NABINAGAR POWER GENERATING CORPORATION LIMITED

3 X 660 MW NABINAGAR STPP

TECHNICAL SPECIFICATION
FOR
MISCELLANEOUS FGD TANKS

SPECIFICATION NO.: PE-TS-457-167-A102

BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, INDIA

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INTENT OF SPECIFICATION

1.0 **SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION**

1.1 This specification includes, but not limited to Supply part, Services part comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles(as applicable) along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, Rubber lining, final painting at site, minor civil work and carrying out Performance guarantee / Functional / Demonstration tests at site (as applicable) and handover in flawless condition of Miscellaneous FGD Tanks turnkey package specified above for **3X660 MW NABINAGAR FGD Project** complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order.

1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee/demonstration testing of **Miscellaneous FGD Tanks** within quoted price.

1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment / system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.

1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded and notwithstanding that they may have been omitted in drawings / specifications or schedules.

1.5 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.

1.6 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are hereby made part of the tender specifications. The equipment / material and works covered by this specification is subject to compliance to all the attachments referred in the specification. The tenderer shall be responsible for adherence to all requirements stipulated herein.

1.7 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Sec.-III of the specification within 10 days

of receipt of tender documents. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.

1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.

1.11 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.

1.12 BHEL's Customer's representative shall be given full access to the shop in which the equipment's are being manufactured or tested and all test records shall be made available to him.

1.13 Various codes and standards to be used shall be as indicated in various parts of the specification. In case bidder uses any standard other than those indicated in the specification, the onus of establishing equivalence of the same with the specified standards will rest with the bidder and acceptance of the same shall be sole prerogative of customer. The bidder will also arrange for BHEL a copy of the standards in ENGLISH language. The cost of such service will be deemed to have been included by the bidder in the total cost of the package. BHEL will not entertain any additional cost on account of the same.

1.14 All text/ numeric in the document / drawings to be generated by the successful bidder will be in English language only.

1.15 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

Note:

Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link (http://dmsserver.bhelpem.com/Wrench%20Web%20Access/Login.aspx.).

PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

CLAUSE NO.	PROJECT INFORMATION
1.00.00	**BACKGROUND** A Joint Venture Agreement was signed between NTPC and BSEB/ Govt. of Bihar on 14.02.2008 for Establishment and Operation & Maintenance of 3x660 MW capacity coal based thermal power project near Nabinagar Distt Aurangabad Bihar and thereafter a Joint Venture company namely, Nabinagar Power Generating Company Private Limited (NPGCPL) was incorporated with equity structure of 50% each by NTPC and BSEB on 09.09.2008.The project shall be a mega project and shall be implemented during XII Plan period.
1.01.00	**Location** The plant is located in Aurangabad district of Bihar at a distance of about 15 kms. from Barun in Aurangabad district of Bihar and is approachable from NH-2 through a 20 kms (approx.) long single lane metalled road. The Aurangabad city is about 55 kms. from project site. Nearest railway station is Ankorha on Sone – Garwa Road Section of Eastern Central Railway at about 1.0 Kms. from the project site. **Airport** The nearest airport at Gaya is at a distance of about 120 Kms from project site. The distances of site from Patna Airport and Varansi Airport are about 250 Kms & 220 Kms respectively. Vicinity plan of the proposed project is placed at **Annexure -I**
1.02.01	**Land** About 2500 acres of land required for the project (main plant, township, ash disposal areas and corridors etc.) has been identified. Govt. of Bihar have accorded in-principle clearance for availability of land vide letter dated 15.06.2007 and 27.02.2009.
1.02.02	**Coal** Coal requirement for the project is estimated about 11.25 million tonnes/annum corresponding to 90% PLF. Likely coal source for the project is North Karanpura coalfields of CCL. Application for Long Term Coal Linkage has been submitted to Ministry of Coal, Govt. of India on 21.06.2007 & 06.10.2008.
1.02.03	**Water** The project site is located near the river Sone and the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage on river Son, which is about 3 kms from the proposed site. Make up water requirement for this project would be about 7550 Cu.M/hr with ash water recirculation system and about 8480 Cu.M/hr with once through ash water system.

CLAUSE NO.	PROJECT INFORMATION
	Govt. of Bihar has accorded water commitment for availability of 125 cusecs of water vide letter dated 06.06.2007.
1.03.00	**Railway Siding** Employer intends to construct the Railway siding to project site from the nearest existing railway line. However, the same may not be available to the bidder for his use to transport equipment & material. Bidder may visit the site and acquaint themselves with the facilities available.
1.04.00	(i) **Coal Quality Parameters / Fuel Oil Characteristics & Plant Water details:** The coal quality parameters and Fuel oil Characteristics are indicated in Table-1 & Table-2A & 2B resp. below. **Water data** (ii) Process water: Source: Terminal point: Process water quality is based on COC given in Table-3. (iii) Clarified water: Terminal point: Clarified water quality is indicated in Table-3. (iv) DM water for Equipment cooling water system. Terminal point: DM water quality is indicated in Table-4.
1.05.00	**Steam Generator and ESP data**: refer Table-5.
1.06.00	Drawings are enclosed as per **Table-6** for initial overview to the Bidder.
2.00.00	NOT USED
3.00.00	**Capacity** : 3 x 660 MW
4.00.00	**Metrological Data** Important meteorological data from nearest observatory at Dehri is placed at Annexure -II.
5.00.00	**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 finalization

of Part 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 the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-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 Appendix-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 to 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 (Part 1).

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 ($\bar{V}_B$) 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 $\bar{V}_B$/ V_B. However, no reduction is permitted if $\bar{V}_B$ is less than V_B.

For regular buildings less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS:1893 (Part 1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (Ah) shall be computed for the fundamental natural period as per clause 7.6 of IS:1893 (Part 1) using site specific spectral acceleration coefficients with appropriate multiplying factor given in Appendix-I.

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.

APPENDIX – I

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 : 0.16g

2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra

a) for ordinary moment resisting steel frames designed and detailed as per IS:800 : 0.04

b) for braced steel frames designed and detailed as per IS:800 : 0.03

c) for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024

d) For RCC chimney : 0.08

e) For Liquid retaining tanks : 0.048

d) for Steel chimney and Absorber tower : 0.06

d) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below : 0.04

3) Multiplying factor to be applied to the site specific 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.

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for **BRBCL** project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.050	1.750	1.607	1.443
0.100	3.737	3.060	2.374
0.104	3.904	3.174	2.443
0.123	3.904	3.401	2.753
0.150	3.904	3.401	2.753
0.200	3.904	3.401	2.753
0.250	3.904	3.401	2.753
0.300	3.904	3.401	2.753
0.350	3.904	3.401	2.753
0.400	3.904	3.401	2.753
0.450	3.904	3.401	2.753
0.500	3.904	3.401	2.753
0.516	3.904	3.401	2.753
0.550	3.662	3.401	2.753
0.600	3.357	3.142	2.753
0.607	3.320	3.105	2.753
0.670	3.006	2.813	2.493
0.700	2.877	2.693	2.386
0.750	2.685	2.513	2.227
0.800	2.518	2.356	2.088
0.850	2.369	2.218	1.965
0.900	2.238	2.094	1.856
0.950	2.120	1.984	1.758
1.000	2.014	1.885	1.670
1.050	1.918	1.795	1.590
1.100	1.831	1.714	1.518
1.150	1.751	1.639	1.452
1.200	1.678	1.571	1.392
1.250	1.611	1.508	1.336
1.300	1.549	1.450	1.285
1.350	1.492	1.396	1.237
1.400	1.439	1.346	1.193
1.450	1.389	1.300	1.152
1.500	1.343	1.257	1.113
1.550	1.299	1.216	1.077

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS

In units of 'g' for **BRBCL** project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
1.600	1.259	1.178	1.044
1.650	1.221	1.142	1.012
1.700	1.185	1.109	0.982
1.750	1.151	1.077	0.954
1.800	1.119	1.047	0.928
1.850	1.089	1.019	0.903
1.900	1.060	0.992	0.879
1.950	1.033	0.967	0.856
2.000	1.007	0.943	0.835
2.050	0.982	0.920	0.815
2.100	0.959	0.898	0.795
2.150	0.937	0.877	0.777
2.200	0.915	0.857	0.759
2.250	0.895	0.838	0.742
2.300	0.876	0.820	0.726
2.350	0.857	0.802	0.711
2.400	0.839	0.785	0.696
2.450	0.822	0.769	0.682
2.500	0.806	0.754	0.668
2.550	0.790	0.739	0.655
2.600	0.775	0.725	0.642
2.650	0.760	0.711	0.630
2.700	0.746	0.698	0.619
2.750	0.732	0.685	0.607
2.800	0.719	0.673	0.596
2.850	0.707	0.661	0.586
2.900	0.694	0.650	0.576
2.950	0.683	0.639	0.566
3.000	0.671	0.628	0.557
3.050	0.660	0.618	0.548
3.100	0.650	0.608	0.539
3.150	0.639	0.598	0.530
3.200	0.629	0.589	0.522
3.250	0.620	0.580	0.514
3.300	0.610	0.571	0.506
3.350	0.601	0.563	0.499
3.400	0.592	0.554	0.491
3.450	0.584	0.546	0.484

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for **BRBCL** project

Time Period (Sec)	Damping Factor (as a percentage of critical damping)		
	2%	3%	5%
3.500	0.575	0.539	0.477
3.550	0.567	0.531	0.470
3.600	0.559	0.524	0.464
3.650	0.552	0.516	0.458
3.700	0.544	0.509	0.451
3.750	0.537	0.503	0.445
3.800	0.530	0.496	0.439
3.825	0.527	0.493	0.437
3.850	0.523	0.490	0.434
3.900	0.516	0.483	0.428
3.950	0.510	0.477	0.423
4.000	0.504	0.471	0.418

6.00.00 **CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT**

All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – B for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than "5" and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement

factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

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) Welded steel structures	: 1.0%
b) Bolted steel structures	: 2.0%
c) Reinforced concrete structures	: 1.6%
d) Steel stacks	: As per IS:6533 & CICIND Model Code whichever is more critical.

ANNEXURE-B

SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a) The basic wind speed "V_b" at ten

b) The risk coefficient "K_1" : 1.07

c) Category of terrain : Category-2

7.00.0 FOUNDATION SYSTEM AND GEOTECHNICAL DATA

7.00.01 Geotechnical data and foundation system for the respective project are enclosed at annexure-III. The corresponding bore logs are enclosed at annexure-IV.

7.00.02 The available soil data is of vicinity of proposed structures, therefore, bidder shall carryout his own detailed soil 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 7.07.00 and shall be approved by owner before execution. Geotechnical investigation work shall got executed by the Contractor through the agencies as mentioned in Clause No. 7.07.03. However, no time extension shall be given on account of soil investigation carried out by the Bidder. The geotechnical investigation report shall be prepared with detailed recommendations regarding type of foundation and allowable bearing pressure for various structures/ facilities and other soil parameters. The report shall be submitted for Owner's approval prior to commencement of design of foundation.

7.00.03 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.

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7.00.04	Tank Foundations a) The tanks shall rest on flexible tank pad foundation, resting on sand with concrete ring wall to retain sand. Base of the concrete ring wall shall not rest on the expansive soil, if any. b) Entire loose/ soft soil inside the concrete ring wall shall be removed and shall be filled with sand. Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone I to III. c) Sand shall be spread in layers not exceeding 30cm compacted thickness over the area. Each layer shall be uniformly compacted by mechanical means like plate vibrators, small vibratory rollers, etc to achieve a relative density of not less than 80%. d) Other requirements of tank foundations shall be as per IS 803 and as specified elsewhere in the specifications.
7.02.00	**Foundation System** The requirements for the foundation system to be adopted are as given in subsequent clauses. Depending upon the depth of competent strata/stratum, type of structures, functional requirement of facility, extent of cutting / filling, suitable foundation, open or pile shall be adopted with approval of owner.
7.02.01	**General Requirements** a) All structures/equipment shall be supported either on suitable open foundations (isolated, combined, raft) or pile foundations depending on type of structures/facilities, sub-strata, topography etc. 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) 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. 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) All foundations shall be designed in accordance with relevant parts of the latest revisions of Indian Standards.

h) The water table for design purpose shall be considered at Finished Ground Level.

i) A combination of open and pile foundations shall not be permitted under the same equipment / structure / building.

j) Foundation for equipments on ground floor

For equipments of static weight upto 1.5 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 4T/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 1.5 T, the equipment foundation shall be taken to the founding level or shall be built up with PCC from the level as mentioned in the Table 1. 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.

7.02.02 **Open Foundations**

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.

7.02.03 Pile Foundations –

In case piles are adopted, following shall be adhered to :

i) The pile foundation shall be of RCC, Cast-in-situ bored piles as per IS:2911. Pile boring shall be done using Rotary Hydraulic Rigs/conventional tripod rig. Two stage flushing of pile bore shall be ensured by airlift technique duly approved by the Employer.

If required, temporary or permanent MS liner may be provided for piling.

ii) The minimum diameter of pile shall be 600 mm. The allowable load capacity of the pile in different modes (vertical compression, lateral and pullout) shall be as per approved geotechnical report & as enclosed in relevant annexure:

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 Minimum of 2 Nos. in each mode.

Uplift

vii) The initial pile load test shall be conducted with test load upto three times the estimated pile capacity. 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 :

i) Vertical : 0.5% of the total number of piles provided.

ii) 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 by means of reaction from anchor piles / rock anchors 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.

xv) 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 7.02.03 (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.

xvi) 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.

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

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

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

7.03.00 **Special Requirements**

7.03.01 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.

7.04.00 **Excavation, Filling and Dewatering**

7.04.01 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.

7.04.02 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.

7.04.03 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

Rock pieces having size less than 150 mm and interstices filled with soil may be used for backfilling around foundation, plinths etc. and shall be compacted to minimum of 85% of original stack of material after filling the interstices.

CLAUSE NO.	PROJECT INFORMATION
7.04.04	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.
7.04.05	CBR tests for pavement/road design shall be carried out by the Contractor after earth filling (if applicable) has been completed upto the formation level.
7.04.06	The contractor shall take all necessary measures during excavation to prevent the hazards of falling or sliding of material or article from any bank or side of such excavation which is more than one and a half meter above the footing by providing adequate piling, shoring, bracing etc. against such bank or sides. 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.
7.05.00	**EXCAVATION IN ROCK** Excavation in rock shall be carried out by mechanical means and if blasting is required for founding of some of the structures under this package, control blasting only shall be carried out.
7.05.01	Controlled blasting shall be done by a specialised agency duly approved by Engineer. All controlled blasting shall be done by using time delay detonators (i.e. excel type).
7.05.02	a) Contractor shall engage an agency expert in blasting such as, NIRM (National Institute of Rock Mechanics), CMPDIL, Central Institute of Mining and Fuel Research Dhanbad, Dept. of Mining of Govt. Institutions etc. to design detailed blasting scheme and get the same approved from Engineer before carrying out the blasting operation. All blasting shall be done as per the approved blasting scheme & initial blasting operations shall be done under the supervision & guidance of the representative of the blasting expert. b) All the statutory laws, (Explosives Act etc.) rules, regulations, Indian Standards, etc. pertaining to the acquisition, transport, storage, handling and use of explosives, etc. shall be strictly followed. c) The Contractor shall obtain Licenses from Competent Authorities for undertaking blasting work as well as for procuring, transporting to site and storing the explosives as per explosives act. The Contractor shall be responsible for the safe transport, use, custody and proper accounting of the explosive Materials. d) The Contractor shall be responsible and liable for any accident and injury / damage which may occur to any person or property of the project or public on account of any operations connected with the storage, transportation, handling or use of explosive and blasting operations.

