles, the allowable safe pile capacities in compression and bending shall be considered.

b) Tension + bending piles: For these piles, the actual pile forces to be considered. However, maximum 3 types of combinations for varying percentage of tension capacity + bending case may be designed & adopted by contractor for the entire scope of work under this package.

1.08.0

Special Requirements

1.08.01

Details of treatment for foundations / underground structures required to counteract soil / water chemical environment shall be as per detailed geotechnical investigation to be carried out by contractor. Contractor shall carry out chemical analysis during detailed geotechnical investigation and required treatment shall be provided accordingly.

	<div>एनटीपीसी NTPC</div>		
1.09.0	Excavation, Filling and Dewatering		
1.09.01	For excavation works, comprehensive dewatering with well point or deep wells arrangement, if required, shall be adopted. Scheme for dewatering and design with all computations and back up data for dewatering shall be submitted for the owner's information. The water table shall be maintained at 0.5m below the founding depth.		
1.09.02	Excavation for shallow foundations shall be covered with PCC immediately after reaching the founding level. In case of any local loosening of soil or any loose pockets are encountered at founding level during excavation the same shall be removed and compensated by PCC M7.5. The final layer of about 300 mm thickness above the founding level shall be excavated by suitable means, so as to avoid disturbance to founding stratum.		
1.09.03	Backfilling around foundations, pipes, trenches, sumps, pits, plinths, etc. shall be carried out with approved material in layers not exceeding 300 mm compacted thickness (higher thickness of layers upto 500mm with heavy mechanical compacting equipment) and each layer shall be compacted to 90% of standard proctor density for cohesive soils and to 80% of relative density for non-cohesive soils		
1.09.04	Founding level for trenches/channels shall be decided as per functional requirement. The bottom of excavation shall be properly compacted prior to casting of bottom slab of trenches / channels.		
1.09.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed up to the formation level. Adequate and suitable warning signs shall be put up at conspicuous places at the excavation work to prevent any persons or vehicles falling into the excavation trench. No worker should be allowed to work where he may be stuck or endangered by excavation machinery or collapse of excavations or trenches.		
1.10.0	Following details shall be submitted by the Bidder before start of work at site. Scheme for initial pile load tests in vertical, lateral and uplift modes along with supporting design calculations and methodology for installation of working piles.		
1.11.0	Sheeting & Shoring The contractor shall ascertain for himself the nature of materials to be excavated and difficulties, if any, likely to be encountered in excavation while executing the work. Sheet piling, sheeting and shoring, bracing and		
DEMONSTRATION OF METHANOL FIRING IN RAJIV GANDHI COMBINED CYCLE POWER PLANT, KAYAMKULAM		TECHNICAL SPECIFICATION PART-B	SUB SECTION D01 CIVIL WORKS
			PAGE 23 OF 42

1.12.0	<p>maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.</p> <p>Geotechnical Investigation</p> <p>The Contractor shall carry out detailed geotechnical investigation in the areas under his scope for establishing the sub-surface conditions and to decide type of foundations for the structures envisaged, construction methods, any special requirements/treatment called for remedial measures for sub-soil/ foundations etc. in view of soft sub-soils, aggressive sub-soils and water, expansive/swelling soils etc. prior to commencement of detailed design/drawings. The Contractor shall obtain the approval for the field-testing scheme proposed by him from the Owner before undertaking the geotechnical investigation work.</p>		
1.12.01	Scheme of geotechnical Investigation		
1.12.01.1	<p>Field test shall include but not be limited to the following:</p> <p>Boreholes, Standard Penetration Test (SPT), Dynamic Cone Penetration Test (DCPT), collection of disturbed samples (DS) and undisturbed soil samples (UDS), Trial Pits (TP), Plate Load Tests (PLT), Electrical Resistivity Test (ERT), In situ field permeability tests, collection of water samples, etc.</p>		
1.12.01.2	<p>The diameter of borehole shall be minimum 150 mm in soil and 76 mm in rock. The diameter of UDS sampler shall be 100 mm minimum. SPT shall be carried out by driving a standard split spoon sampler in the bore hole by means of a 63.5 kg hammer having a free fall of 0.75 m with auto trip hammer. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.</p>		
1.12.01.3	<p>The minimum tests are indicated in Clause No. 1.12.02. Adequate number of tests shall be conducted up to sufficient depth for complete determination of subsoil conditions. The depth of boreholes shall be as specified in Appendix A. SPT shall be carried out in all types of soil deposits and in all rock formations with core recovery up to 20%, met within a borehole. This test shall be conducted at every 3.0 m interval or at change of strata, up to the final depth. SPT 'N' of 100 and above shall be referred as refusal. UDS shall be collected at every 3.0 m interval or at change of strata up to depth of borehole. UDS may be replaced by additional SPT, if SPT'N' value in the strata is above 50.</p>		
1.12.01.4	<p>Laboratory tests shall be done as per relevant IS codes. The laboratory tests, not be limited to the following shall be conducted on disturbed and undisturbed soil samples, rock samples & water samples collected during field investigations in sufficient numbers.</p>		
DEMONSTRATION OF METHANOL FIRING IN RAJIV GANDHI COMBINED CYCLE POWER PLANT, KAYAMKULAM		TECHNICAL SPECIFICATION PART-B	SUB SECTION D01 CIVIL WORKS
			PAGE 24 OF 42

Laboratory Tests on Soil Samples

Laboratory tests shall be carried out on disturbed and undisturbed soil samples for Grain Size Analysis, Hydrometer Analysis, Atterberg Limits, Triaxial Shear Tests (UU), Natural Moisture Content, Specific Gravity and Bulk Unit Weight, Consolidation Tests, Unconfined Compression Test, Free swell Index, Shrinkage Limit, Swell Pressure Test, Chemical Analysis test on soil and water samples to determine the carbonates, sulphates, chlorides, nitrates, pH, organic matter and any other chemicals harmful to concrete and reinforcement/ steel.

Laboratory Tests on Rock Samples

Moisture content, porosity & density, Specific Gravity, Hardness, Soundness, Slake durability index, Unconfined compression test (Both at saturated and in-situ water content), Point load strength index and deformability test (Both at saturated and in-situ water content) shall be carried out on rock samples.

1.12.01.5

Geotechnical investigation (field & laboratory) shall be carried out in accordance with the provisions of relevant Indian Standards.

On completion of all field & laboratory work, geotechnical investigation report shall be submitted for Owner's review/approval. The Geotechnical investigation report shall contain geological information of the region, procedure adopted for investigation, field & laboratory observations/ data/ records, analysis of results & recommendations on type of foundation for different type of structures envisaged for all areas of work with supporting calculations. Recommendations on treatment for soil, foundation, based on subsoil characteristics, soft soils, aggressive chemicals, expansive soils, etc.

Recommendations on foundation system and the net allowable bearing pressures shall be based on the conservative values of geotechnical investigation data.

1.12.02

Geotechnical Investigation Scheme

a)

Boreholes (Minimum)

S	Structure	Spacing/Number of boreholes	Depth of borehole	Remarks
1	Tank	Minimum 2 Nos. under each tank	Depth of boreholes shall be 30m to 35m.	Depth of boreholes shall be as mentioned in column "Depth of Borehole"
2	Other Structure /Facility	Minimum 2 Nos. boreholes under each area / facility	30 to 35 m	

- Depth and location of Boreholes and other field tests (PLT, ERT, field permeability tests etc.) shall be approved by Owner before execution of geotechnical investigation work.
- Investigation in any other building / structure / facilities / trestles which are not mentioned above shall also be carried out, if required, by the bidder for the facilities under his scope.

GEOTECHNICAL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in vicinity to the proposed area. Logs of representative boreholes solely for bidder's information in the vicinity of proposed area are enclosed at Annexure-II.

The bidder is required to carry out geotechnical investigation as per Clause No 1.12.01 & 1.12.02 and ascertain the pile capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder.

a) The foundation system to be adopted for different structures shall be as given in Table – 1 below

Table – 1: Net Allowable Bearing Pressure

STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED
Tank and other facilities/structures	Piles

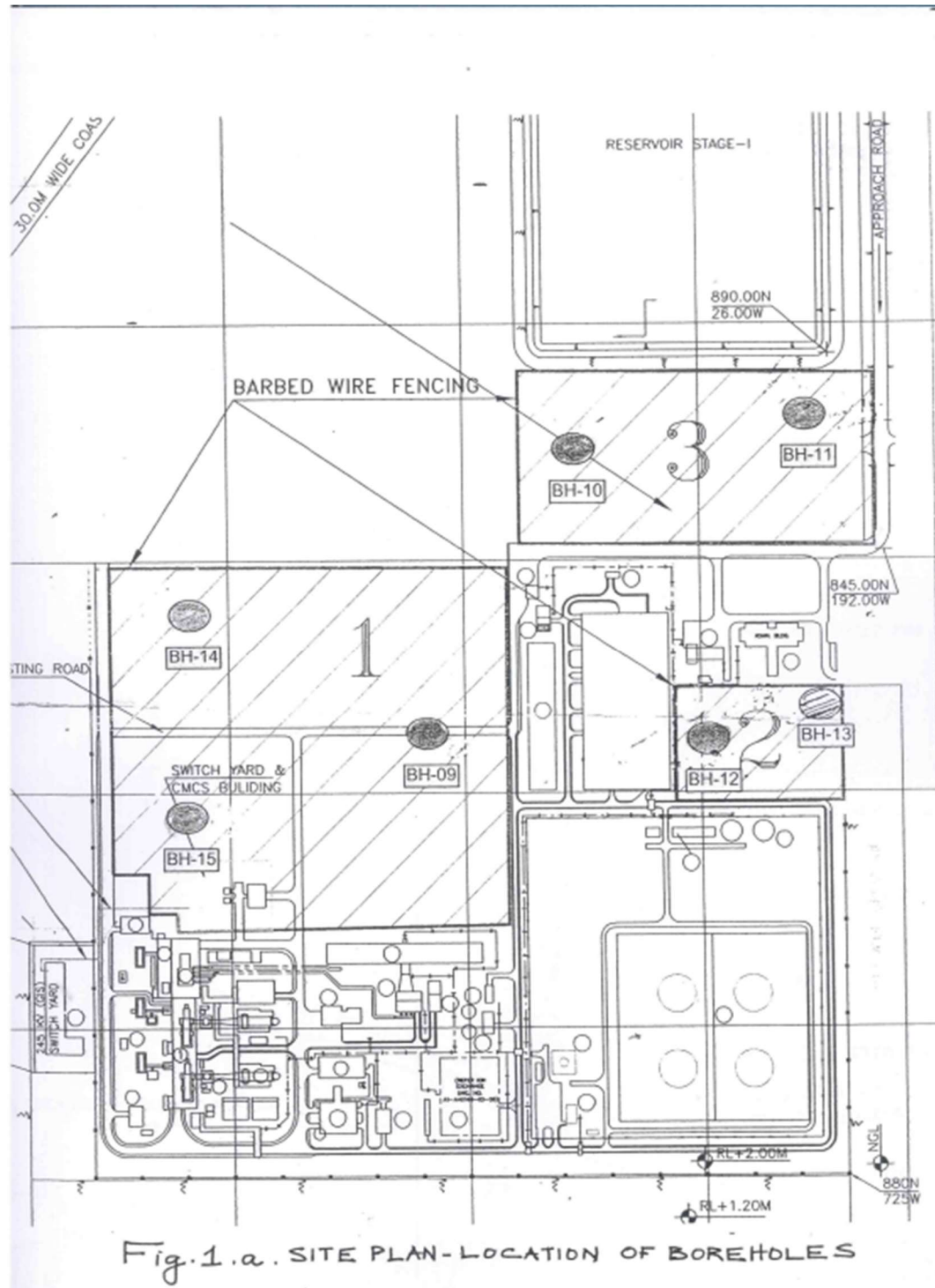
b) The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be least of the three values i.e. as per approved geotechnical report, as per the values furnished in following table and pile capacity achieved in pile load tests.