CLAUSE NO.	PROJECT INFORMATION
7.06.00	**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 maintaining suitable slopes, drainage, etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer.
7.07.00	**Geotechnical Investigation** 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.
7.07.01.00	**Scheme of geotechnical Investigation**
7.07.02.01	Field test shall include but not be limited to the following: 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.
7.07.02.02	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. Core drilling in rock shall be done by using hydraulically feed rotary drill & double tube core barrel with diamond bit.
7.07.02.03	The minimum tests are indicated in Clause No. 7.08.00. 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.
7.07.02.04	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. **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.

7.07.02.05 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 and pile capacity shall be based on the conservative values of geotechnical investigation data.

7.07.03.00 Geotechnical investigation work shall be got executed by the Contractor through the following agencies.

1. C.E.TESTING COMPANY Pvt. Ltd, Kolkata
2. Cengrs Geotechnica Pvt. Ltd, New Delhi
3. M.K. Soil Testing Laboratory, Ahemdabad
4. SECON Pvt Ltd, Bangalore
5. Soil Engineering Consultants, New Delhi
6. Orbital Infrastructure Consultancy & Research Pvt. Ltd. Cuttack
7. KCT Consultancy Services, Ahemdabad
8. ARKITECHNO Consultants (India) Pvt. Ltd. Bhubaneswar

7.08.00 Geotechnical Investigation Scheme

a) **Boreholes (Minimum)**

S.N	Structure	Spacing/Number of borehole	Depth of borehole	Remarks
1	FGD	Minimum 14 Nos.	Depth of boreholes shall be 25m to 35m.	Depth of

2	Crusher House	Minimum 2 Nos.	Depth of boreholes shall be 25m to 35m.	boreholes shall be as mentioned in column "Depth of Borehole" or 5m continuous in rock with RQD > 25% whichever is earlier.
3	Gypsum and Lime storage area	Minimum 10 Nos.	Depth of boreholes shall be 15m to 25m	
4	Other Structure/Facility	Minimum 2 Nos. boreholes under each area / facility	15 to 20 m	
5	Chimney	Minimum 2 Nos.	30 to 35m	

b) **Other Field Tests (Minimum)**

1	Cyclic Plate Load Test (CPLT)	3 nos	Test Depth from 2 to 4 m	
2	Trial Pit (TP)	5 Nos.	Depth - 3 m	
3	In Situ Permeability Test In Boreholes	In minimum 3 Nos. of boreholes	Tests shall be conducted at depths of 1.0m, 3.0m, 5.0m, 8.0m and 12.0m.	
4	ERT	Minimum 10 Nos.		

- 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.

Annexure-III (New Nabinagar-I)

SOIL DATA AND FOUNDATION SYSTEM

Employer has carried out geotechnical investigation in the areas near to this package. Logs of representative boreholes to be used 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. 7.07.00 and ascertain the pile capacity and bearing capacity. The onus of correct assessment / interpretation and understanding of the existing subsoil condition / data is on the Bidder. Ground water table is encountered at a depth of about 12.0 to 14.0m below natural ground level (NGL) at the time of investigation. Fluctuation may occur in ground water table due to seasonal variation. The natural ground level is varying as per enclosed contour/spot level drawing.

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

2.00.00Table – 1: Net Allowable Bearing Pressure

STRUCTURE	TYPE OF FOUNDATION TO BE ADOPTED
FGD and related structures	Open/Piles

b) During design the Allowable Bearing Pressure shall be as furnished in Table-2. Bidder is required to carry out geotechnical investigation in this area. The allowable bearing pressure shall be adopted after approval of geotechnical investigation report by owner. However, the maximum allowable bearing pressure shall be as per the approved geotechnical report and shall be limited to the values as furnished in Table-2.

3.00.00

4.00.00Table – 2: Net Allowable Bearing Pressure

Structure	Founding Level in RL	Net Allowable Bearing Pressure T/m^2		
		Isolated / Strip		Rafts (width > 6m) for 75mm settlement
		width upto 6 m for 25mm settlement	Width upto 6m for 40mm settlement	
FGD and related structures	1.5 m below NGL	5.0	6.0	7.0
	2.5 m below	6.0	7.0	8.0

	NGL			
	3.5 m below NGL	9.0	10.0	12.0

The net allowable bearing pressure higher than above mentioned values shall not be permitted. At intermediate levels the bearing capacity shall be same as the net allowable bearing pressure corresponding to the immediate shallower level mentioned above.

c) Permissible Settlement of Foundations:

For open foundations, the total permissible settlement and differential settlement shall be governed by IS: 1904 and from functional requirements whichever is more stringent. However, total settlement shall be restricted to the following:

Isolated, Strip & Raft (Mill foundations/machine foundation)	25 mm
Isolated & Strip (Other than Mill foundations/machine foundation)	40 mm
Raft (widths greater than 6 m) (Other than Mill foundations/machine foundation)	75 mm

In case the total permissible settlement is to be restricted to less than as above specified from functional requirements, then the net allowable bearing pressure shall be reduced after review in consultation with Engineer.

d) The diameter of pile, minimum length and maximum allowable capacity of piles shall be as given below:

Area/ Location	Pile Diameter (mm)	Minimum Length of Bored Pile Below Cut-off Level (m)	Safe Load Capacity in		
			Vertical Comp. (MT)	Pullout (MT)	Lateral (MT)
FGD and related structures	600	26.0	140.0	45.0	7.0
	760	27.0	250	75.0	12.5

- Cut off Level (COL) is assumed at 3.0 m below FGL (RL (+) 121.2m). If the COL is shallower than the assumed COL, then the length of the pile shall be increased accordingly.

e) The criteria for Pile Termination (founding level) shall be as given below:

Cement Type	Ordinary Portland Cement (OPC)/Portlanld Pozzolana Cement (PPC)
Concrete Grade	As specified elsewhere in the specifications
Type of Reinforcement	As specified elsewhere in the specifications
Cover to Reinforcement	As specified elsewhere in the specifications

The termination level of the pile shall be decided based on the following criterion

i) Minimum length of the pile below COL (cut off level) shall be as specified above

ii) The minimum pile length for each group of piles shall be determined based on the nearest borelog. A minimum embedment of 4.0m into the very dense sand strata with SPT 'N' value greater than 40 as observed in such borelog shall be ensured, while deciding the minimum length of pile. For pile termination, SPT 'N' values shall be used from the nearby borelog data. The boreholes are in the bidder's scope and shall be conducted as per the enclosed scheme.

iii) However, in no case the length of pile shall be less than the minimum length determined as in (i) or (ii) above whichever is longer, for that pile group.

g) Special Requirements:

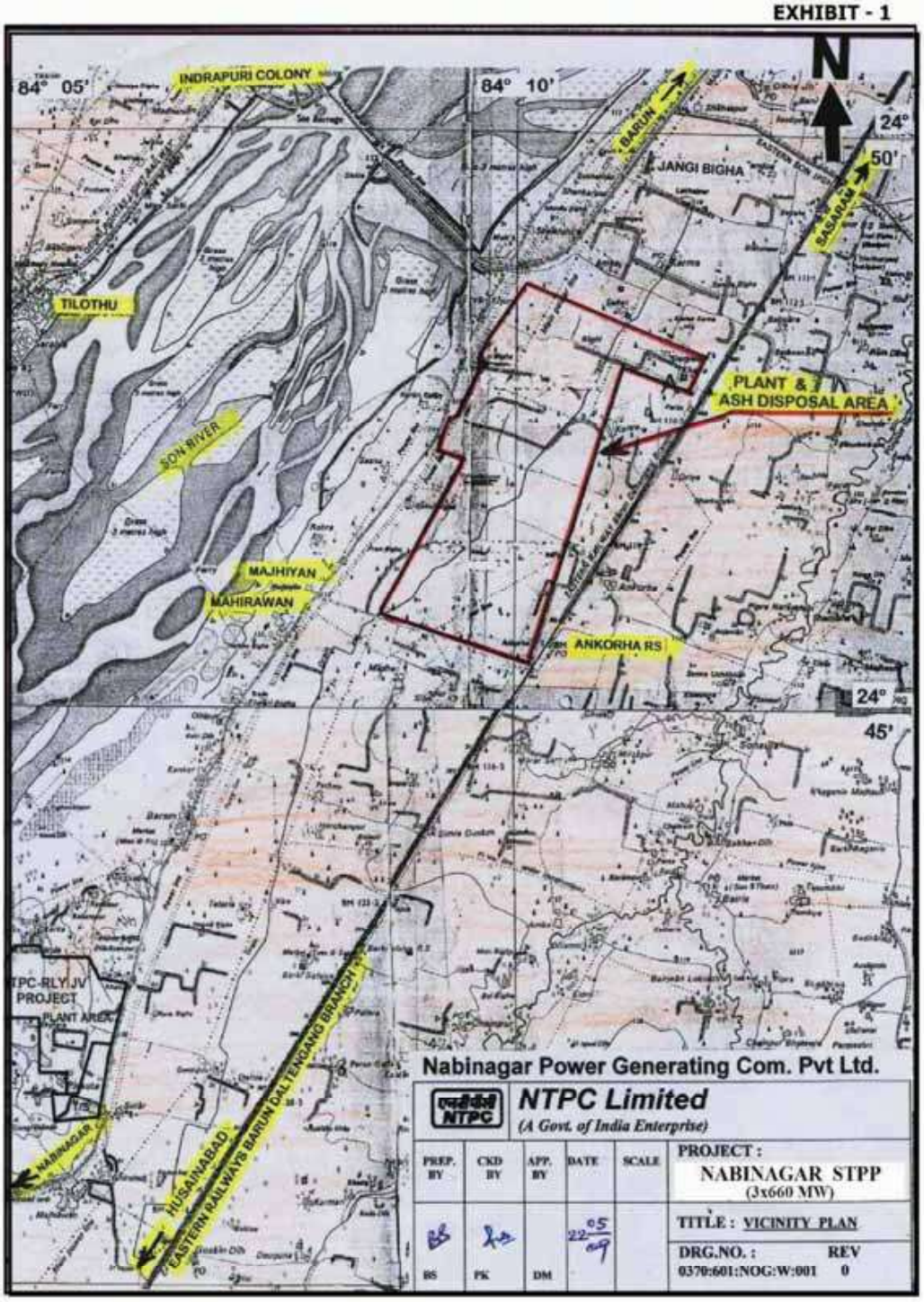
1) Chemicals in ground water and subsoil, as observed during investigation are:

Chemical	SO_3	Chlorides	pH
Ground Water	35 -40	15 - 22 ppm	7.2 - 7.7
Sub-soil	0.01 - 0.02%	0.016 -0.02%	7.0 - 9.0

2) In view of the above, the following shall be adopted for all foundations and sub-structures,

ANNEXURE – I

EXHIBIT - 1



ANNEXURE –II

ANNEXURE - I
SHEET 1 OF 2

जलवायवी सारणी
CLIMATOLOGICAL TABLE

STATION : Dehri — LAT 24°55' N, LONG 84°11' E — HEIGHT ABOVE M.S.L. 107 METRES — BASED ON OBSERVATIONS FROM 1951 TO 198?

MONTH		STATION LEVEL PRESSURE (hPa)	AIR TEMPERATURE – MEAN – DRY BULB (°C)	WET BULB (°C)	DAILY MAX (°C)	DAILY MIN (°C)	HIGHEST IN THE MONTH (°C)	LOWEST IN THE MONTH (°C)	EXTREMES – HIGHEST (°C)	DATE AND YEAR	LOWEST (°C)	DATE AND YEAR	HUMIDITY – RELATIVE HUMIDITY (%)	VAPOUR PRESSURE (hPa)	CLOUD AMOUNT – ALL CLOUDS (Oktas of sky)	LOW CLOUDS	RAINFALL – MONTHLY TOTAL (mm)	NO. OF RAINY DAYS	TOTAL IN WETTEST MONTH WITH YEAR (mm)	TOTAL IN DRIEST MONTH WITH YEAR (mm)	HEAVIEST FALL IN 24 HOURS (mm)	DATE AND YEAR	MEAN WIND SPEED (Km/h)
जनवरी JAN	I	1004.9	15.1	12.6	23.8	10.1	27.8	6.1	30.8	28 1958	-1.0	18 1977	74	12.7	1.7	0.9	17.5	1.7	94.0 1930	0.0	65.0	27 1950	3.9
	II	1001.4	21.5	15.3									49	12.5	1.6	1.1							
फरवरी FEB	I	1002.5	18.5	14.3	27.1	12.9	32.2	8.3	35.3	23 1964	3.0	15 1974	62	12.9	1.5	0.7	11.2	1.3	103.9 1907	0.0	52.6	05 1915	4.9
	II	998.9	25.3	16.8									40	12.5	1.3	0.7							
मार्च MAR	I	999.3	24.5	17.2	33.2	17.7	38.5	12.7	41.5	31 1973	6.8	03 1976	46	13.7	1.6	0.5	11.7	1.2	88.9 1944	0.0	43.7	18 1944	5.8
	II	995.1	31.5	19.0									27	12.0	1.3	0.8							
अप्रैल APR	I	995.2	30.9	20.2	38.9	23.1	42.7	17.8	44.4	23 @ 1973	10.3	04 1976	35	15.2	1.3	0.3	7.2	0.7	48.3 1914	0.0	43.2	08 1914	6.6
	II	990.8	36.9	21.6									22	13.3	1.3	0.4							
मई MAY	I	990.7	33.3	23.2	41.1	26.2	44.7	21.3	46.7	21 1951	12.8	16 1976	41	20.2	1.2	0.4	16.8	1.2	103.4 1914	0.0	96.0	31 1914	6.6
	II	986.5	38.8	23.9									27	17.7	1.1	0.3							
जून JUN	I	987.0	32.2	25.8	38.5	26.7	44.0	22.7	47.2	09 1966	14.8	15 1976	61	28.2	3.9	2.0	100.5	6.0	505.4 1961	0.0	220.0	13 1961	6.4
	II	983.5	35.5	26.1									49	26.3	4.3	2.7							
जुलाई JUL	I	987.2	29.2	26.5	33.4	25.2	37.8	22.4	42.2	01 1962	15.3	15 1976	81	32.5	6.4	4.8	315.2	14.5	655.6 1922	55.1 1903	202.4	01 1925	5.8
	II	984.3	31.1	27.0									73	32.5	6.3	4.9							
अगस्त AUG	I	988.6	28.6	26.6	32.3	25.0	35.0	22.7	39.4	03 1972	15.8	25 1976	85	33.0	6.2	4.9	277.8	15.0	748.3 1948	78.8 1979	254.5	14 1910	4.9
	II	985.4	30.2	27.1									79	33.4	6.2	5.1							
सितम्बर SEP	I	992.7	28.5	25.9	32.2	24.4	34.9	22.0	37.1	12 1979	14.0	19 1976	81	31.4	4.8	3.5	193.7	9.4	771.7 1976	25.1 1928	218.4	12 1936	4.8
	II	989.0	29.9	28.5									77	32.0	4.9	3.8							
अक्तूबर OCT	I	998.8	26.6	23.1	31.9	20.9	34.4	16.7	37.1	14 1974	9.3	31 1976	73	25.5	1.9	1.2	48.0	3.1	240.3 1928	0.0	153.7	08 1928	3.2
	II	995.2	29.3	24.2									65	26.1	1.9	1.3							
नवम्बर NOV	I	1003.2	21.3	17.5	29.2	14.6	31.9	10.7	35.1	07 1977	2.8	30 1975	65	17.3	1.3	0.5	7.7	0.4	105.2 1915	0.0	100.6	19 1915	2.8
	II	999.7	26.0	19.6									53	18.0	1.0	0.5							
दिसम्बर DEC	I	1005.3	16.2	13.6	25.1	10.9	28.2	7.1	31.7	01 1952	0.3	22 1976	74	13.7	1.3	0.4	4.9	0.6	47.7 1913	0.0	21.6	21 1940	3.1
	II	1001.7	22.3	16.1									49	13.1	1.2	0.4							
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	996.3	25.4	20.6	32.2	19.8	45.1	5.4	47.2		-1.0		65	21.4	2.8	1.7	1038.9	55.1	1789.8	530.1	254.5		4.8
	II	992.6	29.9	21.5									51	20.8	2.7	1.5			1961	1966			
वर्षों की सं. NUMBER OF YEARS	I	30	30	30	30	30	30	30	30		35		30	30	30	22	28	28	78	78	78		30
	II	30	30	30									30	30	30	22							