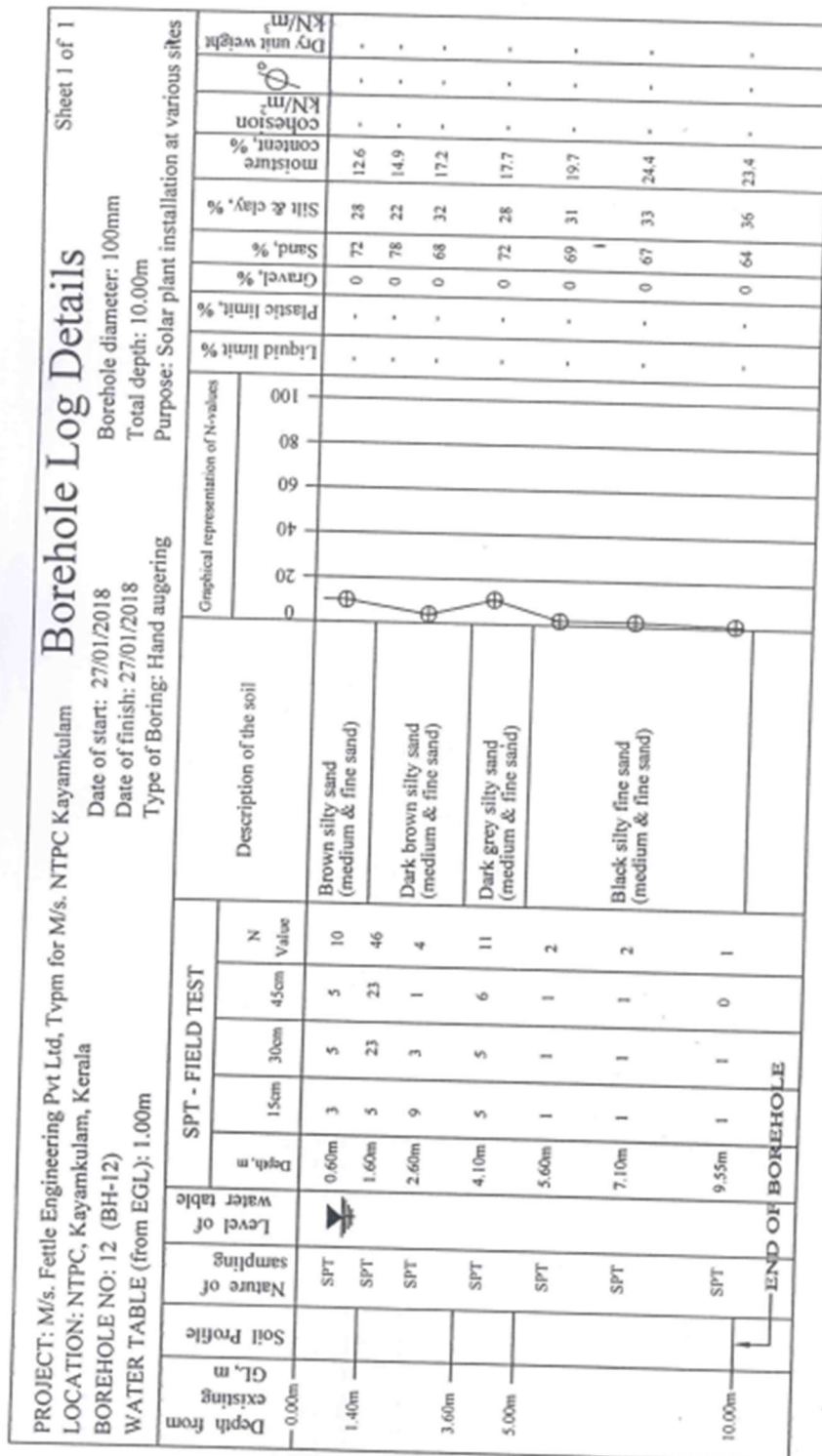
STRUCTURE	Pile Diameter (mm)	Minimum Length of Bored Pile Below Cut-off Level (m)	Safe Load Capacity in		
			Vertical Comp (MT)	Pull out (MT)	Lateral (MT)
Tank and other facilities/structures	500	15	30	12	2.5
	500	21	46	18	2.5
	600	15	40	16	3.5
	600	21	60	24	3.5

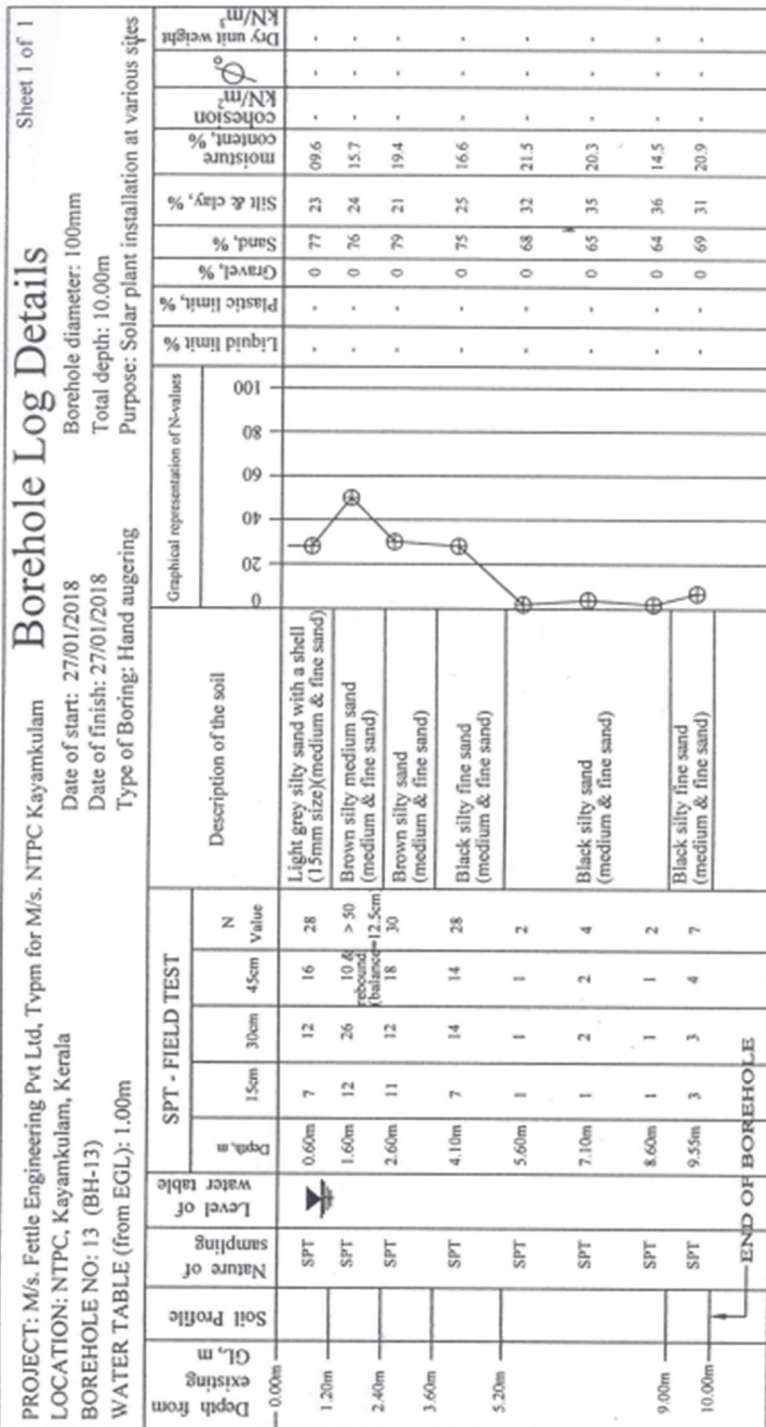
- Cut off Level (COL) is assumed at 2.0 m below FGL.

c) Special Requirements:

Cement Type	Cement shall be Ordinary Portland Cement with C3A content from 5 to 8 percent / Portland slag cement confirming to IS 455 having more than 50% slag.
Concrete Grade	M30 for piles Minimum cement content shall be 370 kg/m³ and maximum free water-cement ratio shall be 0.45 for foundation works other than Pile works and for Pile works Minimum cement content shall be 400kg/m³.
Type of Reinforcement	Reinforcement steel (High Strength Deformed steel bars) shall be Corrosion Resistance thermo-mechanically treated (CRS-TMT) bars and shall confirm to grade Fe-500 of IS:1786 (with minimum percentage of elongation of 14.5%)
Cover to Reinforcement	For foundations including piling, the minimum cover to reinforcement shall be 60mm. “Severe” exposure condition as per IS 456 to be considered for mix design.







RAJIV GANDHI COMBINED CYCLE POWER PROJECT, KAYAMKULAM

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalisation of Parts 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Annexure-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Annexure-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 and Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

- | | | | |
|----|--------------------------------|---|----|
| a) | Steel structures | : | 2% |
| b) | Reinforced Concrete structures | : | 5% |
| c) | Reinforced Concrete Stacks | : | 3% |
| d) | Steel stacks | : | 2% |

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893.

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\square V_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\square V_B / V_B$. However, no reduction is permitted if $\square V_B$ is less than V_B .

Design/Detailing for Ductility for Structures

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

Annexure-I to Annexure-B

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

- 1) Peak ground horizontal acceleration (MCE) : 0.16g
- 2) Multiplying factor to be applied to the horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra
 - a) for special moment resisting steel building frames designed and detailed as per IS:800 : 0.04
 - b) for special concentrically braced steel building frames designed and detailed as per IS:800 : 0.03
 - c) For special moment resisting RC building frames designed and detailed as per IS:456 and IS:13920 : 0.024
 - d) for RCC chimney, RCC Natural Draft Cooling Tower : 0.08
 - e) : 0.08
 - f) for liquid retaining tanks (ground supported) : 0.06
 - for steel chimney, Absorber tower, Vessels
- 3) Multiplying factor to be applied to the horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL
COEFFICIENTS**
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.031	1.027	1.024	1.019
0.050	1.523	1.436	1.335
0.060	1.770	1.635	1.480
0.070	2.010	1.823	1.615
0.080	2.244	2.005	1.742
0.086	2.382	2.110	1.815
0.088	2.427	2.145	1.839
0.090	2.473	2.179	1.862
0.095	2.585	2.264	1.920
0.098	2.652	2.315	1.954
0.100	2.697	2.348	1.977
0.103	2.763	2.398	2.010
0.108	2.873	2.480	2.065
0.110	2.917	2.512	2.086
0.112	2.961	2.545	2.108
0.115	3.026	2.593	2.139
0.118	3.091	2.640	2.171
0.121	3.155	2.688	2.202
0.122	3.177	2.704	2.212
0.125	3.241	2.751	2.243
0.127	3.284	2.782	2.263
0.129	3.326	2.813	2.283
0.130	3.348	2.828	2.293
0.132	3.390	2.859	2.313
0.134	3.432	2.890	2.333
0.145	3.663	3.056	2.439
0.157	3.910	3.233	2.552
0.158	3.910	3.250	2.561
0.160	3.910	3.250	2.580
0.200	3.910	3.250	2.580

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL
COEFFICIENTS**
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.250	3.910	3.250	2.580
0.300	3.910	3.250	2.580
0.350	3.910	3.250	2.580
0.400	3.910	3.250	2.580
0.431	3.910	3.250	2.580
0.442	3.910	3.250	2.580
0.450	3.910	3.250	2.580
0.474	3.910	3.250	2.580
0.488	3.910	3.250	2.580
0.500	3.910	3.250	2.580
0.517	3.910	3.250	2.580
0.525	3.910	3.250	2.580
0.542	3.910	3.250	2.580
0.550	3.910	3.250	2.580
0.562	3.910	3.250	2.580
0.576	3.910	3.250	2.580
0.588	3.910	3.250	2.580
0.597	3.910	3.250	2.580
0.603	3.910	3.250	2.580
0.609	3.910	3.250	2.580
0.615	3.910	3.250	2.580
0.625	3.910	3.250	2.580
0.640	3.910	3.250	2.580
0.658	3.910	3.250	2.580
0.667	3.910	3.250	2.580
0.690	3.910	3.250	2.580
0.700	3.910	3.250	2.580
0.750	3.910	3.250	2.580
0.770	3.809	3.250	2.580
0.800	3.666	3.250	2.580
0.850	3.451	3.059	2.428
0.900	3.259	2.889	2.293
0.950	3.087	2.737	2.173
1.000	2.933	2.600	2.064
1.050	2.793	2.476	1.966
1.100	2.666	2.364	1.876

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL
COEFFICIENTS**
(In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
1.150	2.550	2.261	1.795
1.200	2.444	2.167	1.720
1.250	2.346	2.080	1.651
1.300	2.256	2.000	1.588
1.350	2.173	1.926	1.529
1.400	2.095	1.857	1.474
1.450	2.023	1.793	1.423
1.500	1.955	1.733	1.376
1.550	1.892	1.677	1.332
1.600	1.833	1.625	1.290
1.650	1.778	1.576	1.251
1.700	1.725	1.529	1.214
1.750	1.676	1.486	1.179
1.800	1.629	1.444	1.147
1.850	1.585	1.405	1.116
1.900	1.544	1.368	1.086
1.950	1.504	1.333	1.058
2.000	1.467	1.300	1.032
2.050	1.431	1.268	1.007
2.100	1.397	1.238	0.983
2.150	1.364	1.209	0.960
2.200	1.333	1.182	0.938
2.250	1.304	1.156	0.917
2.300	1.275	1.130	0.897
2.350	1.248	1.106	0.878
2.400	1.222	1.083	0.860
2.450	1.197	1.061	0.842
2.500	1.173	1.040	0.826
2.550	1.150	1.020	0.809
2.600	1.128	1.000	0.794
2.650	1.107	0.981	0.779
2.700	1.086	0.963	0.764
2.750	1.067	0.945	0.751
2.800	1.048	0.929	0.737
2.850	1.029	0.912	0.724
2.900	1.011	0.897	0.712

**HORIZONTAL SEISMIC ACCELERATION SPECTRAL
COEFFICIENTS**
(In units of 'g')

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
2.950	0.994	0.881	0.700
3.000	0.978	0.867	0.688
3.050	0.962	0.852	0.677
3.100	0.946	0.839	0.666
3.150	0.931	0.825	0.655
3.200	0.917	0.813	0.645
3.250	0.902	0.800	0.635
3.300	0.889	0.788	0.625
3.350	0.876	0.776	0.616
3.400	0.863	0.765	0.607
3.450	0.850	0.754	0.598
3.500	0.838	0.743	0.590
3.550	0.826	0.732	0.581
3.600	0.815	0.722	0.573
3.650	0.804	0.712	0.565
3.700	0.793	0.703	0.558
3.750	0.782	0.693	0.550
3.800	0.772	0.684	0.543
3.850	0.762	0.675	0.536
3.900	0.752	0.667	0.529
3.950	0.743	0.658	0.523
4.000	0.733	0.650	0.516

SUBSECTION-E-01

QUALITY ASSURANCE

QUALITY ASSURANCE-MECHANICAL

METHANOL STORAGE TANK AND ASSOCIATED PIPES, VALVES & FITTINGS

1.00.00

METHANOL STORAGE TANK

1. Material Tests (Chemical Analysis, Mechanical Tests & other tests) as per applicable material standard of all components (plates, forgings etc)
2. Only Qualified welders as per approved WPS and PQR shall be deployed for fabrication of tanks.
3. Dimensional checks, during in-process and final inspection, shall be carried out for alignments, circularity, verticality, orientation of connections, slope of bottom plate etc.
4. NDT on weld joints shall be done as per relevant / applicable standard. However, minimum requirement of NDT, as given below, shall be complied :
 - a. 100% DPT on root run (butt welds / back-gouged welds).
 - b. 100% DPT on all finished welds.
 - c. RT on butt welded seams (which shall cover 'T' / Cross joints) as per design code / Standard.
5. Tanks shall be subjected to following tests (as applicable)
 - (i) Hydraulic/Water fill test:
Initial lift (by water), Leak test of roof, Leakage test of roof drain, hydrotest of completed tanks, Hammer test during hydraulic test shall be carried out.
 - (ii) Vacuum Box for Bottom plate and Annular plate:
Oil Chalk leakage for shell to bottom (inside welding) for pontoon Box/Rim plate (for Double deck).
 - (iii) Pneumatic test of reinforcement pad welds and air test of Buoys of floating roof shall be carried out.
 - (iv) Roof flotation test (Proof test) as per applicable code shall be carried out.

2.00.00

PIPING, VALVES AND FITTINGS:

1. Material Tests (Chemical Analysis, Mechanical Tests & other tests) as per applicable material standard of all components (plates, forgings, castings etc)

2. All pipes and fittings shall be tested as per applicable code. Welds of Steam Pipe joints(if applicable) shall be 10% radiographed and 100% DP tested. Other Pipe joints shall be 100% DP tested on root and 10% finished weld.
3. Pipes dia 450mm and above if fabricated from plate as well as fabricated fittings shall be hydro tested at 1.5 times design pressure or 2 times the working-pressure whichever is higher. All such fabrication welds are also to be 100% DP tested after root run and 10% on finished welds.
4. All valves shall be hydraulically tested for body, seat and back seat (as applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.
5. Valves shall be offered for inspection in unpainted condition.
6. Functional checks of the valves for smooth operation, valve travel, opening and closing time shall be checked. Current drawn by actuators shall also be checked.
7. Fire safe test for ball/Plug valves shall also be done as per applicable codes/standards.
8. All fabricated strainers shall be subjected to Welding Checks & NDT checks as per design standard requirements. Strainer body shall be hydraulically tested and Pressure drop v/s flow rate test shall be done for Strainers. Weld joints are to be DP tested.
9. Vendor list shall be tied up with main contractor during detailed Engineering.