ANNEXURE - I
SHEET 2 OF 2

जलवायवी सारणी
CLIMATOLOGICAL TABLE

STATION : Dehri

MONTH		WEATHER PHENOMENA – No. OF DAYS WITH: 0.3mm or more	HAIL	THUNDER	FOG	DUST STORM	SQUALL	WIND – No. OF DAYS WITH WIND SPEED (Km. p. h.): 62 or more	20-61	1-19	0	WIND – PERCENTAGE No. OF DAYS WIND FROM: N	NE	E	SE	S	SW	W	NW	CALM
जनवरी JAN	I	2.3	0.1	0.4	0.1	0.0	0.0	0	0	30	1	2	3	4	11	20	40	9	6	5
	II							0	0	30	1	18	11	5	1	2	6	34	17	6
फरवरी FEB	I	2.1	0.0	0.2	0.2	0.0	0.0	0	0	28	0	3	3	4	9	17	40	16	7	1
	II							0	0	28	0	13	8	5	2	2	4	43	21	2
मार्च MAR	I	1.6	0.0	0.8	0.1	0.0	0.0	0	0	31	0	3	3	4	10	15	41	18	5	1
	II							0	0	31	0	8	5	4	2	2	5	50	20	0
अप्रैल APR	I	1.0	0.0	0.4	0.0	0.1	0.0	0	0	29	1	3	4	9	12	14	31	16	8	3
	II							0	0	30	0	6	11	6	3	2	6	43	22	1
मई MAY	I	1.7	0.0	0.6	0.0	0.2	0.0	0	0	31	0	5	12	14	17	9	21	12	8	2
	II							0	0	31	0	9	23	10	2	2	5	28	21	0
जून JUN	I	7.2	0.0	0.9	0.0	0.0	0.0	0	0	29	1	8	11	17	18	8	15	13	6	3
	II							0	0	30	0	10	20	21	8	2	8	19	11	1
जुलाई JUL	I	16.9	0.0	3.1	0.0	0.0	0.0	0	0	30	1	5	7	18	23	10	19	10	6	4
	II							0	0	30	1	11	13	20	12	6	11	17	8	4
अगस्त AUG	I	17.6	0.0	5.1	0.0	0.0	0.0	0	0	30	1	5	7	18	27	10	14	10	7	2
	II							0	0	30	1	10	15	22	10	4	9	19	8	3
सितम्बर SEP	I	11.5	0.0	3.6	0.0	0.0	0.0	0	0	29	1	6	7	16	24	11	11	12	9	4
	II							0	0	30	0	15	16	19	9	3	4	19	12	3
अक्तूबर OCT	I	4.0	0.0	1.0	0.3	0.0	0.0	0	0	30	1	4	5	10	20	19	26	8	5	3
	II							0	0	29	2	18	15	12	3	3	5	23	11	10
नवम्बर NOV	I	0.5	0.0	0.0	0.1	0.0	0.0	0	0	29	1	4	3	6	13	21	39	8	3	3
	II							0	0	28	2	25	11	5	1	2	7	23	15	11
दिसम्बर DEC	I	0.7	0.0	0.0	0.3	0.0	0.0	0	0	30	1	2	2	4	11	23	41	9	5	3
	II							0	0	29	2	18	9	2	1	2	5	40	16	7
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	67.1	0.1	15.9	1.1	0.3	0.0	0	0	356	9	4	6	10	16	15	28	12	8	3
	II							0	0	358	9	13	13	11	5	3	8	30	15	4
वर्षों की सं. NUMBER OF YEARS	I	29						24				29								
	II							24				23								

MONTH		CLOUD – No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) OKTAS: 0	T-2	3-5	6-7	8	CLOUD – No. OF DAYS WITH LOW CLOUD AMOUNT OKTAS: 0	T-2	3-5	6-7	8	FOG 9	VISIBILITY – No. OF DAYS WITH VISIBILITY: UP TO 1 Km	1-4 Kms	4-10 Kms	10-20 Kms	OVER 20 Kms
जनवरी JAN	I	23	0	2	2	4	27	0	0	1	3	0	0.1	0.4	0.5	4.0	26.0
	II	24	0	1	2	4	27	0	0	1	3	0	0.0	0.1	0.1	0.7	30.1
फरवरी FEB	I	21	0	2	2	3	26	0	0	0	2	0	0.3	0.1	0.3	1.9	25.4
	II	22	0	1	2	3	25	0	0	1	2	0	0.0	0.0	0.0	0.6	27.4
मार्च MAR	I	23	0	3	2	3	28	0	0	0	2	1	0.0	0.1	0.1	0.9	29.9
	II	24	0	2	2	3	29	0	0	0	2	0	0.0	0.2	0.2	1.5	29.1
अप्रैल APR	I	22	1	3	2	2	29	0	0	0	1	0	0.0	0.0	0.0	1.1	28.9
	II	24	0	2	2	2	29	0	0	0	1	0	0.0	0.0	0.1	0.3	29.6
मई MAY	I	25	0	2	2	2	30	0	0	0	1	0	0.0	0.0	0.0	0.2	30.8
	II	25	0	2	2	2	30	0	0	0	1	0	0.0	0.0	0.0	0.2	30.8
जून JUN	I	11	0	5	5	9	22	0	1	2	5	0	0.0	0.0	0.4	1.9	27.7
	II	12	0	3	5	10	19	0	1	2	7	1	0.0	0.1	0.4	2.3	27.2
जुलाई JUL	I	2	0	6	7	16	10	0	2	4	15	0	0.0	0.0	0.3	3.9	26.8
	II	2	1	5	7	16	10	0	2	5	14	0	0.0	0.0	0.5	5.8	24.7
अगस्त AUG	I	2	0	6	9	14	10	0	2	6	13	0	0.0	0.6	0.7	2.7	27.0
	II	3	0	5	8	15	10	0	2	6	13	0	0.0	0.7	1.0	3.6	25.7
सितम्बर SEP	I	7	1	5	7	10	15	0	2	4	9	0	0.0	0.1	0.5	2.5	26.9
	II	8	1	5	6	10	13	1	2	4	10	0	0.0	0.1	0.2	3.3	26.4
अक्तूबर OCT	I	20	1	3	3	4	26	0	1	1	3	0	0.0	0.1	0.3	0.9	29.7
	II	21	1	3	2	4	25	0	1	1	4	0	0.0	0.0	0.3	0.7	30.0
नवम्बर NOV	I	24	0	2	2	2	29	0	0	0	1	0	0.0	0.0	0.3	1.1	28.6
	II	25	0	1	2	2	28	0	0	1	1	0	0.0	0.0	0.2	0.4	29.4
दिसम्बर DEC	I	24	0	2	3	2	30	0	0	0	1	0	0.1	0.1	0.7	1.5	28.6
	II	25	0	2	2	2	29	0	0	1	1	0	0.0	0.0	0.1	0.5	30.4
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	204	3	41	46	71	282	0	8	18	56	1	[illegible]	1.5	1.1	22.6	336.3
	II	215	3	32	42	73	274	1	8	22	59	1	0.0	1.2	3.1	19.9	340.8
वर्षों की सं. NUMBER OF YEARS	I	28					28						28				
	II	27					27						27				

TABLE – 1

COAL CHARACTERISTICS

Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
1	2	3	4	5	6	7
A.	**PROXIMATE ANALYSIS** (As received basis)					
1.	Total Moisture	%	15.00	17.00	12.00	11.00-17.00
2.	Ash	%	45.00	48.00	38.00	36.00-49.00
3.	Volatile matter	%	18.00	17.00	22.00	23.00-17.00
4.	Fixed carbon	%	22.00	18.00	28.00	30.00-17.00
B.	**ULTIMATE ANALYSIS** (As received basis)					
1.	Carbon	C%	29.80	25.40	39.00	41.20-24.90
2.	Hydrogen	H2%	3.00	2.80	3.20	3.30-2.60
3.	Nitrogen	N2%	0.8	0.70	1.00	1.30-0.50
4.	Oxygen (By difference)	O2%	5.4	5.10	5.70	6.00-5.00
5.	Sulphur	S%	0.3	0.50	0.20	0.20-0.60
6.	Carbonates	CO3%	0.50	0.40	0.60	0.70-0.30
7.	Phosphorous	P2%	0.2	0.10	0.30	0.30-0.10
8.	Total Moisture	H2O%	15.00	17.00	12.00	11.00-17.00
9.	Ash	%	45.00	48.00	38.00	36.00-49.00
10.	Gross Calorific Value	KCal/Kg	3200	2800	4000	4200 - 2700
11.	Hard grove index		55	50	60	65-45
12.	YGP Index		70	80	60	85-55
C.	**ASH ANALYSIS**					
1.	Silica	(SiO2)%	58.65	59.00	58.20	56.9-59.20
2.	Alumina	(Al2O3)%	28.80	28.00	29.50	27.70-30.00
3.	Iron Oxide	(Fe2O3)%	5.50	6.00	4.70	4.50-6.50

Sl. No.	Description	Symbol	Design Coal	Worst Coal	Best Coal	Range of Adequacy Coal
1	2	3	4	5	6	7
4.	Titania	(TiO2)%	1.80	2.00	1.70	1.50-2.10
5.	Phosphoric Anhydride	(P2O5)%	0.70	0.60	0.90	0.40-0.95
6.	Lime	(CaO)%	1.50	1.20	1.90	1.00-2.10
7.	Magnesia	(MgO)%	1.30	1.50	1.20	1.50-2.10
8.	Sulphuric Anhydride	(SO3)%	0.50	0.60	0.40	0.40-0.62
9.	Sodium Oxide	(Na2O)%	0.10	0.08	0.30	0.35-0.08
10.	Balance Alkalies (By Difference)	%	1.15	1.02	1.2	1.20-0.90
D.	**ASH FUSION RANGE** (Under reducing atmosphere)					
a)	Initial Deformation Temperature (IDT)	°C	1100	1100	1100	1150-1100
b)	Hemispherical temperature	°C	1300	1250	1350	1400-1250
c)	Flow temperature	°C	1400	1400	1400	1400-1400

TABLE – 2A

FUEL OIL CHARACTERISTICS

Sl. No.	Characteristics	Heavy Furnace Oil grade HV (HFO) IS-1593-1982	Low Sulphur Heavy Stock (LSHS) IS-11489-1985	Heavy Petroleum stock (HPS) IS-11489-1985
1.	Total sulphur content	4.5% Max.	1.0% Max.	4.5% Max.
2.	Gross calorific value (KCal/kg)	of the order of 10,000	of the order of 10,000	of the order of 10,000
3.	Flash Point (Min)	66 deg C	76 deg C	66 deg C
4.	Water content by volume (Max)	1.0%	1.0%	1.0%
5.	Sediment by weight (Max)	0.25%	0.25%	0.25%
6.	Asphaltene content by weight (Max.)	2.5%	2.5%	2.5%
7.	Kinematic viscosity in Centistokes	370 at 50deg C	100 at 100deg C	100 at 100deg C
8.	Ash Content by weight (Max.)	0.1%	0.1%	0.1%
9.	Acidity (inorganic)	Nil	Nil	Nil
10.	Pour Point (Max.)	57 deg C	66 deg C	72 deg C
11.	Sodium content	—	—	100 ppm
12.	Vanadium content	25 ppm	25ppm	25 ppm
13.	Specific heat below pour point (KCal/Kg °C)		0.65	

TABLE – 2B

LIGHT DIESEL OIL CHARACTERISTICS

AS PER IS 1460-2000

	Characteristics	LDO
1.	Pour Point (max)	21 deg.C & 12°C for Summer and Winter respectively
2.	Kinematic viscosity in centistokes at 40 deg.C	2.5 to 15.7
3.	Sediment percent by mass (max)	0.10
4.	Total sulphur percent by mass (max)	1.8
5.	Ash percentage by mass (max)	0.02
6.	Carbon residue (Rans bottom) percent by pass (max.)	1.50
7.	Acidity in organic	Nil
8.	Flash point(Min.) - Pensky Martens	66 deg.C
9.	Copper strip corrosion for 3 hours at 100°C	Not worse than No. 2
10.	Water content, % by volume(max)	0.25
11.	GCV (Kcal/kg)	10,000

Table-3

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	$CaCO_3$	131
2.	Magnesium	$CaCO_3$	52
3.	Sodium + Potassium	$CaCO_3$	65
4.	Total Cations	$CaCO_3$	248
5.	Chloride	$CaCO_3$	20
6.	Sulphate	$CaCO_3$	93
7.	Nitrate	$CaCO_3$	10
8.	Alkalinity	$CaCO_3$	125
9.	Total Anions	$CaCO_3$	248
10.	Iron(total)	Fe	0.3
11.	Total Silica	SiO_2	22
12.	pH value	---	7.0-8.2
13.	Turbidity	NTU	10

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dozing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

Table-4

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER

Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as Sio2
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 -7.2
5.	Conductivity	Not more than 0.1 micro mhos/cm excluding the effects of free CO2

Table-5

9.00.00 STEAM GENERATOR DATA

1.	Location	Outdoor
2.	Operation	Base load
3.	Type	Pulverised coal fired
4.	Maximum Continuous Rating	2120 Tons/hr.
5.	Steam pressure at SH outlet	255 Kg/cm² (a)
6.	Steam temperature at SH outlet	568°C
7.	Oil for start-up and flame stabilisation	HFO/LSHS/HPS/LDO
8.	Fuel oil system sizing	30% of Boiler MCR for Heavy oil/ LSHS/HPS (7.5% BMCR for LDO)
9.	Pulverised coal size	Minimum 70% through 200 Mesh and 99% thru 50 mesh
10.	Type of pulveriser	Vertical spindle mills
11.	Type of oil burners	Steam atomised, (Air atomised for LDO)
12.	No. of air heaters	Two Bisector(2) for the secondary air side & Two Bisector(2) for the primary air side
13.	No. of ID Fans	Two (both working)

10.00.00 ESP DATA

1.	Location:	Downstream side of Air preheaters
2.	Operation:	Base load
3.	Type:	Rigid Discharge frame
4.	Rapping:	Intermittent

Table-6

List of Drawings placed below in this sub section:

Sl.No.	Drawing Description	Drawing No.
1.	General Layout Plan	Enclosed
2.	Equipment Layout Plan	Enclosed
3.	ID system-Elevation & Plan	Enclosed
4.	Pipe Cable Trestle Layout	Enclosed
5.	Pipe Cable Trestle Foundation	Enclosed
6.	Chimney foundation details	

	Chimney shell outer diameter at ground level (m)	Chimney foundation outer diameter (m)	Type of foundation	Level of Top of foundation (m)	Level of Bottom of foundation (m)
Unit #1	32	46.7	Raft supported on piles	RL(+) 120.20	RL(+) 115.95
Unit #2&3	34.5	51.22	Raft supported on piles	RL(+) 120.20	RL(+) 115.70