QUALITY ASSUARANCE- ELECTRICAL AND C&I

1.00.0

Quality tie-up for Electrical and C&I portion shall be carried out after award of the contract with the Main Contractor during detailed engineering.

1.00.00	<p style="text-align: center;"><u>QUALITY ASSURANCE FOR CIVIL WORKS</u></p> <p>GENERAL QA REQUIREMENTS</p> <p>The contractor shall ensure that the works, BOIs and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the NTPC's site or at any other place of work are in accordance with the NTPC technical specification, applicable standards / codes, approved drawings / data sheets / and BOQ.</p>		
2.00.00	<p>SAMPLING AND TESTING OF CONSTRUCTION MATERIALS</p> <p>a) The method of sampling for testing of construction materials and work / job samples shall be as per the relevant IS / standards / codes and in line with the requirements of the technical specifications.</p> <p>b) Before execution of any civil work the contractor shall conduct full-scale suitability tests on various construction and building material such as soil, fine and coarse aggregates, cement, construction chemicals, supplementary cementitious materials, and construction water to ascertain their suitability for use and the concrete mix designs conducted from Owner/NTPC Acceptable labs. (Attached as annexure 1A). The test samples for such full-scale testing shall be jointly sampled and sealed by the Owner/NTPC and contractor, thereafter these shall be sent to the concerned laboratory through the covering letter signed by field quality assurance department (FQA) representative of the Owner/NTPC. Format for sampling and testing of cement, coarse aggregate, fine aggregate, chemical admixture, fly ash, water, concrete mix design is enclosed at Annexure-I.</p> <p>Design mix will be carried out at the starting of the work with all tests as per Annexure I.</p> <p>c) The contractor shall carry out testing in accordance with the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer in Charge (EIC). All testing shall be done in a site lab. / NTPC acceptable third-party Laboratory.</p>		
3.00.00	<p>FIELD QUALITY PLAN</p> <p>a) Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans (FQP) and obtain approval of Owner/NTPC, which shall detail out for all the works, equipment, services, quality practices and procedures etc. in line with the requirement of the technical specifications to be followed by the contractor at site. This FQP shall cover for all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at site. An Indicative Field Quality Plan for civil works is enclosed at Annexure II for reference purposes.</p>		
<p>DEMONSTRATION OF METHANOL FIRING IN RAJIV GANDHI COMBINED CYCLE POWER PLANT, KAYAMKULAM</p>		<p>TECHNICAL SPECIFICATION PART-B</p>	<p>SUB SECTION E01 QUALITY ASSUARANCE</p>
			<p>PAGE 42 OF 42</p>

LIST OF THIRD-PARTY LABORATORIES ACCEPTABLE FOR TESTING AND EVALUATION OF BUILDING MATERIALS

Sl.	Name of Laboratory/ Test Centre	Contact Details (Address, Phone, Fax, E-mail)	Tests	Remarks
1	Indian Institute of Technology Bombay, Powai, Mumbai -400076	Head, Deptt of Civil Engg, Phone : 022 25722545	Mix design and material properties on selective basis	In situ non-destructive testing (UPV) of concrete structures, design of mass concrete, temperature studies, distress assessment
2	Indian Institute of Technology Madras, Chennai-600 036	Head, Deptt of Civil Engg. Phone: 044 22574266/5255	Selective specialised studies such as design of fly ash concrete and special concrete, non-destructive testing (UPV) of structures	
3	Indian Institute of Technology Guwahati -781039	Head, Deptt of Civil Engineering, Phone: 0361 2582401, 258 2442, 258 2440	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, steel reinforcement, petrography, alkali aggregate reactivity, mix design	In situ non-destructive testing (UPV) of concrete structures (selective basis), design of mass concrete, studies on properties of fly ash concrete
4	Indian Institute of Technology Kanpur (UP) -208016	Head, Deptt of Civil Engineering, Phone: 0512 2597346	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	Non-destructive testing (UPV) on concrete structures, structural health assessment
5	Indian Institute of Technology Kharagpur (WB) -721302	Head, Deptt of Civil Engineering, Phone: 03222 283421	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design, petrography	
6	Indian Institute of Technology Delhi, Hauz Khas, New Delhi -1100 016	Head, Deptt of Civil Engineering, Phone: 011 26591191	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	In situ non-destructive testing (UPV) of concrete structures (selective basis)
7	Indian Institute of Technology, Roorkee -247667	Head, Deptt of Civil Engineering, Phone: 01332 285439, 273560	Testing and evaluation of cement (physical and chemical), aggregates (mechanical), fly ash (physical and chemical), admixtures, water, steel reinforcement, mix design, petrography, alkali aggregate reactivity	Various tests on other building materials such as silica fume, mass concrete, steel, bricks, tiles, doors, ferrocement covers, pipes, bridge bearings, PVC water tanks, etc.
8	Indian Institute of Science Bangalore 560012	Head, Deptt of Civil Engineering, Bangalore	Design of roller compacted concrete, radiation shield concrete, high volume fly ash concrete, fire behaviour of concrete, micro cracking of concrete, non-destructive testing (research & development) activities, behaviour of concrete under shrinkage and creep, assessment of fire damaged concrete	IISC basically involved in R&D activities related to civil engineering and may only be contacted in case of specific studies / consultancy.

LIST OF THIRD-PARTY LABORATORIES ACCEPTABLE FOR TESTING AND EVALUATION OF BUILDING MATERIALS

9	Institute of Technology, Banaras Hindu University (BHU) Varanasi (UP) - 221005	Head, Deptt of Civil Engineering, Phone: 0542-2307016	Testing and evaluation of cement physical properties), aggregates (mechanical properties), admixtures, water, mix design, petrography	
10	Central Building Research Institute (CBRI), Roorkee - 247667	Head, Structural Engineering division, Phone: 01332 283382	Testing and evaluation of cement (physical and chemical), aggregates (mechanical), fly ash (physical and chemical), admixtures, water, mix design, alkali aggregate reactivity	Fire rating of doors, non-destructive testing of structures, various tests on other building materials such as bricks, steel, tiles etc.
11	Central Soil and Materials Research Station (CSMRS), Near IIT Delhi, Olof Palme Marg, New Delhi -110016	Joint Director Phone: 011 26962608, 011 2656 3140	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, mix design	Various tests on other building materials such as steel, geotextiles, geomembrane, soil, instrumentation, monitoring, etc.
12	National Council for Cement and Building Materials (NCB), 34 KM Stone, Delhi Mathura Road Ballabgarh (Haryana)	Head, Center for Construction Development & Research Phone: 0129 2246173	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, temperature cycle test, XRD, steel reinforcement, mix design	In situ non-destructive testing (UPV) of concrete structures and special studies, testing of bricks, paving blocks, steel bars, silica fume, etc.
13	National Council for Cement and Building Materials (NCB), NCB Bhawan, Old Bombay Road Hyderabad 500008	General Manager, Phone 040 23000344, 04023000343	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, petrography, alkali aggregate reactivity, steel reinforcement, mix design	In situ Non-destructive testing (UPV) of concrete structures (selective basis)
14	National Test House, Taramani Chennai 600 113	S.O.(Civil) Phone:04422432374, Fax:04422433158	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement, water, mix design	Various tests on other building materials such as paving blocks, GI pipes, wires, steel plate, flush doors, salt spray test, etc.
15	National Test House, Block CP Sector V, Salt Lake City Kolkata-700 091	S.O. (Civil), Phone:033 2367 3870	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, steel reinforcement, mix design	Various tests on other building materials such as paving blocks, GI pipes, wires, steel plate, flush doors, etc.
16	National Test House (NTH), Kamla Nehru Nagar, Ghaziabad (UP)	S.O. (Civil), NTH Ghaziabad	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, steel reinforcement	Timber, clay products, water proofing compound, flush doors, laminated sheets, plywood, etc.
17	Structural Engineering	Head, Department of	Testing and evaluation of cement (physical and	In situ Non-destructive testing (UPV)

LIST OF THIRD-PARTY LABORATORIES ACCEPTABLE FOR TESTING AND EVALUATION OF BUILDING MATERIALS

	Research Centre (SERC), Taramani, Chennai 600 113	Material Testing, Phone: 044 22549152, 22541735	chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement water, mix design	of concrete structures (selective basis) and special studies such as cement admixture compatibility, design of special concrete, evaluation of structures
18	Vishveswaraiya National Institute of Technology (VNIT), Nagpur (MH) - 440010	Director, VNIT Nagpur, Phone: 0712 2223710, 2222828	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design, petrography	In situ non-destructive testing (UPV) of concrete structures and soil tests
19	Anna University, Department of Structural Engineering, Chennai -600 025	Head, Deptt of Civil Engineering	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	
20	Shriram Institute for Industrial Research, 19 University Road, Delhi 110007	Dr (Mrs) Laxmi Rawat, Asstt Director & Chief, Phone: 011 27667267	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water, mix design	Various tests on other building materials such as steel, geotextiles, geomembrane, soil, bricks, tiles, etc.
21	Spectro Analytical Lab, E-41, Okhla Industrial Area, Ph II, New Delhi 110021	Phone: 011 26383048-49 Fax: 40503150, 40503151	Testing of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, water	Chemical and physical tests on steel reinforcement
22	Motilal Nehru National Institute of Technology (MNIT), Allahabad -211004	Director, MNIT Allahabad, Phone: 0532 2271305, Fax: 0532 2545341	Testing and evaluation of cement (physical and chemical), aggregates (mechanical properties), fly ash (physical and chemical), admixtures, steel reinforcement water, mix design	In situ non-destructive testing (UPV) of concrete structures.
23	Govt Engineering College, Jalpaiguri (WB) -735102	Head Deptt of Civil Engg, Phone No: 03561256143	Testing and evaluation of cement (physical), aggregates (mechanical properties), water, mix design	
24	College of Engineering Pune -411005	Head Deptt of Civil Engg, Phone No: 02025507067, Fax: 02025507299	Testing and evaluation of cement (Physical & Chemical properties), fly ash (Physical & Chemical properties), aggregates (Mechanical properties except alkali aggregate reactivity & Petrography), water, admixtures, and mix design	
25	Maulana Azad National Institute of Technology, Bhopal (MP)	Head Deptt of Civil Engg, Phone No: 07554051390	Testing and evaluation of cement (physical), aggregates (mechanical properties), water, mix design	In situ non-destructive testing (UPV) of concrete structures and soil tests.
26	National Institute of	Head Deptt of Civil	Testing and evaluation of cement (physical),	In situ non-destructive testing (UPV)

LIST OF THIRD-PARTY LABORATORIES ACCEPTABLE FOR TESTING AND EVALUATION OF BUILDING MATERIALS

	Technology, Rourkela (Odisha)	Engg., Phone No: 06612462300	aggregates (mechanical properties), mix design,	of concrete structures and soil tests. Test on steel reinforcement, bricks and bitumen
27	Indian Institute of Technology (ISM), Dhanbad, Jharkhand	Department of Civil Engg., Dhanbad – 826004 Dr. Sarat Kumar Panda, Associate Professor Ph- 03262235091 M- 9570151300 Email id: sarat@iitism.ac.in	Testing of Soil, Building Materials & Road Materials, Concrete Design Mix	
28	National Institute of Technology (NIT), Jamshedpur, Jharkhand	Department of Civil Engg., Dr. Virendra Kumar, Associate Professor. M- 9431330642, 8340607039 Email id: kumarvirendra57@gmail.com Department of Mechanical Engg., Dr. Anil Kumar Prasad, Associate Professor & Principal Investigator Ph- 0657-2374056, M- 9835314761 Email id: akpradas.me@nitjsr.ac.in, anilnitj@yahoo.com	Testing of Soil, Building Materials & Road Materials, Concrete Design Mix, NDT of old structures, Rebound Hammer, Core Test of Concrete, UPV, Mini structure scanner etc. Reinforcement Rod testing, Weld Strength test etc.	

ANNEXURE – I

Format of Request Letter for Evaluation of Materials

Ref: _____

Date: _____

To,

Sub.: Evaluation of materials and concrete mix design

Dear Sir,

We have awarded the work of on M/s vide our LOA No. dated for execution of Civil Works. Based on provisions of contract, M/s are expected to get the following tests/ evaluation done through your laboratory and accordingly the tests have been described below.

M/s have been advised to deposit the requisite evaluation/ testing charges and to deliver the test samples of quantities, specified below.

1. Evaluation of Cement:

- a) To carry out different physical tests on cement samples i.e. Blaine's fineness, initial and final setting time, soundness and compressive strength at 3, 7 and 28 days as per IS: 4031 and drying shrinkage and specific gravity in case of PPC.
- b) To carry out chemical analysis of the cement samples as per IS: 4032, including the total alkali content of the cement (Na_2O equivalent).
- c) To advise the suitability of cement based on the test results of a) and b) above.

2. Evaluation of Aggregates:

- a) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material content (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials), soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 383 & IS: 2386.
- b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis, soundness, deleterious material content (coal & lignite, clay lumps, material finer than 75-micron sieve, soft fragment, shale, Total of % of all deleterious materials), silt content, organic impurities and mica content as per IS: 383 & IS: 2386.
- c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates to be used with the cement of 1) above.

3. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:

- a) To carry out petrographic analysis and Alkali-Aggregate Reactivity as per IS 2386 (PART VIII & VII).
- b) If rock type is limestone, X-Ray diffraction test (XRD) shall be carried out to determine clay mineral in the rock for preliminary conclusions and to carry out repeated temperature cycle test to determine residual expansion of aggregate for concrete to be used in dynamic foundations like TG, Fans, mills, crushers etc. Additionally, Alkali carbonate reactivity test may be carried out wherein the parameters shall be reported in conjunction with the petrographic analysis.
- c) To prepare a report based on test results of a) and b) above and to advise regarding suitability of aggregates to be used with the cement of 1) above and further testing required if any.

4. **Evaluation of Flyash Sample (if applicable):**
 - a) To carry out various physical and chemical tests on fly ash sample i.e. Blaine's fineness, lime reactivity, specific gravity, loss on ignition and other chemical tests as per IS: 3812, conforming to grade-I.
 - b) To advise the suitability of fly ash sample based on the test results of a) above.
5. **Evaluation of water:** To carry out various physical and chemical tests as per IS: 456 and IS:3025.
6. **Evaluation of admixtures:** To carry out various physical and chemical tests as per IS: 9103.
Note: Test certificate shall be obtained from the supplier to compare the values given in Table 2 of IS: 9103 i.e. uniformity tests and requirements.
7. **Concrete Mix Design:** Based on the provisions of technical specification, the Following may be specified by site Construction department/Quality department **
 - a) For RCC Work
 - i. Grade of concrete :
 - ii. Slump required, mm :
 - iii. Cement- Type and grade :
 - iv. Max Size of Aggregates, mm:
 - v. Exposure conditions :
 - vi. Maximum water-cement ratio:
 - vii. Minimum cement content :
 - viii. Concrete admixture to be used or not (If yes, specify the brand/type/batch no. of admixture) :
 - ix. Fly ash to be used or not (If yes, indicate % of fly ash to be used):
 - b) For PCC work: Same as i) to ix) of a) above
 - c) For piling work (if required): Same as i) to ix) of a) above
8. **Details of material sampled:** In order to facilitate the above mentioned tests, specified quantities of samples have been collected and sealed jointly (by Owner – Quality department, Execution department and contractors' representative) is being sent for testing. The impression of seal has also been punched below.
 - a) **Quantity of material required for each mix-design:**

Sl. No.	Material Description	Quantity Required
i)	Cement	2 bags (sealed in double polythene bags)
ii)	Coarse Aggregates	100 Kg of each fraction as explained below: e.g.; If Maximum size of aggregates (MSA) is 20mm, then 100 Kg each of 20-10mm and 10mm down are required. If MSA is 40mm then 100Kg each of 40-20mm, 20-10mm and 10mm down are required.
iii)	Fine Aggregates	200Kg
iv)	Chemical Admixtures	2 Litres
v)	Water	100 Litres
vi)	Fly ash (If decided to be used)	100Kg

b) Quantity of material required for Alkali-Aggregate reactivity

Sl. No.	Material Description	Quantity Required
i)	Coarse aggregate	
a)	80-40mm	60Kg
b)	40-20mm	60Kg
c)	20-10mm	60Kg
d)	<10mm	60Kg
ii)	Fine aggregates	60Kg
iii)	Cement	2 samples (1 bag each), contemplated for use in construction.

c) Impression/ Punch Mark of seal:

You are requested to kindly forward us the test reports along with the recommendations regarding the suitability of materials to us at the earliest.

Thanking you,

Yours faithfully,

Name:

Designation:

Contact Number:

Email ID:

(Quality department Representative of Owner)

Note:

1. Based on provisions of technical specification, the testing charges for all the above-mentioned tests shall be borne by the contractor.
2. The content of the letter is for guidance only, and if required may be suitably modified to suit the specific requirements of the package in consultation with Construction and quality department.

**** This line may be deleted in the letter sent to the institute.**

INDICATIVE FIELD QUALITY PLAN											Annexure II
SUPPLIERS NAME AND ADDRESS		ITEM : Civil Work		QP NO. :			PROJECT:	KAYAMKULAM			
		SUB-SYSTEM : GEOTECH INVESTIGATION, FOUNDATIONS, EXCAVATION & FILL, SITE LEVELLING, CONCRETE, ROAD, BUILDING ETC.		REV. NO. :			PACKAGE:	DEMONSTRATION OF METHANOL FIRING IN KAYAMKULAM GT			
				DATE :			CONTRACT NO. :				
				PAGE :			MAIN CONTRACTOR :				
Sl. No	Activity and operation	Characteristics / instruments		Class of check	Type of Check	Quantum Of check	Reference Document	Acceptance Norms	Format of Record	Remarks	
1	2	3		4	5	6	7	8	9	D*	
2	EXCAVATION, FILLING/BACKFILLING AND COMPACTION WORKS										
2.1	Excavations-										
i		Nature, type of soil/rock before and during excavations	As agreed / required	B	Visual/ Measurement	Random	Tech Specs and Const. Drawings/IS 1892	SR	√	GTI report to be referred. In case of ambiguity localised GTI may be carried out or excavation samples to be send to NTPC acceptable Third party lab for determination of soil/rock strata.	
ii		Initial ground level before start of excavations, shape, Dimensions of excavations & Side slope of final excavation and Final excavation levels.	As agreed / required	B	Measurement	100%	Tech Specs and Const. Drawings	SR	√		
2.2	Excavation in Hard Rock- If required										
i		Receipt, Storage, accountability of Explosive	As agreed / required	B	Physical	Random in each week	Indian Explosive Act 1940/all statutory norms, Tech Specs and Const. Drawings	SR	√	Owner approved specialist blasting agency such as CMRI, NIRM shall be deployed at site for trial blasts, design blasts, blast	
ii		Execution of Blasting Operation	As agreed / required	B	Physical	Random in each shift	IS:4081, Tech Specs and Const. Drawings/	SR		vibration monitoring etc. Seismographs shall be deployed at site for monitoring of blast operation vibrations.	
iii		Submission of Blasting report to EIC	As agreed / required	B	Physical	Each blast	Tech Specs and Const. Drawings		√		
iv		Excavation in Hard Rock (Blasting Prohibited)	As agreed / required	B	Physical	100%	As per approved drawing/ scheme, Tech Specs and Const. Drawings	SR	√		
2.3	Filling/ Backfilling										
i	Suitability of fill material	Grain size analysis, Organic Matter, Liquid Limit, plastic limit, Shrinkage limit & Free Swell Index and chemical analysis(like Organic Matter, Calcium carbonate, pH value, Total soluble sulphate etc.) as required in TS	As per IS: 2720	B	Physical	Once per each type of source or change of source subject to a min. of 2 samples	IS:2720 (Pt.IV), IS:2720 Pt.XXII, IS:2720 (Pt.XI)/relevant part, Tech Specs and Const. Drawings	SR/TR	√	Test report along with the recommendations regarding suitability of the fill material from NTPC acceptable laboratories to be submitted to EIC for review and acceptance. Geo technical investigation report may also be considered as basis for suitability of fill material if available as per the discretion of EIC.	
2.4	Standard proctor Test	Optimum moisture content (OMC) and max. dry density (MDD) of filling/backfilling materials	As per IS: 2720	A	Physical	One in every 10000 cum for each type and source of fill materials	IS 2720 (Pt.VII), Tech Specs and Const. Drawings	SR/TR	√		
2.5	Compaction of Filling / Backfilling Works										
i	Moisture content	Moisture content of fill before compaction	As per IS: 2720	B	Physical	Random	IS 2720 (Pt.II), Tech Specs and Const. Drawings	SR/TR	√		
ii		Dry density by core cutter method ---- OR ---- Dry density in place by sand replacement method ---- OR ---- any other method as per IS 2720	As per IS: 2720	A	Physical	i) For foundation back fill: one in every 10 foundations for each compacted layer. ii) For area filling: every 1000 SQM area for each compacted layer.	IS 2720 (Pt. XXIX)/ IS 2720 (Pt. XXVII)/ IS 2720 Relevant Part/ Tech Specs and Const. Drawings	SR / TR	√	Number of readings for field density test may be decided by EIC according to the size of the soil bed which is subject to testing as the dry density of the soil varies appreciably from point to point. However, in no case, readings should be less than three as compaction result drawn out of less than three readings may give erroneous result.	
iii		Relative density (Density Index)	As per IS: 2720	A	Physical	----do---- (I) & (ii) above	IS 2720 (Pt. XIV), Tech Specs and Const. Drawings	SR/TR	√		
3	RAW MATERIALS FOR CONCRETE										
3.1	CEMENT										
i	Material	Physical and chemical properties as per relevant IS codes	As required/ agreed	A	Review of MTC/ test reports	for each manufacturing Week number	IS : 269/ IS:1489/ IS:455, Tech Specs and Const. Drawings	MTC	√	To be procured from BIS approved source having valid BIS License. Each consignment of cement shall be duly correlated with manufacturers' TC.	
ii		Testing of cement for Setting time (Initial & Final) and compressive strength	As per IS:4031	A	Physical	one for each manufacturing Week number	IS : 269/ IS:1489/ IS:455, Tech Specs and Const. Drawings	SR/Test Report	√	Additionally, If the cement is stored more than 90 days in godown of contractor then the same shall be retested for Setting time & Comp. Strength.	