ANNEXURE-IV

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 600N 2510E Elv. 120.213	Depth of Boring (m) 35.0	DATE from 28/6/2009 to 2/7/2009	WATER TABLE (m) NIL	LOCATION BH-23	SHEET 54	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLI-DATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	1.0		Dark grey silty clay with kankar of high plasticity (CH)	18		6	10	66	18	62	35	27	15	1.85	1.59	16.4	2.68	47		0.65	0	0.69	0.130	0.15
SPT	2.0																							
SPT	3.0	3.0																						
	4.0		Dark grey silty clay with kankar of medium plasticity (CI)	22																				
SPT	5.0																							
UDS	6.0																							
SPT	7.0																							
SPT	8.0			27																				
SPT	9.0																							
UDS	10.0					5	13	73	9	45	28	17	12											
SPT	11.0			30																				
SPT	12.0																							
UDS	13.0																							
SPT	14.0			34																				
SPT	15.0																							

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 600N 2510E Elv. 120.213	Depth of Boring (m) 35.0	DATE from 28/6/2009 to 2/7/2009	WATER TABLE (m) NIL	LOCATION BH-23	SHEET 55	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x; Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLI-DATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	16.0																							
SPT	17.0		Dark grey silty clay with kankar of medium plasticity (CI)	38																				
SPT	18.0																							
UDS	19.0																							
SPT	20.0			44																				
SPT	21.0																							
UDS	22.0	21.5																						
SPT	23.0		Brownish poorly graded medium to coarse sand (SP)	48/27																				
UDS	24.0					0	96	4	0	NON-PLASTIC				1.90	1.60	18.8	2.65			0.00	34	0.66		
SPT	25.0																							
SPT	26.0			55/28																				
UDS	27.0																							
SPT	28.0																							
SPT	29.0			59/28																				
SPT	30.0																							

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 600N 2510E Elv. 120.213	Depth of Boring (m) 35.0	DATE from 28/6/2009 to 2/7/2009	WATER TABLE (m) NIL	LOCATION BH-23	SHEET 56	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x; Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLI-DATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	31.0		Brownish poorly graded medium to coarse sand (SP)																					
SPT	32.0			61/29																				
SPT	33.0																							
UDS	34.0																							
SPT	35.0			67/29																				

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 570N 2230E Elv. 120.501	Depth of Boring (m) 25.0	DATE from 4/6/2009 to 12/6/2009	WATER TABLE (m) 13.70	LOCATION BH-24	SHEET 57	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLIDATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	1.0																							
SPT	2.0		Dark grey silty clay with kankar of high plasticity (CH)	19		6	13	66	15	63	34	29	14	1.84	1.59	15.7	2.68	45		0.65	0	0.69	0.135	0.15
SPT	3.0																							
	4.0	4.0		25																				
SPT	5.0			30																				
UDS	6.0																							
SPT	7.0			31																				
SPT	8.0			34																				
SPT	9.0			36																				
UDS	10.0		Dark grey silty clay with kankar of medium plasticity (CI)			4	12	77	7	38	28	10	9					34						
SPT	11.0			38																				
SPT	12.0			40																				
UDS	13.0																							
SPT	14.0			42																				
SPT	15.0			44																				

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 570N 2230E Elv. 120.501	Depth of Boring (m) 25.0	DATE from 4/6/2009 to 12/6/2009	WATER TABLE (m) 13.70	LOCATION BH-24	SHEET 58	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLI-DATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	16.0		Dark grey silty clay with kankar of medium plasticity (CI)																					
SPT	17.0			38																				
SPT	18.0			42																				
UDS	19.0																							
SPT	20.0			47																				
SPT	21.0		Greyish poorly graded fine silty sand (SP-SM)	52/28		0	91	9	0	NON-PLASTIC				1.89	1.61	17.4	2.66			0.00	32	0.65		
UDS	22.0																							
SPT	23.0			55/28																				
UDS	24.0																							
SPT	25.0	25.0		56/29																				

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 625N 1980E Elv. 120.502	Depth of Boring (m) 30.0	DATE from 14/7/2009 to 16/7/2009	WATER TABLE (m) NIL	LOCATION BH-25	SHEET 59	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x; Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARAMETER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLIDATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	1.0		Dark grey silty clay with kankar of high plasticity (CH)	22																				
SPT	2.0																							
SPT	3.0																							
	3.5																							
	4.0		Dark grey silty clay with kankar of medium plasticity (CI)																					
SPT	5.0			24																				
UDS	6.0					7	13	65	15	43	24	19	12					37		0.30	13			
SPT	7.0																							
SPT	8.0			30																				
SPT	9.0																							
UDS	10.0																							
SPT	11.0			33																				
SPT	12.0																							
UDS	13.0																							
SPT	14.0			36																				
SPT	15.0																							

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 625N 1980E Elv. 120.502	Depth of Boring (m) 30.0	DATE from 14/7/2009 to 16/7/2009	WATER TABLE (m) NIL	LOCATION BH-25	SHEET 60	ANNEX. 'A'

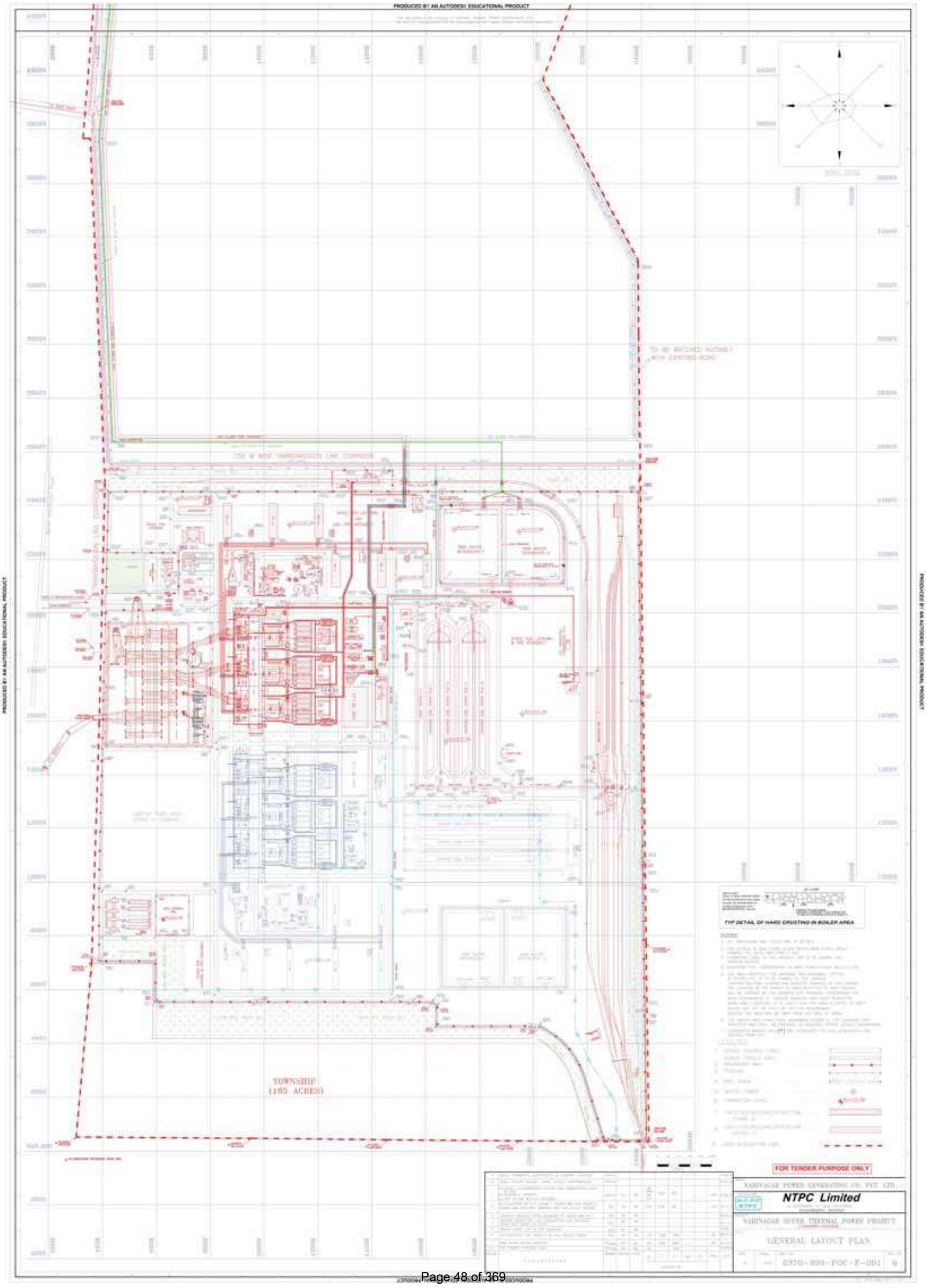
TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x / Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLI-DATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	16.0					7	15	73	5	38	23	15	9	1.85	1.58	17.1	2.66	34		0.25	17	0.68	0.118	0.1
SPT	17.0		Dark grey silty clay with kankar of medium plasticity (CI)	39																				
SPT	18.0																							
UDS	19.0																							
SPT	20.0			41																				
SPT	21.0	21.0																						
UDS	22.0		Brownish poorly graded medium to coarse sand (SP)																					
SPT	23.0			45/23																				
UDS	24.0																							
SPT	25.0																							
SPT	26.0			47/23																				
SPT	27.0																							
UDS	28.0					0	95	5	0	NON-PLASTIC				1.89	1.61	17.4	2.65			0.00	33			
SPT	29.0			49/25																				
SPT	30.0	30.0		54/26																				

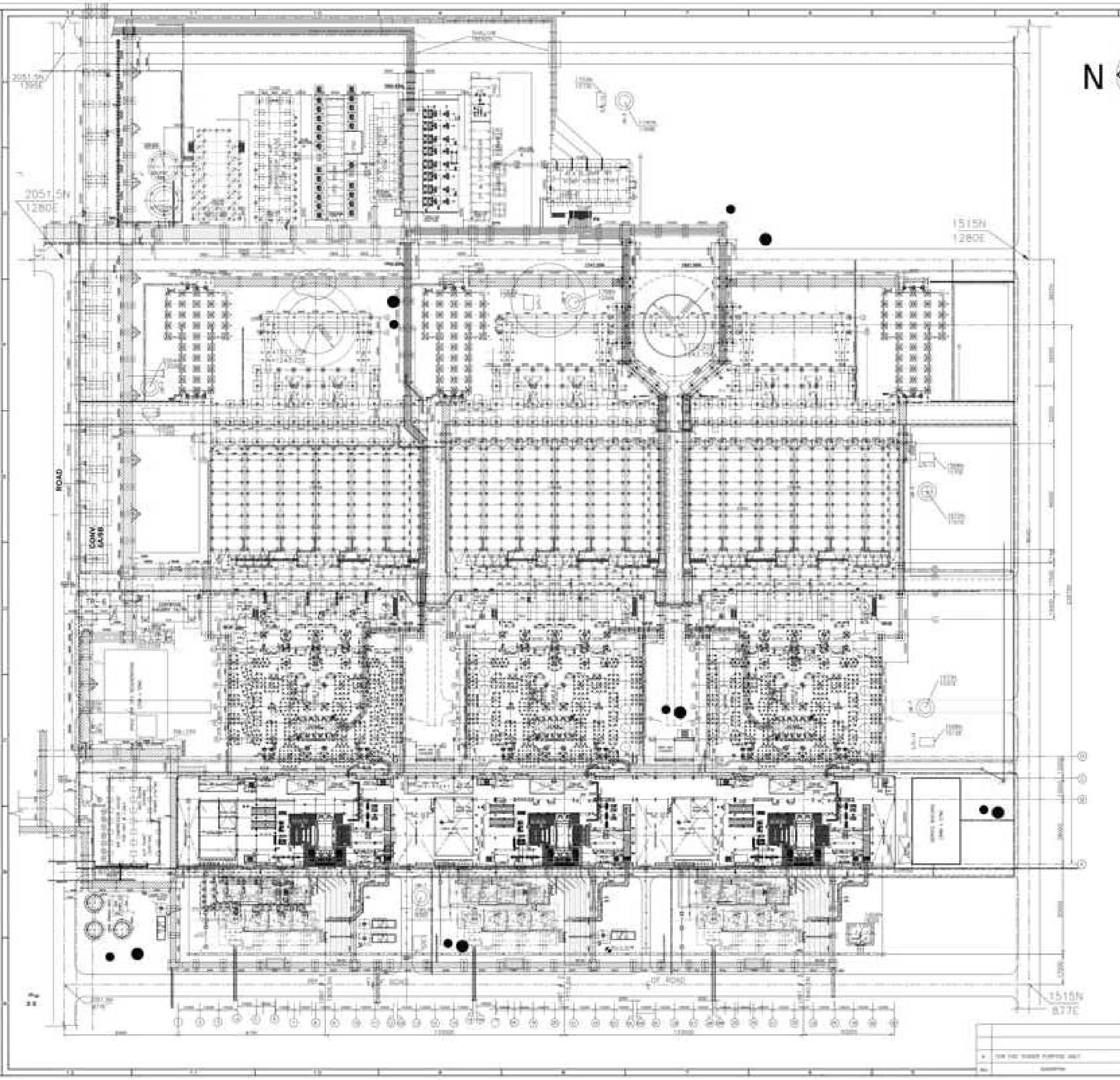
The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 850N 1965E Elv. 120.246	Depth of Boring (m) 30.0	DATE from 30/6/2009 to 5/7/2009	WATER TABLE (m) NIL	LOCATION BH-26	SHEET 61	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x; Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING(%)	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLI-DATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	1.0		Dark grey silty clay with kankar of high plasticity (CH)	18		3	15	68	14	58	33	25	13	1.80	1.58	13.9	2.67	45		0.60	0	0.69	0.128	0.2
SPT	2.0																							
SPT	3.0																							
	4.0	4.0																						
SPT	5.0		Dark grey silty clay with kankar of medium plasticity (CI)	27																				
UDS	6.0																							
SPT	7.0																							
SPT	8.0			31																				
SPT	9.0																							
UDS	10.0					5	17	71	7	41	22	19	9											
SPT	11.0			33																				
SPT	12.0																							
UDS	13.0																							
SPT	14.0			35																				
SPT	15.0																							

The Designers' Consortium	SOIL PROFILE	NTPC LTD.	Geotechnical Investigation for New Nabinagar STPP (4x660MW)	COORDINATE 850N 1965E Elv. 120.246	Depth of Boring (m) 30.0	DATE from 30/6/2009 to 5/7/2009	WATER TABLE (m) NIL	LOCATION BH-26	SHEET 62	ANNEX. 'A'

TYPE OF SAMPLES	DEPTH BELOW NGL (m)	SUB SOIL PROFILE	SOIL DESCRIPTION AND ITS CLASSIFICATION	SPT 'N' VALUES	PLOT OF SPT 'N' VALUES (Recorded x x x, Corrected o o o; 20 40 60 80)	GRAIN SIZE DISTRIBUTION: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	ATTERBERGS' LIMIT: LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SHRINKAGE LIMIT	DENSITY (gm/cm³): BULK DENSITY	DRY DENSITY	NATURAL MOISTURE CONTENTS (%)	SPECIFIC GRAVITY	FREE SWELLING	RELATIVE DENSITY	SHEAR PARA-METER: COHESION C (Kg/cm²)	FRICTION ANGLE f	CONSOLI-DATION PARAMTR.: VOID RATIO e_0	COMPRESSION INDEX C_c	SWELLING PRESSURE (Kg/cm²)
UDS	16.0																							
SPT	17.0			35																				
SPT	18.0		Dark grey silty clay with kankar of medium plasticity (CI)																					
UDS	19.0																							
SPT	20.0			38																				
SPT	21.0																							
UDS	22.0	22.0																						
SPT	23.0			40/25																				
UDS	24.0																							
SPT	25.0																							
SPT	26.0		Dark brown poorly graded fine silty sand (SP-SM)	45/26		0	94	6	0	NON-PLASTIC				1.89	1.61	17.4	2.65			0.00	33	0.65		
UDS	27.0																							
SPT	28.0																							
SPT	29.0			48/26																				
SPT	30.0	30.0		55/27																				