3.1 b	Fly ash (if applicable)								
		Physical and chemical properties as per IS 3812 Part I (Table 1 and 2)	As per IS 3812 Part I	A	Physical	once in a week or change of source whichever is earlier	IS:3812 Part I and Tech. Spec./Design mix.	SR/Test Report	✓ Batching plant shall have facility for mixing of fly ash.
3.2	Coarse Aggregate								
i		Moisture content	IS:2386	B	Physical	To be done every day before start of work	IS : 456/IS : 383/IS: 2386 Part-III/Tech Spec	SR/LB	✓ During monsoon, frequency may be increased and accordingly water content in concrete will be adjusted.
ii		Sieve analysis, flakiness index, elongation index	IS:2386	B	Physical	One per 100 cum. or part thereof	IS: 2386 Part-I, IS:383 / Tech Spec	SR/LB/TR	✓
iii		Specific gravity, Soundness, Water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials),	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS: 2386 Part-II, IS: 2386 Part-V, IS:456, IS:383/Tech Spec	SR/LB/ TR	✓
iv		Alkali aggregate reactivity and Petrographic examination	IS 2386	A	Physical	Once for each source & for every change of source.	IS: 2386 (Part-VII/III), IS:383 Spec/ASTM C-1260 / ASTM 1293 /Tech	SR/LB/ TR	✓ During Design mix, these tests to be carried out
v		Crushing value, Abrasion value and Impact value	IS:2386	A	Physical	Once for each source & for every change of source	IS:383, IS-2386 Part IV/Tech Spec	SR/LB/ TR	✓
3.3	Fine Aggregate								
i		Moisture content	IS:2386	B	Physical	To be done every day before start of work	IS : 456/IS : 383/IS: 2386 Part-III/Tech Spec	SR/LB	✓ During monsoon, frequency may be increased and accordingly water content in concrete will be adjusted.
ii		Sieve analysis, Silt content	As agreed / required	B	Physical	One per 100 cum. or part thereof	Tech Spec/ IS 2386 / IS 456/ IS 383	SR/LB/ TR	✓
iii		Specific gravity, Soundness, Water absorption, Deleterious materials (coal & lignite, clay lumps, material finer than 75 micron sieve, soft fragment, shale, Total of % of all deleterious materials (excluded mica as well as included mica content)), organic impurities	IS:2386	A	Physical	Once for each source & for every change of source	IS: 2386 Part-III, IS: 2386 Part-II, IS: 2386 Part-V, IS:456, IS:383/Tech Spec	SR/LB/ TR	✓ During Design mix, these tests to be carried out
iv		Alkali aggregate reactivity and Petrographic examination	IS 2386	A	Physical	-do-	IS: 2386 (Part-VII/III), IS:383 Spec/ASTM C-1260 / ASTM 1293 /Tech	SR/LB/ TR	✓
3.4	Water	Complete Testing as per IS:456-2000	As per IS:456	B	Testing	Once for each source and thereafter yearly in case of borewell. If water is used from open source like river, stream, canal etc., then water testing is to be done quarterly.	IS:456-2000/ Tech. spec.	TR	✓
3.5	Admixtures for Concrete	Material/Type of admixture and its suitability	As per IS:9103	A	Review of MTC/ test reports	For each lot received at site	As per Designed mix and IS:9103/ Tech. Spec.	Test Report/ MTC	✓ Random sample may be send to Owner acceptable third party testing lab. for testing requirements as per TS and IS codes. Frequency of check may be decided by EIC/Head FQA based on quantity, requirement and Relevant IS code.
4	CONCRETING (MIXING, CONVEYING, PLACEMENT, COMPACTION, CURING & TESTING)								
4.1	Batching Plant (if installed)								
i		Calibration of Batching Plant		A	Physical	After initial setting up of batching plant, calibration by NABL accredited agency must be done before use of batching plant for production of concrete.	Review of calibration chart/ Certificate/IS 4925	Calibration Certificate	✓ Additionally, Batching Plant shall be calibrated regularly at least once in a 3 months in-house. The weights for batching plant calibration to be calibrated once in year by NPL/NABL accredited lab./Weights & Measures Dept.
4.2	CONCRETE								
i)		Design Mix.	As per IS 456	A	Physical	Before the start of the work	Tech. Spec., IS 456	TR	✓ Design mix will be carried out at the start of the work with all tests as per Annexure I.


i		4 Trial mixes to ascertain the workability and cube strength	After receiving the recommended design	A	Physical	4 trial mix for each mix proportion as per IS 10262	Tech. Spec., IS 456/IS 10262	SR/LB	✓	The concrete for field trials shall be produced by methods of actual concrete production. (Initially Baby/mini mixture may be used till the installation of Batching Plant at site).
ii		Concrete Cube strength Test	IS:516	A	Physical	As per IS 456 clause 15.2.2	IS:516, IS:456, Tech. Spec.	SR/LB/ TR	✓	Min. of 6 cubes for each mix, 3 specimen shall be tested at 7 days & remaining 3 shall be for 28 days Comp. Strength. <i>Quantity of Concrete in the Work, m³</i> 1 - 5 1 6 - 15 2 16 - 30 3 31 - 50 4 51 and above 4 plus one additional sample for each additional 50 m³ or part thereof <i>NOTE—At least one sample shall be taken from each shift.</i>
iii		Workability - slump test	IS:1199	B	Physical	At the time of concrete pouring at site every two hrs.	IS:456/Tech. Spec.	SR/LB/ TR	✓	
iv		Temperature Control of Concrete as per Tech. spec./IS standard	Thermometer	B	Physical	100%	Temperature as per technical specification/Relevant standard	SR	✓	
v		Water Cement Ratio		B	Physical	For each batch of concrete	As per approved Design Mix	SR/Batch slip	✓	
vi		Placement of concrete, Compacting, Curing	As required	B	Physical	At Random	IS:456, Period of curing as per IS 456	SR		
4.3	TESTS / CHECKS ON RCC STRUCTURE IN HARDEDDED CONDITION									
i		Visual inspection of concrete surface just after removal of shuttering	As agreed / required	B	Visual	100%	As per IS:456/ tech. Specification.	SR		
ii		Dimensional check on finished structures	As agreed / required	B	Measurement	100%	As per IS:456/ tech. Specification and Const. Drawings	SR/LB	✓	
iii		Position and alignment of embedded parts and inserts	As agreed / required	B	Visual	100%	As per provisions and tolerances of equipment supplier, Tech Specs and Const. Drawings			
iv		Embedment of inserts in concrete shall be checked for gap if any using hammer for all dynamic foundations	As agreed / required	B	Physical	100%	As per Technical Specification	SR	✓	No hollow sound
v		Submission of grouting / repair methodology to EIC for approval if concrete surface / position and alignment of embedded parts / inserts are found defective	--	B	Review and approval	once for each type of defect	As per provisions and tolerances, Tech Specs and Const. Drawings		✓	
vi		UPV Tests on top deck of TG foundation, Columns & Other Foundations as per Technical Spec.	IS : 516	A	Physical	As per Tech. Spec.	IS : 516/ As per Technical Specification	Test Report	✓	
vii		Core Test	IS:516	A	Physical	As required by Owner EIC.	As per IS:456, IS 516	SR/LB/ TR	✓	Compressive strength based on core test is required to be carried out in case of doubt regarding the grade of concrete used, either due to poor workmanship or based on the results of cube strength test as per 4.2 ii) above and as per discretion of EIC.
viii		Water Tightness Test of liquid retaining structure/ tanks	As required	A	Test	100%	IS:3370/ Tech. Specification	SR/LB	✓	
5	REINFORCEMENT STEEL AND ITS PLACEMENT									
i	Material	Physical and chemical properties as per relevant IS codes and Tech spec.	As agreed/required	A	Review of MTC	Each batch/lot of delivery	As per IS 1786, IS 432, IS 1566, IS 13920 , Tech spec and cont. drawing	MTC	✓	To be procured from Owner approved source.
	Coupler	Physical and chemical properties as per relevant IS codes and Tech spec.	As agreed/required	A	Review of MTC	Each batch/lot of delivery	IS 16172, Tech spec and cont. drawing	MTC	✓	MTC shall contain all the parameters specified in the technical specifications
ii		Freedom from cracks surface flaws, Lamination & excessive rust.	As agreed / required	B	Visual	Random in each shift	IS: 1852, IS:432, IS:1786, Tech Specs and Const. Drawings	SR		To be checked at site. Steel collected from source should be free from excessive rust. To be stored as per Technical Specs.
iii		Bar bending schedule with necessary lap, Spacers & Chairs	As agreed / required	B	Physical & Measurement	Random in each shift	Approved Drawings, Tech Specs and Const. Drawings, IS:2502	SR	✓	
iv		Acceptance - disposition of cage w.r.t. reference axes, cover, spacing of bars, spacers and chairs after the reinforcement cage is put inside the formwork	Measuring tape & as required	B	Visual & Measurement	Random in each shift*	IS 456, Tech Specs and Const. Drawings	SR	✓	* for foundations, frequency shall be Each foundation