LEGEND

	PIPE HATCH
	VERTICAL BRACING
FPD	FIRE PROOF DOOR
	GRATING
	CHEQUERED PLATE
R	REMOVABLE
	HAND RAILING
	PIPE & CABLE TRESTLE
	FIRE BARRIER WALL

NOTES:-

1. THE EQUIPMENT SHALL BE GENERALLY IN ACCORDANCE WITH THE LAYOUT AND DIMENSIONAL REQUIREMENTS INDICATED IN THESE DRAWINGS. HOWEVER BUILDING SIZES INDICATED ARE MINIMUM REQUIREMENT AND ACTUAL SIZE SHALL BE AS PER FUNCTIONAL REQUIREMENT BUT NOT LESS THAN THOSE INDICATED IN THESE DRAWINGS.
2. NO PIPES, CABLES, STRUCTURES ARE TO BE PLACED BELOW 7.0M (BOP, BOC OR BOS) IN FRONT OF BOILER BETWEEN THE 12.0M CORRIDOR SEPARATING MAIN PLANT AND FIRST ROW OF BOILER COLUMNS (i.e. CD BAY) EXCEPT IN CONTROL TOWER AREA.
3. LOCATION OF DOORS/REMOVABLE COVERS SHOWN IN THE DRAWINGS ARE INDICATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING.
4. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
5. FIRE BARRIER WALL IS PROVIDED ON A-ROW BETWEEN AXIS NO. 2-8,14-20 & 26-32.
6. ALL ELEVATIONS INDICATED IN THE DWG ARE w.r.t. T.G. BUILDING GROUND FLOOR ELEVATION AS (±)0.00M.
   i) FINISHED FLOOR OF PAVING SLAB IN BOILER/ESP/ID FAN AREA SHALL BE (-)0.2M
   ii) FINISHED FLOOR ELEVATION IN MILL BAY AT GROUND LEVEL SHALL BE 0.00M.
   iii) FINISHED FLOOR LEVEL IN X-FMR YARD SHALL BE (-) 0.10M.
   iv) FINISHED FLOOR LEVEL INSIDE CHIMNEY SHALL BE 0.00M.
   v) FINISHED FLOOR LEVEL IN THE VARIOUS BUILDINGS IN MAIN PLANT AREA SHALL BE 0.00M.
7. ALL CABLE SPREADER ROOMS TO BE PROVIDED WITH DRAINAGE ARRANGEMENT.
8. BOTTOM OF STEEL OF PIPE / CABLE RACK IN MILL BAY AREA SHALL BE MINIMUM EL 17.0M.
9. FOR FLY ASH HANDLING EITHER VACUUM PUMPS OR EXTRACTION AIR COMPRESSORS SHALL BE PROVIDED.
10. IN CASE OF VACUUM PUMPS FOR DRY ASH SYSTEM, THESE SHALL BE LOCATED BELOW ESP NEAR ITS 1ST FIELD AND THE SWGR. ROOM FOR THE SAME ALONG WITH TRANSFORMERS SHALL BE LOCATED IN ONE OF THE MAIN PLANT TP. IN CASE OF EXTRACTION AIR COMPRESSORS, THESE ALONG WITH SWGR. ROOM SHALL BE LOCATED IN AHP AREA, ACROSS THE ROAD BEHIND CHIMNEY.
11. BRICK WALL REQUIREMENTS :
   i) ALL STAIRCASES AT 'A' ROW & 'C' ROW SHALL BE PROVIDED WITH 230 mm THICK BRICK ENCLOSURE.
   ii) ALL CABLE SPREADER ROOM WALLS.
   iii) WALLS OF SWAS ROOM.
   iv) HT/LT SWITCH GEAR ROOMS, BOILER MCC ROOM.
   v) AIR HANDLING UNITS(AHU).
   vi) DL EQUIPMENT ROOM .
12. RCC WALL - 250 mm THK RCC WALL FROM EL 0.0M TO 0.6M FOR LUBE OIL ROOM.
13. D-ROW IS THE FIRST ROW OF BOILER AND MILL BAY COLUMNS.
14. RAIN WATER PIPES SHALL BE ROUTED INSIDE THE COLUMN DEPTH IN ELECTRICAL BAYS AND IP BUSDUCT BAY.
15. EL 0.0M CORRESPONDS TO RL (+) 121.7 M.
16. LOCATION AND SIZES OF TRANSFORMERS SHOWN IN TRANSFORMER YARD IS INDICATIVE ONLY.
17. NO VERTICAL BRACING IN ELECTRICAL BAY AND I.P. BUS DUCT BAY SHALL BE PROVIDED.
18. CLP TENDER DRAWING IS TO BE REFERRED FOR AVAILABLE SPACE FOR FGD SYSTEM.

FOR FGD TENDER PURPOSE ONLY

एन टी पी सी लिमिटेड
NTPC Limited

NEW NABINAGAR SUPER THERMAL POWER PROJECT

EQUIPMENT LAYOUT PLAN AT EL 0.00M.

0370-999-POM-A-001

SPECIFIC TECHNICAL REQUIREMENT – MECHANICAL

SUB SECTION-C1A

SPECIFIC TECHNICAL REQUIREMENTS - TANKS

1.0 SCOPE OF SUPPLY

1.1 Steel tanks fabricated and supplied at site under this specification shall be as per enclosed FGD Tank schedule (Section-III, Annexure-8) and GA DRAWINGS OF TANKS (Annexure-III, sub Section-D, Section-I). Modifications may be made by the bidder to suit good engineering practice to the satisfaction of the customer. The customer, however, reserves the right to reject any modifications.

1.2 General design, selection of rubber/glass flake lining materials, construction features, manufacturing, shop inspection, testing at manufacturer's works, surface preparation, lining, inspection & testing of the lined surface at site. For detail specification of rubber/glass flake lining refer Sub Section-C1-B/C1-C, section-I.

1.3

a) The connections and accessories which are required to be supplied with each tank by the bidder shall be as indicated in the enclosed FGD Tank schedule and GA drawings of Tanks.

b) The piping material inside the tank shall be **provided by BHEL (excluded from Bidder's scope).** All inlet piping shall be extended up to the bottom of the tank and the clearance between the bottom of the tank and the edge of the inlet piping shall be kept as 500 mm (maximum).
The inlet pipes for slurry storage tanks shall be lined with replaceable wear resistant natural rubber lining of minimum 6 mm thickness from inside. Additional thickness of 2 mm in rubber lining shall be provided at bends.

c) The inside piping shall be adequately supported and shall be provided with adequately sized vent(anti-siphoner) connection at pipe top.

d) Weir plates of adequate thickness (minimum 8 mm) shall be provided for all inlet piping.

e) Pad plates on the tanks for supporting piping shall be provided by the bidder. Details of the pad plates (sizes, quantity etc.) shall be informed to bidder during detail engineering.

f) Fabrication and supply of all flanges and counter flanges for all nozzles of tank connections shall be included in the scope of work of the bidder. Necessary bolts, nuts and gaskets for these connections shall also be supplied by the bidder. **Further, rubber lining of these nozzles** including flanges, counter-flanges shall be in bidder's scope of work.

g) The manhole shall be of hinged and bolted type with nuts, bolts and gaskets in bidder's scope of supply. The size of the manhole shall be minimum 800 mm if not specified in the specification.

h) Void.

1.4 The scope of works shall also include supply and installation of special accessories including agitator supporting arrangements, agitator platform, baffle plates, **support structure for Agitator handling equipment above Roof** etc. as indicated in FGD Tank schedule and GA drwgs of. The necessary fixtures and other accessories for mounting these special accessories shall be included in the scope of work of the bidder.

1.5 Baffle plates for the agitators shall be mounted on the tank. The supply and erection of the baffle plates shall be in bidder's scope of work. The minimum no. of baffle plates and minimum dimension

of the baffle plates have been indicated in the drawing attached with the Tank schedule. The final quantity and dimensions of the baffle plates shall be decided during detail engineering.

1.6 Void.

1.7 Pipes, fittings, nozzles, flanges and counter flanges **along with the rubber lining** shall be supplied by the bidder. The minimum requirement like quantity, size, type, MOC etc. are indicated in the FGD Tank schedule and may undergo change during detail engineering stage and these shall be supplied by the bidder as per the approved drawings / documents for which no commercial implication shall be entertained by BHEL.

1.8 The minimum number of anchor bolts along with the minimum size has been specified in Tanks GA drwgs. However, any additional anchor bolts of higher size if found applicable during detailed Engineering shall be provided by bidder without any commercial implication. The material of construction for anchor bolts shall be IS 1367 Part-3.

1.9 Painting of the tanks is included in bidder's scope of work. Painting specifications of storage tanks are given under Painting schedule in Sub Section-C2-C, section-1. Painting requirement specified under Painting schedule are minimum requirement. Any modification in painting requirement found applicable during detained engineering, shall be under bidder's scope without any commercial implication.

1.10 Commissioning spares as required for commissioning of the tanks are in bidder's scope.

1.11 Platforms, inter-connecting platforms, platforms for agitator maintenance, monkey ladder inside tank, staircase, hand railing, knee guard and toe guard (in stair case, agitator platform and all along the periphery of roof of the tank), as per the relevant design code / good engineering practice shall be included in bidder's scope of work. All staircase treads and platforms shall be 32 mm steel fabricated gratings. Gratings shall be galvanized as given for handrails in painting specification.

2.0 SCOPE OF SERVICES

Services shall include but not be limited to the followings:

2.1 Design, engineering, preparation of detailed fabrication drawings, GA drawings, design calculation, bill of material, tag and piece numbers, welding procedures etc. Stiffeners and other structural framing for supporting the tank shall be designed by the fabricator and properly shown in the fabrication drawings.

2.2 Erection & Commissioning of Tanks.

2.3 Erection & Commissioning of rubber/glass flake lining.

2.4 Erection of the agitators, agitator mounting arrangement, agitator supporting arrangements, Support S**tructure for agitator handling equipment above tank Roof** etc., shall be in bidder scope. The Agitator shall be provided by BHEL as a free issue item.

2.5 Erection of all foundation bolts / anchor bolts etc. as required for any equipment/ foundation /concrete.

2.6 Minor civil work like chipping of foundation, grouting below base plate for all structures, Tanks, equipment, grouting of pockets. Supply of grouting material is under bidder's scope.

2.7 Inspection & testing and carrying out demonstration test of tanks.

2.8 Inspection & testing and carrying out demonstration test for the rubber/glass flake lining of tanks.

2.9 Painting of tank and other equipment within the battery limit.

2.10 Any other services as required to make the installation complete in all respects shall be deemed to be included in bidder's scope of work whether mentioned above or not.

3.0 DESIGN CONSIDERATIONS

3.1 The successful bidder shall furnish design calculations to BHEL during detailed engineering stage for approval along with the Xerox copies of relevant pages of authentic supporting literature e.g. Code, Hand book, National / international Standards etc. Calculation shall be necessarily done in **SI UNITS** only for the followings: -

a) Tanks shall be designed as per IS – 803 / API – 650 / AWWA – D 100 / IS –2825 / BS – 2594 / Good engineering practice as applicable and referred code shall be of latest edition.

b) Weight calculation of plates, appurtenances, platforms & structures separately shall be included in the Design calculation.

c) Design of roof and roof structures for vertical storage tanks along with agitators & agitator platforms shall be designed based on guidelines given in the book titled "Process equipment design" by Brownell and Young. **Further, roof structure shall preferably be constructed on external side of roof.**

d) Tank stability calculation (wind load / seismic / overturning stability) considering static and dynamic loads of Agitator and its platforms and supporting arrangement shall be done as per API – 650/IS-803, latest edition. However, factors / coefficients as required for the design of tank shall be obtained from BHEL by the bidder after placement of order.

d) Vent sizing calculation shall be done as per API – 2000, latest edition

e) Void.

3.2 The successful bidder shall indicate references of all the clauses indicating their page number from respective standard in the design calculation during detail engineering stage. All steps including formulas and abbreviations shall be clearly shown in the calculation. All inputs / assumptions shall be indicated in the first sheet of the calculation.

3.3

a) Bottom plate shall be 8.0 mm thick (minimum). Minimum 6 mm (excluding tolerance on plate as per relevant IS) thick plates including corrosion allowance shall be provided for shell plates and minimum 8 mm for roof plates for all tanks. However, Auxiliary absorbent tank shall be provided with minimum 8 mm thickness for shell.

b) Negative tolerance on plate thickness shall not be considered in the plate thickness calculation and also shall not be provided in the tank. Only positive tolerance shall be considered.

3.4 Tank shall be suitably constructed for safe, proper and continuous operation under all conditions that can be expected in a plant life without undue strain, corrosion or other operating difficulties.

3.5 In calculating the minimum plate thickness, the specific gravity of the liquid shall be taken as per Tank schedule.

3.6 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.

3.7 Vessels seams shall be so positioned that they do not pass though vessel connections. For cylindrical vessels consisting of more than two sections longitudinal seams shall be offset.

3.8 Wherever possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.

3.9 The joint efficiency factor to be adopted for design calculation of shell thickness shall be 0.7.

3.10 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m^2 of projected area. Further, the static and dynamic loads of the agitator assembly along with the agitator platform & support structure for Agitator handling equipment shall be considered over and above the uniform live load.

3.11 Code conformance for flanges / counter flanges shall be ANSI B 16.5. Code conformance for bolts and nuts shall be SA 193 & 194 respectively. Further, all fasteners used in wetted condition must be of Alloy 926 or better material so that even if it comes in contact with liquid by swelling of rubber lining, thread remains unaffected. Raw material of fastener must undergo Inter-Granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.

3.12 The number & size of nozzles (including flanges, counter flanges and inside piping) indicated in the tank schedule are tentative and bidder guidance purpose only and the same may undergo change during detail engineering stage for which no commercial implication shall be entertained by BHEL.

3.13 Bidder shall furnish the STADD calculation along with the roof structure calculation during detail engineering for checking the stability of roof.

3.14 Bidder to note that surface cleaning shall be of Blast clean type. However, Grit blasting shall be decided during detail engineering for which no commercial implication shall be entertained by BHEL. Further, the surface cleaning of the tanks shall be in line with the requirements specified in the specification for rubber/glass flake lining (Section-I, Sub Section-C1B)

3.15 Bidder to note that foundation drawing along with loading data & anchor bolt details shall be provided by bidder within two weeks' time from the LOI. However, Bidder to provide minimum anchor bolts for the Miscellaneous FGD tanks, as specified in tank schedule.

3.16 A corrosion allowance of 1.5 mm shall be considered for calculating the shell thickness of tanks.

4.0 WELDING

4.1 Welding shall be in accordance with the requirement of IS: 803, 816, 817 and 823 or equivalent and as specified in the specification for lining (Section-I, Sub-Section-C1B).

4.2 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him, which should meet prior approval of the Engineer.

4.3 All welders shall be BHEL / customer / consultant qualified as per the approved quality plan / field quality plan which will be submitted by the successful bidder during detail engineering stage. WPS and PQR shall be submitted by the successful bidder to BHEL / customer / consultant for review and approval.

5.0 TEST AND INSPECTION

5.1 The particulars of the proposed tests and the procedure for the tests shall be submitted to the Owner / Engineer for approval before conducting the tests. The successful bidder shall submit FQP (field quality plan) and demonstration test procedure for BHEL / customer / consultant's approval during detail engineering stage. In the event of any change in the field quality plan and demonstration test procedure, the same shall be incorporated by the bidder in the document and approved document shall be adhered by the bidder without any commercial implication.

5.2 DPT / MPI on all welds (100%).

5.3 All cross / Tee joints and butt welds to be Radio graphed in line with the joint efficiency as specified.

5.4 For the offered tanks, fill test shall be carried out for at least 24 hours. Atmospheric storage tanks on inside surface shall be leak tested before painting/ rubber or glass flake lining.

5.5 All quality plans / checklists for various items shall be furnished during detail engineering stage for BHEL / customer's approval and any changes required by BHEL / customer shall be incorporated in the documents and adhered without any price implication. However, minimum requirement of MQP as indicated in the technical specification shall be followed. All necessary items as required for inspection and testing of the tank including instruments shall be arranged by the bidder.

6.0 MANDATORY SPARES:

Not Applicable.

7.0 LIST OF COMMISSIONING SPARES:

SL. NO.	DESCRIPTION OF ITEMS	QUANTITY
1	Rubber Gasket of each size	2 nos.
2	Nuts, bolts & washers of each size (nos. of bolts, nuts & washers as required for each nozzle) as per approved Drg.	1 lot

3	Any other item required for successful commissioning of the tanks including rubber lining (to be specified clearly by bidder)	1 lot

8.0 TERMINAL POINTS

- Matching counter flanges for all nozzles mounted on the tanks. However, counter flanges for all nozzles of tank shall be provided by the bidder.

9.0 EXCLUSIONS

1) Tank foundation & associated civil works, all instruments like level gauges, Level Transmitters, etc are excluded from bidder's scope of work. However, required no. of nozzles for the same shall be in bidder's scope of work.
2) All agitators including the agitator of drain sumps shall be provided as a free issue item to the bidder. The erection and commissioning of the agitators shall be in bidder's scope of work. However, BHEL shall arrange for the supervision of the erection & commissioning of the agitator assembly to the bidder as a free issue service.
3) The Sumps/drain pits indicated in the **Tank schedule** is excluded from bidder's scope of work. However, the erection and commissioning of the agitators and lining within the sump/drain pits shall be in bidder's scope of work.
4) All valves are excluded from bidder's scope of work.
5) All piping from the counter flange of the nozzles of respective tanks is excluded from bidder's scope of work. However, matching counter flanges for all nozzle shall be in bidder's scope of work. Further the supply and erection of the piping material inside the tank shall be in bidder's scope. The rubber lining of the inlet pipes shall be in bidder's scope of work.
6) **Hoists/Chain pulley blocks for agitator handling is excluded from Bidders's scope. However necessary structural arrangement for handling of agitators shall be in bidders' scope (refer handling arrangement in the GA of tanks attached with the specification).**

10.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

The bidder must submit the drawings / documents as mentioned under "LIST OF DOCUMENTS TO BE SUBMITTED WITH BID" (In Section-III, Annexure-I) along with their bid. In absence of any of these documents, BHEL reserves right not to evaluate the offer of the concerned bidder.

11.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

The successful bidder shall submit the drawing / documents as mentioned under SECTION-I, Sub-Section-D, Annexure-IV during detail engineering for approval / information / reference (as the case may be).

12.0 OTHER TECHNICAL REQUIREMENTS

1) 15 days' time is required by BHEL to offer their comments on the drawings and documents being submitted by the bidder (during detailed engineering stage in the event of L.O.I being placed) from the date of receipt.

2) Bidder to depute competent designer (s) at BHEL's office during detailed engineering stage to discuss drawings and other technical documents as and when required by BHEL.

3) Bidder to assess the capability of their sub-vendors in terms of preparation of drawings, calculations, documents, quality assurance, supply of material etc. as per project schedule before placing the order on them. No deviations shall be entertained.

4) Commercial implication includes price implication as well as delivery implication.

5) Size of hand rails on stairway and tank roof / top shall be minimum 32 NB and shall conform to IS 1239 (M). Handrails shall be galvanized as per painting specification.

6) Type of roof for vertical cylindrical storage tanks shall be either supported cone roof or self-supporting cone roof as per latest edition of relevant design code.

7) Commissioning of tanks will consist of installation of all accessories of tanks as per approved drawing/specification, charging of tank, water-fill test (for minimum 24 hours after complete filling of tank), satisfactory functioning of all accessories, emptying of tank, subsequent painting of complete tanks and changing of gaskets as per specification requirement.

8) Bidder to furnish prices and unit price of each item of proposed tanks as per BHEL's price format only along with the final price bid.

9) Bidder shall check that specifications of all the items are available in the NIT specification. However, in the event of absence of specification for any item, bidder will approach BHEL to furnish the specification of missing items and new specification will be adhered by the bidder for which no commercial implication shall be entertained by BHEL.

10) All tools and plants including welding machines, crane, hydra, etc. and instruments as required for construction, erection and commissioning, trial run and functional demonstration test at site shall be arranged by the bidder.

11) Bidder to furnish list of sub-vendors based on sub-vendor list enclosed with the specification during detail engineering stage for BHEL's / Customer review and approval and items shall be procured from these suppliers only.

12) Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges, counter flanges etc. from BHEL approved sub vendor only. No argument on this account shall be entertained.

13) All rubber lined pipes shall be provided with flanged type connections only. In other words, Rubber lined pipes shall be flange joined only.

SUB SECTION-C1B

SPECIFIC TECHNICAL REQUIREMENTS – RUBBER LINING

1.0 SCOPE OF WORKS

1.1 Design, manufacture, testing and supply of rubber lining material for the duty condition for FGD Tanks as specified in Annexure- 8 (Tank schedule), Section-III.

1.2 Erection and Commission of rubber lining, delivery of material at site, surface preparation for lining surfaces, lining the surface to the satisfaction of the customer shall be under bidder's scope, cost for Erection and Commission shall be included in the offer.

1.3 Ten (10) copies of Operation manuals containing all details of reference drawings and technical data shall be furnished by the Bidder.

2.0 SURFACE PREPARATION

2.1 The Tanks surface to be lined should be blasted to a bright grey metal finish (Sa 2½ requirement), free from rust, weld marks, oil and any other foreign matter. The blasting is carried out with the help of dry grit (copper sludge)/Sand under dry air pressure of 7 kg/cm2 by Compressor. Surface roughness shall be 50-60 Microns.

2.2 After blast cleaning, blasted surface will be applied by surface protecting primer to prevent the corrosion. After 100% blasting of the particular Tank is completed, the surface is cleaned by appropriate solvent, so as to see that all the small dust particles are removed. Sharp corner shall be suitable rounded off. Surface should not have any sharp notch**.**

2.3 After this procedure suitable bonding agent and 3 to 4 coating of the specially formulated rubber adhesive should be applied for proper bonding of the Rubber Sheets to be lined.

2.4 Compressor and any other facilities required for grit/shot blasting shall be arranged by vendor. Any hoses provided in the compressed air line shall be tested with air before commencement of grit blasting job.

2.5 The grit/shot blasting machine shall be provided with safety valve (safe trip) as a protection against over pressure.

2.6 Scaffolding shall be done by the vendor. Any scaffolding provided by the vendor shall be of steel only.

3.0 GUIDELINES FOR DESIGNING AND FABRICATION OF STEEL CONSTRUCTIONS FOR RUBBER LINING:

Please refer Section-II, Sub-Section-A

4.0 RUBBER LINING

4.1 The lining shall completely cover the roof, sides and internals of Slurry Tanks, support angle, insert plates, openings, Man Hole / Inspection / Flange openings. etc.,

4.2 The rubber used for the lining of the tank is given below:

Sl. No	Tank	Rubber Lining details of interior surface / Painting details of interior surface

1	Auxiliary absorbent tank, Limestone slurry storage Tank and Primary hydro cyclone Tank.	Bromobutyl rubber lining with Shore A hardness as 55±5 and **min 4 mm thickness.**
2	Process water Tank, Belt Filter Wash Tank and Clarified (Cake wash) Water Tank.	Epoxy lining of minimum 150 micron thickness (3 coats of 50 micron each)

4.3 After Rubber sheet applied on the surface, rubber sheets should be systematically pressed to the metal surface by the help of mechanical tools like Rubber Rollers and metal thin rollers to remove the air between metal and rubber sheet. All rubber joints are properly overlapped by 25 to 35 mm wide tapered cut rubber sheet. All the joints will be covered by 75 mm X 1.5 - 1.7 mm thick rubber strip.

4.4 Vendor shall specify the shelf life of the rubber material being supplied and shall furnish the storage methods to be followed at site to ensure that the rubber material shall not be spoilt during storage.

4.5 Vendor shall submit the surface preparation and lining procedure to the purchaser for approval. The lining work shall start only after obtaining approval from Purchaser.

5.0 INSPECTION AND TESTING OF RUBBER LINING

1	Ageing Test	:	70°C for 24 hrs. (IS: 3400 Pt.4) Change in Tensile Strength: ± 5% Elongation at break: ± 10%
2	Abrasion Test	:	Wt. loss – Max. 25%
3	Tensile Strength	:	35 kg/cm2 (min) for Bromo Butyl and 40 kg/cm2(min) for Chloro Butyl Rubber
4	Elongation at break	:	≥ 300% minimum for 4mm thk rubber specimen
5	Peeling strength	:	≥ 3 N/mm
6	Hardness	:	55 ± 5° Shore A
7	Spark Test	:	1.5 KV/ mm

8 Lining shall be visually inspected to ensure free from poorly weed out fibers, entrapped air and exposed fires. Defects are to be repaired by slandering a generous area around the defected portion and applying a layer of rubber material.

9 Spark test shall be carried out at appropriate areas in the presence of Purchaser. Vendor should conduct test as per relevant standards.

10 After installation, the Rubber lining shall be subjected to testing at site as per relevant standards. If the performance is found not to meet the requirements as specified, the Rubber lining shall be rectified or replaced by the Vendor without any extra cost to the Purchaser.

6.0 FINISHING & INTERNAL TESTING

6.1 Rubber surface of all flanges and manhole of Equipment will be finished by the mechanical tools to get leakage free surface during commissioning.

6.2 After above finishing, 100% testing will be carried out for continuity by high frequency high voltage spark tester. If there is any puncture, they are checked and rectified as per the standard procedure of repair (Clause 6.1) as mentioned in procedure.

7.0 REPAIRING PROCEDURE

7.1 Faulty spots on the rubber lining are cut off down to be substrate and the seams of the remaining rubber are beveled.

7.2 Rubber sheet with a broad bevel cut is glued on the substrate laid bare.

7.3 On spots to be repaired of a diameter < 300 mm, a second layer of Rubber sheet is glued covering the seams of the first layer.

7.4 Several spots to be repaired in a small area are jointly covered with a second layer of Rubber sheet.

8.0 PERFORMANCE GUARANTEE

The lining material shall be guaranteed for **an uninterrupted minimum life of 25000 hrs**. Performance parameters to be guaranteed by the vendor and tolerances permitted shall be as indicated in the data sheet. Rubber lining or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters. The lining should be guaranteed for faultless material and workmanship. During Guarantee period any defects noticed due to faulty material and workmanship, shall be rectified by vendor free of cost.

9.0 PACKING

9.1 The part items of the Rubber lining should be identified by Tag numbers and should be packed as to minimize the possibility of damage during storage or transit. The packing should be suitable for tropical conditions.

9.2 Please refer Sub Section- C2 – A, SECTION – I for Packing Procedure.

10. DOCUMENTATION

DATA TO BE FURNISHED BY THE VENDOR AFTER RECEIPT OF PURCHASE ORDER:

10.1 List of Drawing and documents to be submitted for review, approval and information with submission dates.

10.2 Quality Assurance Plan to be submitted for approval.

10.3 Detailed dimensional General Arrangement drawing of the lining surfaces.

10.4 Document containing all the design data and information about the material, scope of work and weight of the material supply, Packing procedure etc.

10.5 Installation, operation and maintenance manual.

10.6 Surface preparation procedures.

SUB SECTION-C1-C

SPECIFIC TECHNICAL REQUIREMENTS – GLASS FLAKE LINING

1.0 INTENT OF SPECIFICATION

a) This Specification defines the minimum requirements of glass flake lining of Slurry Tanks/drain sumps in the Flue Gas Desulphurization (FGD) plant.

b) Tanks/Sumps to be lined contain Limestone Slurry/Gypsum Slurry. Slurry details are given in Annexure- 8 (Tank schedule), Section-III. The glass flake lining shall offer better resistance to corrosion/erosion and shall be based on Vinyl ester resin. Thickness of glass flake lining required is 3 mm thk.

c) This specification covers the general design, selection of suitable glass flake material/resin, manufacture, shop inspection (As per latest applicable statutes, regulation and safety codes in the locality where the lining is to be carried out) and delivery at site, surface preparation of lining surface, lining the surface to the satisfaction of the customer, inspection of the lining at site, handling over to the ultimate customer.

d) Compliance to this specification shall not relieve the vendor of the responsibility of furnishing glass flake lining materials of proper design, materials and workmanship to meet the specified requirements.

2.0 CODES AND STANDARDS:

The glass flake lining shall conform to the latest version of Indian/British/American/International Standards. Nothing in this specification shall construe to relieve the contractor of the required statutory responsibility. The Glass Flake Lining material shall be designed for the corrosion protection of the Slurry tank/drain sumps. The lining shall be glass flake filled vinyl ester-based coating system. Only Proven material has to be offered by the bidder. The reference standard are given below:

STANDARD	DESCRIPTION
ASTM D 4285	Standard Test Method for Indicating Oil or Water in Compressed Air
ASTM D 4541	Standard Test Method for Pull-Off Strength of Coating Using Portable Adhesion Testers
ASTM E 337	Standard test Method for Relative Humidity by Wet and Dry Bulb Psychrometer
ASTM D 4618	Standard Specification for Design and Fabrication of Flue Gas Desulfurization System Components for Protective Lining Application
ASTM D 5162	Practice for Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates
NACE Standard RP0178-2003	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be lined for Immersion Service
ISO 8501-1, 1988	Preparation of Steel Substrates Before Application of Paints and Related Products - Visual Assessment of Surface Cleanliness
SSPC"PA2	Measurement of Dry Paint Thickness with Magnetic Gauges

3.0 SCOPE OF WORKS

a) Supply of Vinyl ester based glass flake lining of minimum 3 mm thickness, storage, preparation of the surfaces for lining at site. All equipments required for lining shall be arranged by the lining vendor.

b) Erection and Commissioning of the glass flake lining as per specification. Lining of the internal surfaces of slurry tanks and drain sumps to the satisfaction of the customer and testing the lined surface for proper adhesion, complete coverage and intactness with the base material/surface shall be under bidder's scope.

c) To install the linings, full scaffolding access shall be provided to reach the internal walls and the entire area. Scaffold shall be properly erected with full planking in all work areas. Scaffolding shall not contact wall surfaces in work areas during lining application and surface preparation

d) The execution of the surface preparation and lining shall be carefully planned in stages to obtain optimum lining quality with freedom from contamination and overspray or damage to lined surfaces from preparation in adjacent areas. Surface preparation will commence from the top and proceed progressively to the wall base and floor.

e) Lining and preparation works shall be staggered or proceed progressively in order to meet cleanliness requirements or overcoating times indicated in this specification.

f) Air-Compressor, Airless Spray pumps, hopper, blasting hose, lining hose, spray tip, blasting gun, spray gun and other equipment for blasting and spray application has to be arranged by lining vendor. Any scaffolding shall be made of Steel only.

g) 10 copies of Operation and Maintenance Manuals containing all details of reference drawings and technical data shall be furnished by the Bidder.

4.0 VINYL ESTER BASED GLASS FLAKE LINING

4.1 For slurry tanks, the lining shall completely cover the roof, shell plates, support angle, Man Holes, Flanges, internal piping, baffle plates and any other component which is in contact with slurry. For drain sumps, lining shall cover all internal walls, bottom of sump and any other component which is in direct contact with slurry.