6	FOUNDATION SYSTEM								
i		Foundation casting - Layout, Shape, dimensions, Reinforcement, concreting, curing etc.	As required / agreed	B	Physical	Each foundation	As per technical specifications and construction drawings	SR	√ lines and levels to be checked. Concrete Grade to be checked as per Mix Design
7	STAGING AND FORMS								
i		Materials and accessories	As agreed / required	B	Visual	Once before start of work	As per relevant IS, Tech Specs and Const. Drawings	SR	
ii		Soundness of staging, shuttering and scaffolding including application of mould oil / release agent	As agreed / required	B	Visual	Once before start of work	As per manufacturer's spec. and as per 3696, 4014, 4990, Tech Specs and Const. Drawings	SR	
iii		Acceptance of formwork before start of concreting : disposition w.r.t. reference axes, size, etc.	Measuring tape & as required	B	Physical / visual	Before start of each concreting	As per provisions and tolerances in IS 456, Tech Specs and Const. Drawings	SR	√
9	EMBEDDED PARTS (INCLUDING LAYING OF RAILS & ANCHOR FASTENERS) -If Applicable.								
i		Material	As agreed / required	B	Review of MTC/ test reports	Each batch/lot of delivery	As per Tech Specs and Const. Drawings	SR/MTC	√
i		Position / alignment / levels of embedded parts / bolt hole / pipe sleeves / rails / PVC pipes / etc. as per TS and construction Drg.	As agreed / required	B	Physical/ measurement	100%	As per Tech Specs and Const. Drawings	SR/ Protocol	√ Exposed surface of the embedded parts other than holding down bolts are to be painted with as per technical specifications.
ii		Welding / tying of embedment to reinforcement	As agreed / required	B	Physical/ measurement	Random in each shift	As per Tech Specs and Const. Drawings	SR	
10	JOINTS IN CONCRETE, DAMP PROOF COURSE								
i	JOINTS IN CONCRETE	Joint material - bitumen impregnated fibre board, PVC water stops, Sealing compound, Expanded polystyrene board, Hydrophilic strip, Acrylic polymer etc. (as given in technical spec)	As per manufacturer Standards	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings, IS 1838, IS 1834, IS 12200	SR/MTC	√
ii	DAMP PROOF COURSE	Material - Hot bitumen and water proofing materials etc. (as given in technical spec).	As agreed / required	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings, IS 702	SR/MTC	√
iii		Acceptance of installation of Joints material & Acceptance of damp proof course.	As agreed / required	B	Acceptance	Each installation randomly	Tech Specs and Const. Drawings		√
11	GROUTING								
i		Material	As agreed / required	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR/MTC	√
ii		Compressive strength of grouting material before its use.	As agreed / required	A	Physical	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR/LB/ TR	√
iii		Compressive strength of cubes after grouting.	As agreed / required	A	Physical	Random	Tech Specs and Const. Drawings	SR/LB/ TR	√
iv		Acceptance of the grouts : Mixing, placement, application and grout pressure (as applicable)	As agreed / required	B	Physical	Each grout section	Tech Specs and Const. Drawings	SR	√
12	MASONRY WORKS								
12.1	Test on Bricks								
i		Compressive strength, water absorption, efflorescence.	As agreed / required	A	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS: 13757, IS: 12894 / Tech Specs and const. Drawings	SR/LB/ TR	√
ii		Dimensions , shape, warpage.	As agreed / required	B	Measurement/ Physical Test	As per relevant IS Code/ One Sample for 30,000 nos. or part thereof	IS: 1077, IS: 13757, IS: 12894 / Tech Specs and const. Drawings	SR/LB	√ Warpage test is applicable for facing bricks only as per IS:2691.
12.2	Modular aerated panel								
i	Material	As required	As agreed / required	A	Review of test report	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR/LR	√
12.3	Autoclaved Aerated Concrete (AAC) block								
i		Material	As agreed / required	B	Review of MTC	Each batch/lot of delivery	Tech Specs /IS 2185 Part III and Const. Drawings	SR/MTC	√
ii		Compressive Strength and Density	As agreed / required	A	Physical	As per relevant IS Code/ One Sample for 10,000 nos. or part thereof	Tech Specs /IS 2185 Part III	TR	√
iii		Dimensions, shape	As agreed / required	B	Physical	As per relevant IS Code/ One	Tech Specs /IS 2185 Part III	TR/SR	√
12.4	Test on Mortar								
i	Sand	Grading	As agreed / required	B	Test	once per 100 Cum or part thereof	IS:2116	SR/LB	√
ii		Compressive strength	As agreed / required	B	Test	At random	IS 2250-1981, Tech Specs and Const. Drawings	SR/TR	√
12.5	Masonry construction								
		Workmanship, verticality and alignment	As agreed / required	B	Visual/ Physical	100%	IS 2212, IS 1905 , Tech Specs and Const. Drawings	SR/LB	

13	PLASTERING- MATERIAL AND WORKMANSHIP									
i	Sand	Deleterious Material	As agreed / required	B	Physical	Once per source	IS : 2386 (Part-I & II) & IS :2116, Tech Specs and	SR/TR	✓	
ii		Grading	As agreed / required	B	Physical	50 Cum./or part thereof	Tech Specs and Const. Drawings	SR/TR	✓	
iii		Silt content	As agreed / required	B	Physical	One per 100 cum., or part thereof	CPWD/ Tech Spec/ IS 2386/ IS 456/ IS 383	SR/LB/ TR	✓	
iv	Stone grit plaster/ granular textured coat finish (if applicable)	Material	As agreed / required	B	Review of MTC	For each lot received at site	Tech Specs and Const. Drawings	SR/MTC	✓	
v	Galvanised wire mesh (if applicable)	Galvanized hexagonal wire netting for lath plastering	As agreed / required	B	Review of MTC/ test reports	Each batch/lot of delivery at site	Tech Specs and Const. Drawings	SR/MTC	✓	
vi		Thickness, Trueness and finishing of plaster, grooves etc.	As agreed / required	B	Visual/ Measurement	Random in each shift	Tech Specs and Const. Drawings	SR/LB	✓	
14	PAINTING SYSTEM - CONCRETE WORKS AND PLASTERED MASONARY SURFACES									
i	Materials and accessories- Oil Bound, Acrylic Emulsion, Chemical Resistant, Oil Resistant Paint etc. as applicable (as given in technical spec).	Shade, type from brand and manufacturer as approved by EIC.	As agreed / required	A	Review of MTC/ test reports	Each batch/lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	
ii	Surface preparation	As required	As agreed / required	B	Physical / visual	Random in each shift	Tech Specs and Const. Drawings	SR		
iii	Acceptance of painted surfaces	Shade, finish, WFT	As agreed / required	B	Physical/visual	Each surface at random	Tech Specs and Const. Drawings	SR	✓	
14.2	PAINTING SYSTEM - STEEL WORKS (OTHER THAN STRUCTURAL STEEL WORKS)									
i		Painting Materials and accessories	-	A	Review of MTC/ test reports	Each batch of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	
ii		Surface preparation	As agreed / required	B	Physical / visual	Each Erection Mark	Tech Specs and Const. Drawings, Relevant code/ standards	SR	✓	
iii		Primer Thickness	Elcometer	B	Measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓	
v		Acceptance of painted surfaces : DFT, Finish, Shade	Elcometer	B	Visual and measurement	Each Erection Mark	Tech Specs and Const. Drawings	SR	✓	
17	WATER PROOFING (Roof / Basement Treatment)									
i		Methodology for the application of water proofing system	As required	B	Review	for each type of treatment	Tech Specs and Const. Drawings	SR	✓	
ii	Graded under bed	Levels / slopes	As required	C	Physical	100%	Tech Specs and Const. Drawings			
iii	Elastomeric coatings	Material- Primer coat, finishing coat	As required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	MTC shall contain all the parameters specified in the technical specifications
iv	Wearing course	Materials - As per tech spec.	As required	B	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	MTC shall contain all the parameters specified in the technical specifications
v		Acceptance of water proofing work	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings			
18	Fencing and Gates									
i	PVC coated chain link fencing (IS 2720), Welded wire mesh (IS 1566), Reinforced barbed tape galvanised (IS 2629) etc.	Materials	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	MTC shall contain all the parameters specified in the technical specifications
ii	Structural steel, painting system, caster wheel, ball and bearing, fixtures and fasteners	Materials	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	MTC shall contain all the parameters specified in the technical specifications
iii		Alignments, erection painting, DFT etc. and acceptance of the installation and working	As agreed / required	B	Physical / measurements	Each installation	Tech Specs and Const. Drawings	SR	✓	
19	FLOOR FINISHES AND ALIED WORKS									
i	Cement Concrete Flooring	Glass/ PVC strips in joints	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings	SR		
ii	Ceramic tiles, vitrified tiles, glass mosaic, acid alkali resistant tiles, heavy duty cement concrete tiles (Materials as per TS)	Materials	As agreed / required	B	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	MTC shall contain all the parameters specified in the technical specifications. In case non-availability of MTC, sample to be tested as per relevant IS code.
iii	Interlocking Blocks	Materials	As agreed / required	A	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/MTC	✓	MTC shall contain all the parameters specified in the technical specifications
iv	Kota Stone, Granite and Marble	Materials: Quality, texture, thickness, colour for each lot of delivery	As agreed / required	B	Physical	Each lot of delivery	Tech Specs/ BOQ and Const. Drawings	SR/TR	✓	
v	Metallic / non-metallic hardener	Material	As agreed / required	B	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings	SR/TR/MTC	✓	
vii	Acid / alkali and oil resistant high built seamless epoxy based resin and treatment	Material	As agreed / required	A	Review of MTC / test reports	Each lot of delivery	Tech Specs and Const. Drawings	TR/MTC	✓	work to be done by skilled manpower
		Surface preparation (as applicable)	As agreed / required	B	Physical	Random in each shift	Tech Specs and Const. Drawings, IS 2395			