4.2 The glass flake lining used for the lining of the tanks/sumps is given as below:

Sl. No	Tanks/Sumps	Lining details of interior surface
1	Waste water Tank, Secondary Hydro cyclone feed Tank and Filtrate water Tank.	Vinyl ester-based Glass Flake lining of **min 3 mm thickness.**
2	Absorber Area drain sump (3 nos), Gypsum Area drain sump and Limestone Area drain sump.	Vinyl ester-based Glass Flake lining of min **3 mm thickness.**

5.0 ATMOSPHERIC CONDITION REQUIREMENTS

This section deals with the atmospheric condition requirement to be checked while undertaking the Glass Flake Lining at site.

1. Blasting or Coating shall not be applied if following conditions prevail.

- When temperature of the surface to be coated is less than 3°C above the dew point, or the relative humidity is higher than 85%.
- When the base metal temperature is greater than 60°C.
- When the atmospheric temperature is below 4°C.
- When there is, in the opinion of lining Contractor, the likely hood of an unfavourable change in the weather condition within 2 hours after coating.
- When there is deposition of moisture in the form of rain or condensation.

2. Humidity shall be calculated by bidder using whirling hygrometer whose thermometers are calibrated.

3. Surface temperature shall be measured using suitable temperature gauge and calibration certificate of the same shall be provided by bidder.

4. Record will be maintained throughout the execution period. Readings shall be taken once in every 4 hours up to the time work is in progress. The frequency of reading should be increased during adverse weather conditions.

5. While working in unfavourable weather conditions (like monsoons or winters or if provided for in the contract or in large confined spaces where blasting and priming of the entire surface cannot be completed in one day operation, use of dehumidifier shall be resorted to. The dehumidification equipment will have to be maintained in such a way that the humidity is around 65% -75% inside the sump/tank at all times during the work. No flash rusting of the blast surface should take place till the time it receives a primer coat.

6. Where dehumidification equipment is to be used, the humidity readings are to be taken inside and outside the equipments to be coated.

7. Dehumidification equipment may not be necessary for contained space working if work is done at near ideal atmospheric conditions as described above.

8. In cases where dehumidification is not possible, alternate methods of warming up the work front like use of halogen lights, room heaters are to be adopted.

9. Humidity is to be taken at the location where the blasting coating operations taking place.

6.0 PRELIMINARY CHECK REQUIREMENTS

This section deals with the preliminary check requirements to be done while doing the lining work.

6.1 CHLORIDE CONTAMINATION TEST:

The 2% ferricyanide paper method will generally be used to determine the chloride contamination as described below:

1. Apply de-mineralized water on approximate 12 cm² area of substrate and wait for 3 to 4 minutes.
2. Remove excess moisture by patting the substrate with clean lint free cloth.
3. Press a ferricyanide paper of approximate 12 cm² area against the substrate for approximately 5 seconds and remove the paper.
4. Total absence of blue spots on paper indicates the substrate is free from soluble salts
5. Light speckling paper indicates the substrate has still contamination but it is under the acceptance level. The component should be released for further process.
6. Large blue spots on the paper indicate the substrate is heavily contaminated.
7. In this case the following procedure to be done before coating.

7.1.1. Pressures wash the substrate with copious amount of town water.
7.1.2. Dry the substrate completely.
7.1.3. Re-blasts the surface.
7.1.4. Follow the salt contamination checking procedure again till you get the desired results.

8. The Ferricyanide papers should be stored by vendor in air tight container before and after use and the shelf life of Ferricyanide paper shall be one month.

6.2 ABRASIVE DRYNESS CHECK:

The abrasive to be used will be checked for dryness by taking a small quantity of abrasive on a filter /tissue paper and checking of traces of moisture absorbed in the filter/tissue paper. Frequency of test shall be once in day prior to blasting operation.

6.3 COMPRESSED AIR DRYNESS CHECK:

Compressed air to be used for blasting shall be free from oil & moisture and shall be tested adopting "Blotter Test" by vendor. A piece of blasting Paper will be held in front of blast hose nozzle to check for traces of oil/moisture captured by the blotting Paper. Frequency of test shall be once in day prior to blasting operation.

7.0 SURFACE PREPARATION

This section deals with the methods of surface preparation before coating application

7.1 MASKING:

a. Bidder to ensure that areas not being coated are fully and adequately masked.
b. Bidder to ensure that stud holes, dowel/oil ways etc. are suitably masked or plugged to prevent ingress of blasting abrasives.

7.2 SURFACE PREPARATION METHODS:

The method of surface preparation dry abrasive manual blasting shall be done as follows:

a. Surface to be coated shall be abrasive blasted. Before this operation, removal of existing coating to be carried out by chipping, grinding or by other suitable means. The walls of the tanks are painted with min 60µ DFT of Red Oxide Phosphate (rust proof primer), which is to be removed by vendor during blasting. Clean & dry Copper Slag Abrasive shall be used for ferrous base substrate.

b. The minimum recommended compressed air required for Blasting shall be 7.0 m3/min at 6 kg/cm² pressure. NACE No.1/SSPC-SP-5 equivalent to SA 2½ of Swedish Standard blast profile (75 to 100 Microns) to be followed for cleaning the surface.

c. The blasted surface shall be cleaned with dry compressed air/vacuum cleaner or with clean brush so that there is no presence of Dust & other foreign material. The surface will be then checked for chloride contamination (Refer Clause.6.1 for Chloride contamination check procedure). Vendor to ensure that the blasted surface is free from chloride contamination

d. When cleanliness and blast profile are acceptable, the masking tape adjacent to the area to be coated shall be peeled back to prevent overlap and subsequent edge contamination.

e. If the blasted surface has not been primed within specified time or if there is any previous visible sign of blast condition change then the surface shall be checked for metallic salt contamination and shall be reblasted. Where large areas are required to be blasted in a day, blasting shall be carried out from morning to evening ensuring weather condition. This shall be followed by a light sweep blast of the entire area, before priming. The blast cleaned surface shall be blown off with dry oil free compressed air or vacuum cleaned. A cell tape shall be thoroughly pasted to the cleaned surfaces. The tape shall be removed after a minute to check presence of dust if any. Comparator shall be used by vendor for checking the blast profile.

8.0 COATING APPLICATION

This section deals with the methods & requirements of coating application.

8.1 MIXING

a. All coating material tins shall be individually stirred thoroughly to obtain a homogenous consistency.
b. While doing spray application, the tins which come in pre-measured kits will be fully mixed individually using a pneumatic stirrer. While doing hand application only small batches of 1 Kg. capacity shall be taken. Here the mixing will be done by using a metal spatula.
c. The mixing ratios as specified in the respective data sheet will be strictly adhered to. The base will be weighed out in kgs using mechanical weighing machines calibrated at site using any standard factory packed commercial product available freely in the market. The catalyst will be measured out in ML using marked syringes or measuring cylinders.

8.2 APPLICATION PROCESS

a. The preparation and application of coating is done as per relevant product data sheet. Reference will be made to product datasheet or where appropriate, contract specifications for carrying out coating.
b. Coating in confined spaces should be done when the ambient temperature is low to avoid excess build up of styrene fumes.
c. The entire thickness will be built in multiple coating.
d. Each coat will consist of minimum two passes of wet on wet in perpendicular directions.
e. The Dry film thickness will built of each coat will be checked and recorded.
f. All the other people working with the paint will be provided with eye splash goggles and masks.
g. Glass flake lining material shall be chosen considering the slurry conditions given in Annexure- 8 (Tank schedule), Section-III.
h. Minimum and maximum intercoat intervals are as follows.
   i. For primer coat -At 20ºC - minimum 2 hours, maximum 14 hours.
   ii. For build-up coats-minimum tack free of previous coat, maximum 3 days.

i. Primer coat shall be of 75-100 µm thickness
j. Built up Coat shall be of 3000-3100 µm in multiple coats.
k. Total System DFT: 3000 microns approx.
l. All weld joints phase transition joints will receive a stripe coat by brush in the same sequence of coating on the shell.

8.3 CURING & FINISH

a. Curing:

The completed linings shall be allowed to cure for a minimum of 48 hrs at 30°C prior to being placed in service. However, curing time shall be as per the datasheet provided by vendor for a proven material.

b. Finish:

It is to be noted that the coating will follow the profile of substrate. Any unevenness or other defects in the substrate may be reflected in the finish coating also. The finished coating shall have a matt/semi-glossy finish. A few local paint sag marks will not affect performance of coating and cannot be completely avoided. Hence this is permitted.

9.0 INSPECTION AND TESTING OF GLASS FLAKE LINING

After the completion of lining, the following tests shall be conducted by the vendor to assess the quality of glass flake lined surfaces.

a. Lining shall be visually inspected to ensure that it shall be free from poor weed out fibers, entrapped air and exposed fires. The Glass flake lining shall also be subjected to testing at site as per relevant standards.
b. Testing of coatings is normally carried out as soon as they are sufficiently cured to give true thickness & to withstand damage by the test equipment. If defects are found, repair will be carried out as per clause 10.0
c. Spark test shall be carried out at appropriate areas in the presence of Purchaser. Vendor should conduct holiday test as per relevant standards. If the performance is found not to meet the requirements as

specified, the Glass flake lining shall be rectified or replaced by the Vendor without any additional cost to the Purchaser.

d. Proper documentation with details of tests conducted by the vendor for evaluation of glass flake lining shall be submitted to the purchaser.
e. Detailed QAP of glass flake lining shall be submitted by vendor to BHEL during detailed engineering for approval. Any comments given by BHEL/Customer shall be incorporated/complied by vendor without any commercial implication to BHEL.

10.0 REPAIRING PROCEDURE FOR GLASS FLAKE COATING

a. If the exposed or damaged surface is less than 10cm², then such repair can be carried out without grit blasting. Any area in excess of this amount should be grit blasted using a vacuum blaster where possible.
b. In case of damage area less than 10cm², then it can be repaired as following.
   i. De-contaminate surrounding area by using a suitable solvent such as methylated spirit, acetone, xylene etc. After washing clean and allow solvent to evaporate.
   ii. Roughen up exposed metal & clean using rotary wire brush or a coarse emery paper with at least 60 grade grit. Brush away residues then further roughen surface of the existing coating up to 100 mm away from the damaged area. Brush away residues & ensure the whole area is clean.
   iii. Apply a thin coat of material to the surface of the exposed metal only taking care not to cover more than a few millimetres of the existing coating. Allow this freshly applied material to become tack-free.
   iv. Brush styrene monomer over the whole surface to be repaired (i.e. the whole area roughened by emery) & allow to evaporate from the surface.
   v. Apply at least 2 main coats material over the treated area taking care not to brush on to any roughened or contaminated areas. The Glass flake should be allowed to harden sufficiently to bear the weight of next coat before application of further coats. However, it does not need to be tack-free between coats.

11.0 PERFORMANCE GUARANTEE

The lining shall be guaranteed for uninterrupted minimum life of 25,000 hrs. Performance parameters to be guaranteed by the vendor and tolerances permitted shall be as indicated in the data sheet. Glass Flake lining or any portion thereof is liable for rejection, if it fails to give any of the guaranteed performance parameters. During Guarantee period any defects noticed due to faulty material and workmanship, shall be rectified by vendor free of cost.

12.0 PACKING

The packing should be suitable for tropical conditions. Vendor shall make arrangements for storing the Glass flake lining materials in AC containers at site.

13.0 DOCUMENTATION

DATA TO BE FURNISHED BY THE VENDOR AFTER RECEIPT OF PURCHASE ORDER:

13.1 List of Drawing and documents to be submitted for review, approval and information with submission dates.

13.2 Catalogue/Datasheets for the Vinyl ester-based Glass Flake Lining material

13.3 Detailed dimensional drawing of the lining surfaces indicating the design data and information about the material, scope of work and weight of the material supply etc.

13.4 Surface preparation and Lining procedures

13.5 Manufacturing Quality Assurance Plan for Glass flake material and adhesive to be submitted for approval.

13.6 Repair and rectification procedure for Glass Flake lining

13.7 Installation, Operation and maintenance manual.

CUSTOMER SPECIFICATION

SUB SECTION-C2 – A1

CUSTOMER SPECIFICATION: GENERAL TECHNICAL REQUIREMENT

NTPC Limited

(A Government of India Enterprise)

LOT-IA PROJECTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(1A)-2

NTPC Limited

(A Government of India Enterprise)

LOT-IA PROJECTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

FOR

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE

BIDDING DOCUMENT NO.: CS-0011-109(1A)-2

(This document is meant for the exclusive purpose of bidding against this Package and shall not be transferred, reproduced or otherwise used for purposes other than that for which it is specifically issued).

PART - C

GENERAL TECHNICAL REQUIREMENTS

GENERAL TECHNICAL REQUIREMENTS

PART - C

CONTENTS

1.00.00 **INTRODUCTION**

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 **BRAND NAME**

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 **BASE OFFER & ALTERNATE PROPOSALS**

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognised that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.

4.00.00 **COMPLETENESS OF FACILITIES**

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided, shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **RULES, REGULATIONS, CODES & STANDARDS**

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India, NTPC rules/codes of practices as well as of the locality where they will be installed, including the following:

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m.) Explosive Rules, 1983

(n.) Petroleum Act, 1984

(o.) Petroleum Rules, 1976,

	(p.) Gas Cylinder Rules, 1981
	(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
	(r.) Workmen's Compensation Act, 1923
	(s.) Workmen's Compensation Rules, 1924
	(t.) NTPC Safety Rules for Construction and Erection
	(u.) NTPC Safety Policy
	(v.) Any other statutory codes / standards / regulations, as may be applicable.
5.02.00	Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:
	a) Bureau of Indian standards (BIS)
	b) Japanese Industrial Standards (JIS)
	c) American National Standards Institute (ANSI)
	d) American Society of Testing and Materials (ASTM)
	e) American Society of Mechanical Engineers (ASME)
	f) American Petroleum Institute (API)
	g) Standards of the Hydraulic Institute, U.S.A.
	h) International Organisation for Standardisation (ISO)
	i) Tubular Exchanger Manufacturer's Association (TEMA)
	j) American Welding Society (AWS)
	k) National Electrical Manufacturers Association (NEMA)
	l) National Fire Protection Association (NFPA)
	m) International Electro-Technical Commission (IEC)/European Norm (EN)
	n) Expansion Joint Manufacturers Association (EJMA)
	o) Heat Exchange Institute (HEI)

	p) IEEE standard
	q) JEC standard
5.03.00	Other International/ National standards such as DIN, JIS, VDI, EN, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.
5.04.00	Not used.
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant, equipment, civil, structural and architectural works shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.
6.00.00	**EQUIPMENT FUNCTIONAL GUARANTEE**
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.
6.02.00	Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.00.00	**DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**
7.01.00	**DESIGN OF FACILITIES**
	All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere. The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.
7.02.00	**MAINTENANCE AND AVILABILITY CONSIDERATIONS**
	Equipment/works offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list. Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours , clearly defining the spare parts and man-hour requirement for each stage. Lifting devices i.e. hoists and chain pulley jacks ,etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities. Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the contractor for lifting the equipment and accessories covered under the specification.
8.00.00	**DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**
8.01.00	Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely

engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engg and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i) System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii) Technology scan for each system / sub-system & equipment.

iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv) Optimisation studies including thermal cycle optimisation.

v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Operation Philosophy and the control philosophy of the equipments/system covered under the scope.

ix) General Layout plan of the FGD System incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the FGD System.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, process and instrumentation diagrams along with write up and system description.

iv) Performance curves for Absorber

v) Piping isometric, composite layout and fabrication drawings.

vi) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like mills, fans etc. as per criteria specified elsewhere in specification.

ix) Absorber sizing calculations. Absorber performance data.

x) Mass Balance Diagram

xi) Characteristic Curves/ Performance Correction Curves.

xii) Comprehensive list of all terminal points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiii) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xiv) Protection system diagrams and relay settings.

xv) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, and installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report

xxii) Control system configuration diagramsand card circuit diagrams and maintenance details.

xxiii) Detailed Control system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.drawings and documents.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the

scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling, sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

xxxii) Maintenance schedule for Absorber & auxiliaries clearly indicating interval, duration if shutdown required, manhours required and tools & tackles required for maintenance.

The Contractor's while submitting the above documents/ drawings for approval/ reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall make first submission of instruction manual for all the equipments covered under the Contract as per agreed engineering information schedule. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be take during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at

longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the FGD plant layouts shall be made in computerised 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per **Annexure-VI** of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located in FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE (including all

facilities), and any other facility in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, intelligent P&ID correlated with intelligent 3D Model, BOQ, schematics and logic diagrams etc. attached to the respective equipment / systems in the aforesaid 3D model. Contractor shall make a presentation on 3D model every 3 months from LOA to enable NTPC to review the progress of engineering. After the completion of engineering the corresponding complete 3D review model shall be handed over to the employer for its reference.

Contractor shall provide 3D model (which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for employer's review as & when desired by employer. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings of major buildings, structural arrangement drawings and RCC layout drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

b) All documents/text information shall be in latest version of MS Office / MS Excel / PDF FORMAT as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of subvendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder so as to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer piror to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

n) The Contractor shall submit drawings in line with the suggestive MDL covered in Part-B, Section-VI of Technical Specification and which shall be duly integrated with approved PERT network.

8.04.00 **ENGINEERING INFORMATION SUBMISSION SCHEDULE**

Prior to the award of Contract, a Detailed Engineering Information Submission Scheduler/Master Drawing List duly integrated with approved PERT network shall be tied up with the Employer. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorized into the following parts.

i) Information that shall be submitted for the approval to the Employer before proceeding further, and

ii) Information that would be submitted for Employer's information only.

The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.05.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

8.06.00 Engineering Co-ordination Procedure

8.06.01 The following principal coordinators will be identified by respective organizations at time of award of contract:

NTPC Engineering Coordinator (NTPC EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :

Designation :

Address :

a) Postal :

b) Telegraphic / e-Mail :

c) FAX : TELEPHONE :

8.06.02 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

8.06.03 Contractor's/Vendor's Drawing Submission and Approval Procedure:

a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings".

b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Employer before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.

c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his subvendor along with his purchase order for subvendor's compliance.

d) Employer and contractor shall follow their own numbering systems for the drawings. However, Employer shall intimate the contractor, NTPC drawing number on receipt of the first submission of each drawing. Vendor,

thereafter, shall indicate NTPC's drawing number in subsequent Submission, in the space provided for this purpose in title plate, in addition to his own drawing number.

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.

g) The Contractor shall submit adequate prints of drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within four (4) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories :

CATEGORY- I:	Approved
CATEGORY- II	Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.
CATEGORY –III	Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.
CATEGORY -IV	For information and records.

h) Contractor shall resubmit the drawings approved under Category II, III & IVR within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (eg. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the

Contractor shall resubmit the drawing identifying the changes for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

9.00.00 **TECHNICAL CO-ORDINATION MEETING**

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

9.02.00 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Contractor shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Contractor will be reviewed by the Employer as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Employer shall then be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.

9.02.01 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

9.02.02 Should any drawing remain unapproved for more than six (6) weeks after it's first submission ,this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

9.03.0 Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.

10.00.00 **DESIGN IMPROVEMENTS**

The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

11.00.00 **EQUIPMENT BASES**

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

12.00.00 **PROTECTIVE GUARDS**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00 **LUBRICANTS, SERVO FLUIDS AND CHEMICALS**

13.01.00 I. All the first fills of consumables and one years topping requirement of consumables such as greases, oil, lubricants, servo fluids / control fluids, gases and essential chemicals etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall

	be supplied by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder shall supply a quantity not less than 10 % of the full charge or one (1) year topping requirement mentioned above (whichever is higher) of each variety of lubricants, servo fluids, gases, chemicals etc (as detailed above) which is expected to be utilized during the first year of operation. The additional quantity shall be supplied in separate container.
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.
14.00.00	**LUBRICATION**
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.
15.00.00	**MATERIAL OF CONSTRUCTION**
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.
16.00.00	**RATING PLATES, NAME PLATES & LABELS**
16.01.00	Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

16.03.00 Such nameplates or labels shall be of white nonhygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back. The name plates shall be suitably fixed on both front and rear side.

16.04.00 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

16.05.00 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support or hanger.

16.06.00 Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

16.07.00 Safety and relief valves shall be provided with the following:

a) Manufacturer's identification.

b) Nominal inlet and outlet sizes in mm.

c) Set pressure in Kg/cm^2 (abs).

d) Blowdown and accumulation as percentage of set pressure.

e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

16.08.00 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 **TOOLS AND TACKLES**

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment,

checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. In case these tools and tackles are used by the Contractor during erection, commissioning or initial operation the same shall be refurbished repaired/replaced as required to the satisfaction of the Employer before handing over to the Employer. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00 **WELDING**

18.01.00 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.

19.00.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

19.01.00 All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

20.00.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

20.01.00 **PROTECTION**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.

20.02.00 **PRESERVATIVE SHOP COATING**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the

	equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.
20.03.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.
20.04.00	All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.
20.05.00	All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.
20.06.00	Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.
21.00.00	**QUALITY ASSURANCE PROGRAMME**
21.01.00	To ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. A quality assurance programme of the contractor shall generally cover the following: a) His organisation structure for the management and implementation of the proposed quality assurance programme b) Quality System Manual c) Design Control System

d) Documentation Control System

e) Qualification data for Bidder's key Personnel.

f) The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

h) Control of non-conforming items and system for corrective actions.

i) Inspection and test procedure both for manufacture and field activities.

j) Control of calibration and testing of measuring testing equipments.

k) System for Quality Audits.

l) System for indication and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling storage and delivery.

o) System for maintenance of records, and

p) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per formats enclosed as **Annexure-I** and **Annexure-II** respectively.

22.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

22.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.

22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM (As per format at Annexure-I)
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site (As per format at Annexure – II).
22.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.
22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch

	Clearance Certificate (MDCC).
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.
22.11.00	Welding procedure qualification & Welder qualification test results shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorized representative.
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping system ASME B31.1 or other relevant code as applicable shall be followed. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
22.14.00	No welding shall be carried out on cast iron components for repair.
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination) or equivalent. NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

	In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be ultrasonically tested.
22.17.00	The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the sub-contractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format No. QS-01-QAI-P-01/F3. The contractor's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Monthly progress reports on sub-contractor detail submission / approval shall be furnished preferably on enclosed format at **Annexure-IV.** Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
22.18.00	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the

mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

22.21.00 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

22.22.00 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

22.23.00 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

22.24.00 **Environmental Stress Screening**

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following.

1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

Or

In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service

with load on various components being equal to those which will be experienced in actual service.

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

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

2) <u>Burn in Test Cycle</u>

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

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

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

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

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

23.00.00 **QUALITY ASSURANCE DOCUMENTS**

23.01.00 The Contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓)mark.

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

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

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

23.02.00 Typical contents of QA Documentation is as below:-

(a.) Quality Plan

(b.) Material mill test reports on components as specified by the specification and approved Quality Plans.

(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

23.03.00 Similarly, the contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

23.04.00 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The

supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the despatch of equipment.

23.05.00 **TRANSMISSION OF QA DOCUMENTATION**

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery of equipment.

24.00.00 **PROJECT MANAGER'S SUPERVISION**

24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.

24.02.00 The work shall be performed under the supervision of the Project Manager.

The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract

(d.) Inspect, accept or reject any equipment, material and work under the contract

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

25.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

25.01.00 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

25.02.00 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

25.03.00 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two

	(2) copies.
25.04.00	The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
25.05.00	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
25.06.00	In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 25.03.00 of this chapter, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

25.10.00	**Associated document for Quality Assurance programme**
25.10.01	Manufacturing Quality Plan Format No. : QS-01-QAI-P-09/F1-R1 enclosed at **Annexure-I.**
25.10.02	Field Quality Plan Format No.: QS-01-QAI-P-09/F2-R1 enclosed at **Annexure-II.**
25.10.03	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 **(Annexure-III).**
25.10.04	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at **Annexure-IV.**
25.10.05	Field Welding Schedule Format enclosed at **Annexure-V.**
25.11.00	**Not Used**
25.12.00	**DEMONSTRATION OF APPLICATION ENGINEERING**
25.12.01	Based on NTPC inputs, the Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following. (i) Logics/Loops: a) Drive logics implementation for each type of binary drive along with its display in HMI. b) Sequence implementation along with its display in HMI. c) Single non-cascade controller implementation. d) Cascade loop implementation. e) Master slave implementation with different slave combination. f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable. (ii) HMI Functions: a) LVS Annunciation. b) Graphics. c) HSR d) Logs/Reports.

e) Calculations (Basic & Performance Calculations).

25.12.02 The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.

After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor based on NTPC inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Employer and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.

25.12.03 During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.

26.00.00 **PRE-COMMISSIONING AND COMMISSIONING FACILITIES**

26.01.00 (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.

(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs(standard check list)/TS(testing schedule)/CS(commissioning schedule)] approved by the employer.

(f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

26.01.00 Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain:

(1.) Biodata including experience of the Commissioning Engineers.

(2.) Role and responsibilities of the Commissioning Organisation members.

(3.) Expected duration of posting of the above Commissioning Engineers at site.

26.02.00 **Initial Operation**

(a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

(b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the FGD System shall operate continuously at full load for a period not less than 72 hours.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

(c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.

(d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with- holding the aforesaid permission.

26.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. The contractor's Commissioning, start-up and initial operation shall make the unit ready to conduct such test. Such test will be commenced, within a period of **three (3) months** after the successful completion of Initial Operations. Any extension of time beyond the above **three (3) months** shall be mutually agreed upon.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.

27.00.00 **TAKING OVER**

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with held nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

28.00.00 **TRAINING OF EMPLOYER'S PERSONNEL**

28.01.00 **Training for Employers O&M Personnel**

The scope of service under training of Employer's engineers shall include a training module covering upto six (6) man months in the areas of Operation & Maintenance.

Such training should enable the personnel to individually take the responsibility of operating and maintaining the FGD system in a manner acceptable to the Employer.

28.02.00 **Training for Employers Engineering Personnel**

The scope of services under training for Employer's engineering personnel shall also necessarily include two (2) manmonth. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Employer's Engineering personnel is attached as Annexure-VII.

28.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Employer's approval. Consolidated training period included above {i.e. 6 man months (7 man months in case of projects where ZLD system is included in scope) and 3 man months (4 man months in case of projects where ZLD system is included in scope) respectively for O&M and

Engineering) is indicative only. Employer reserves the right to re appropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.

28.04.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.

28.05.00 In all the above cases, wherever the training of Employer's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Employer's personnel shall be at the cost of Contractor. The Contractor shall make all necessary arrangements towards the same.

28.06.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award.

Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.

29.00.00 **SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION**

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

i) Working platforms should be fenced and shall have means of access.

ii) Ladders in accordance with Employer's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

30.00.00 **NOISE LEVEL**

The equivalent 'A' weighted sound pressure level measured at a height of 1.5 m above floor level in elevation and at a distance of one (1) metre horizontally from the nearest surface of any equipment/machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA . However for Ball Mills the noise levels as per following shall also be acceptable:

a) Ball Mill < 90 dBA

31.00.00 **PACKAGING AND TRANSPORTATION**

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the

time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Contractor shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

32.00.00 **ELECTRICAL EQUIPMENTS/ENCLOSURES**

32.01.00 All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specifications.

33.00.00 **INSTRUMENTATION AND CONTROL**

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

33.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

1 Temperature	-	Degree centigrade (deg C)
2. Pressure	-	Kilograms per square centimetre (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
3. Draught	-	Millimetres of water column (mm wc).
4. Vacuum	-	Millimeters of mercury gauge (mm Hg) or water column (mm Wcl).
5. Flow (Gas)	-	Tonnes/ hour

	6. Flow (Steam)	-	Tonnes/ hour
	7. Flow (Liquid)	-	Tonnes / hour
	8. Flow base	-	760 mm Hg. 0 deg.C
	9. Density	-	Grams per cubic centimeter.

33.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plan-in connection at rear.

33.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalised & components shall be of industrial grade or better.

34.00.00 **ELECTRICAL NOISE CONTROL**

The equipment furnished by the Contractor shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Contractor's equipment which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-61000-2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems as per EN-50082-2 (1995).

35.00.00 **SURGE PROTECTION FOR SOLID STATE EQUIPMENT**

All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates. etc. shall be submitted by the Bidder.

36.00.00 **INSTRUMENT AIR SYSTEM**

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

37.00.00 **TAPPING POINTS FOR MEASUREMENTS**

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Contractor will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Contractor.

i) Temperature test pockets with stub and thermowell

ii) Pressure test pockets

38.00.00 **SYSTEM DOCUMENTATION**

The Bidder shall provide drawings, system overview & description, hardware/ software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C& I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Employer during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Techncial Data Sheets" Part of specifications. In addition to this, system documentation for control system shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

38.01.00 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Employer.

39.00.00 **MAINTENANCE MANUALS OF ELECTRONIC MODULES**

The Contractor shall have to furnish two (2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further , the contractor shall furnish a set of operating manuals which should include block diagrams ,make, model/type ,details wiring and external

connection drawings etc as required to do the testing and maintenance of the electronic modules.

LIST OF CODES AND STANDARDS

Indian Standards	Title	International and Internationally recognised standards
IS:277	Galvanised steel sheets (plain or corrugated)	
IS:655	Specification for metal air duct	
IS:800	Code of practice for use of structural steel in general building construction	BS 449:1969 BS 5950 ASA A57, 1-1952
IS:807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia). DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960 BS 1757:1951 BS 2573:part-I:1960	Draft Revision of A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than earthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)	National Building code of Canada (1953)-Part-IV Design section 4.1

IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)
IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for perform-ance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	
IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957

IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diametre)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocrystallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	
IS:4503	Shell and tube type heat Exchanger	

	IS:4540	Specification for monory-stallines rectifire assembly equipment	
	IS:4671	Expanded polystyrene for thermal insulation purpose	
	IS:4736	Hot dip zinc coating on steel tubes	
	IS:4894	Centrifugal fans	
	IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
	IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
	IS:6392	Steel pipe flanges	BS 4504 : 1969
	IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
	IS:7098	Cross linked Polyethylene insulated PVC sheathed cables	Standard No. 1 to IPCEA (USA) Pub. No. 5-66-524
	IS:7373	Specification for wrought aluminium and aluminium sheet and strips	
	IS:7938	Air receivers for compressed air installation	
	ISO:1217	Displacement compressor-Acceplance test	
	ASHRAE-33 and air heating coils.	Methods of testing for rating of forced circulation air cooling	
	ASHRAE-52-76 particle matter.	Air cleaning device used in general ventilation for removing	

ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.
ASHRAE 23-67	Methods of testing for rating of positive displacement refrigerant compressors.
ARI-450-6	Standard for water cooled refrigerant condensers.
ARI-550	Standard for centrifugal water chilling packages.
ARI-410	Standard for forced circulation air cooling and air heating coils
ARI-430/435 BS:848 (Part-1,2)	Central station AHU/Application of Central Station AHU Fans
BS:400	Low carbon steel cylinders for the storage & transport of permanent gases.
BS:401	Low carbon steel cylinders for the storage & transport of liquified gases.
CTI Code ACT-105	Acceptance test code for Water Cooling Tower.
ANSI-31.5	Refrigerant piping
ASME-PTC-23-1958	Atmospheric Water Cooling Equipment
AMCA A-21C	Test Code for air moving devices
API:618	Reciprocating Compressor for general refinary services.

HYDRAULIC INSTITUTE STANDARDS.

HYDRANT SYSTEM MANUALS OF TAC.

TAC MANUALS OF SPRAY SYSTEM

NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.