viii	Rubber Flooring	Material	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	Tech Specs and Const. Drawings / IS 809	TR/MTC	√	MTC shall contain all the parameters specified in the technical specifications
ix		Finishing and acceptance of all above BOI	As agreed / required	B	Physical	100%	Tech Specs and Const. Drawings	SR		
21.0 SPECIAL ITEMS										
21.1 Earthing Mat (Grounding System)										
i	Material (As per TS)	Earthing mat	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	As per relevant IS and Tech. Specs / Manufacturer's, IS 3043	SR/TR/MT C	√	
ii		Weld sizes & length	Visual/Tape	B	Visual/ Measurement	100%	Tech Specs and Const. Drawings			Owner approved electrodes shall be used
iii		D P test	DP test Kit	A	Physical	10% at random of the offered lot	Tech Specs and Const. Drawings	TR	√	
iv		Earth test	Earthing test kit	A	Physical	100%	Tech Specs and Const. Drawings,	SR/TR	√	
21.2 Bitumen layer for tank foundation										
i	Material (As per TS)	Grade of bitumen	As agreed / required	A	Review of MTC/ test reports	Each lot of delivery	As per relevant IS and Tech. Specs /MTC	SR/MTC	√	APPROVED SOURCE FOR MATERIAL PROCUREMENT SHALL BE ALL GOVERNMENT REFINARIES
ii	Acceptance and workmanship	Application / workmanship	As agreed / required	B	Physical	Random	Tech Specs and Const. Drawings	SR		
23 PILING WORK (If Applicable)										
23.1 Execution										
i		Borehole diameter	As required	B	Physical	100%	As per appd. Drawings and technical specification	SR/LB	√	
ii		Pile layout	Total station	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√	
iii		Recording ground level and pile termination level	As required	B	Measurement	Random	As per appd. Drawings and technical specification	SR/LB	√	
iv		Cleaning/Flushing of pile bore	As required	B	Measurement	Each pile	IS 2911/ Tech. Specs.	SR/LB	√	
v		Size of bore and During boring of pile record commencement of SPT/ core recovery to ensure socketing length equivalent in terms of the Diameter of the pile below the socketing horizon.(if applicable)	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√	
vi		Pouring of concrete to project above cut off level.	As required	B	Measurement	100%	As per appd. Drawings and technical specification	SR/LB	√	
23.2 Testing										
i		Bentonite	IS:2720	A	Physical / Test report	Once per lot	As per IS:2720, IS 2911/ tech. Specs.	MTC/TR	√	One sample from each source (brand/manufacturer) to be tested at Owner acceptable third party lab.
ii		Density check on sample of mud collected from pile bore bottom	IS 2911	B/A	Physical	Each pile/ Randomly 1 in 10 piles (i.e. 10%)	IS 2911/ Tech. Specs./approved PILING METHODOLOGY	SR/LB	√	Tests to be done before placing of concrete.
ii		Slump test of concrete	IS:1199	B	Physical	Every 2 hrs at pouring point of concrete	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√	
iii		Concrete Cube strength Test	IS:456	A	Physical	One set of 6 cubes per 50 Cum or part thereof for each grade of concrete per shift whichever is earlier.	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√	
iv		Initial pile load test, Vertical (Compression), Lateral (horizontal) and pull-out (tension).	IS:2911 / as required	A	Testing	As per Technical Specification/IS standard	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√	
v		Routine pile tests (VERTICAL LOAD TEST (COMPRESSION) and LATERAL LOAD TEST (horizontal))	IS:2911 / as required	A	Testing	As per Technical Specification/IS standard	IS:2911, As per appd. Drawings and technical specification	SR/LB/TR	√	
vi		Pile Integrity Tests (PIT)	PEM / as required	A	Testing	100%	IS:2911, As per appd. Drawings and technical specification and suppliers manual	Test Report	√	

22.0 GEOTECHNICAL INVESTIGATION WORK										
i		Deployment of Owner approved Geotechnical Investigation Agency - Equipment, Manpower etc.	As required / agreed	B	Physical	Once before commencement of work	As per technical specifications and relevant IS Codes	SR	√	
ii		Execution of Geotechnical Investigation - locations, type etc. as per scheme	As required / agreed	B	Physical	Each Location	As per technical specifications , approved drawing and relevant IS Codes	SR	√	
iii		Collection of disturbed and undisturbed samples , their packing and storage	As required / agreed	B	Physical	each sampling	As per technical specifications , approved drawing and relevant IS Codes	SR		
iv		Conducting filed tests as per investigation scheme- such as, SPT/ERT/SCPT/PLT/PMT etc. if applicable	As required / agreed	B	Physical	each field test	As per technical specifications , approved drawing and relevant IS Codes	SR	√	
v		Submission of Owner approved Final Geotechnical investigation report along with recommendations.	As required / agreed	B	Physical	After completion of investigation work	As per technical specifications and relevant IS Codes	-	√	
<p>LEGENDS :</p> <p>* Records identified with tick (√) shall be essentially included by supplier in QA documentation.</p> <p># Class A : Critical, Class B : Major, Class C : Minor.</p> <p>Class 'A' checks shall be witnessed by Owner FQA and Execution Engineer, Class 'B' checks shall be witnessed by Owner Execution Engineer, Class 'C' checks shall be witnessed by Main contractor engineer. CLASS 'A' & 'B' CHECKS SHALL BE NTPC CHP STAGE.</p> <p>SR - Site Register, TR- Test Report, LB-Log Book, IR - Inspection Report, MTC - Manufacturer's Test Certificate.</p> <p>Surveillance of Class 'A' checks shall be perform By Owner Head (FQA), Class 'B' by Owner FQA Engineer and for class 'C' Another Executing Engineer authorised by Head (Executing Deptt).</p> <p>Note: Any non conformity/ deviation to the Quality plan must be brought to notice of NTPC/Owner.</p> <p>Dispositioning authority shall be the authorised representative of NTPC/Owner as per NTPC FQA system manual</p>							For Owner Use	Owner DOC NO. :		
							 A Maharatna Company			
								REVIEWED BY	APPROVE D BY	APPROVAL SEAL

	PROJECT: KAYAMKULAM	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL			DOC NO	
	PACKAGE: DEMONSTRATION OF METHANOL FIRING IN KAYAMKULAM GT				REV. NO.	
	Main supplier:	SUB SYSTEM: CIVIL WORKS			DATE	
	Contract No.:					
SL. NO.	ITEM	QAP / INSP. CAT	PROPOSED SUB SUPPLIER	PLACE OF MANUFACTURING	APPROVAL STATUS / CATEGORY	REMARKS
1.	REINFORCEMENT STEEL	III	STEEL AUTHORITY OF INDIA LTD. (SAIL)	INDIA	A	
			JINDAL STEEL & POWER Ltd. (JSPL)	INDIA	A	
			TATA STEEL LIMITED.	INDIA	A	
			RASHTRIYA ISPAT NIGAM LTD. (RINL)	INDIA	A	
			JSW STEEL LTD.	INDIA	A	
			ESL STEEL LTD.	INDIA	A	
			JSW ISPAT SPECIAL PRODUCTS LTD.	INDIA	A	
2.	CEMENT	III	BIS APPROVED SOURCES HAVING VALID BIS LICENCE	-	-	
3.	CONSTRUCTION CHEMICALS/ADMIXTURE, WATER PROOFING COMPOUNDS AND GROUTS	III	MAIN CONTRACTOR APPROVED SOURCE	-	-	
4.	PAINT AND PAINTING SYSTEM	III	MAIN CONTRACTOR APPROVED SOURCE	-	-	
5.	FOUNDATION BOLTS	III	MAIN CONTRACTOR APPROVED SOURCE	-	-	

LEGENDS:

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY NTPC)

A – For these items proposed vendor is acceptable to NTPC. To be indicated with letter “A” in the list along with the condition of approval, if any.

DR – For these items “Details required” for NTPC review. To be identified with letter “DR” in the list.

2. QP/INSPN CATEGORY:

CAT-I: For these items the Quality Plans are approved by NTPC and the final acceptance will be on physical inspection witness by NTPC.

CAT-II: For these items the Quality Plans approved by NTPC. However, no physical inspection shall be done by NTPC. The final acceptance by NTPC shall be on the basis review of documents as per approved quality plan.

CAT-III: For these items the Quality control to be exercised as per Main Contractor Quality Assurance System. The final acceptance by NTPC shall be on the basis of Certificate of conformance (COC) by Main Contractor.

UNITS/ WORKS: Place of manufacturing Place of Main Supplier of multi units/works.

NOTE 1: For the items placed in CAT-III for Civil Works, the review and final acceptance shall be done by NTPC-EIC/ FQA on the basis of MTC / certificate of conformance in line with Technical Specifications/FQP.