NTPC LIMITED.

4 X250 MW BRBCL NABINAGAR TPP

TECHNICAL SPECIFICATION
FOR
AGITATORS OF FGD SLURRY TANKS

SPECIFICATION NO.: PE- TS- 463 - 571- 18000- A003

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

	4x250 MW BRBCL NABINAGAR TPP	SPEC No: PE-TS-463-571-18000-A003
	TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION
		REV. 00
		DATE OCT 2021

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INTENT OF SPECIFICATION

	TITLE:	SPECIFICATION No: PE-TS-434-571-18000-A009	
	4X250MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATIONS FOR AGITATORS OF FGD SLURRY TANKS	SECTION-I, SUB-SECTION-A	
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1.0 SCOPE OF ENQUIRY/ INTENT OF SPECIFICATION

1.1 The specification covers Supply part, Services part and Mandatory spares 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, fill of lubricants & consumables till handing over, mandatory spares along with spares for erection, start-up and commissioning, forwarding, proper packing, shipment and delivery at site, assembly AND services part covers supervision services for erection & commissioning, trial run at site and carrying out Performance guarantee tests at site, training of customer/ client O&M staff covering all aspects of the Agitator- Operation & Maintenance, Troubleshooting etc., training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding) & handover in flawless condition of the package to the customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification, amendment & agreements till placement of order for Flue Gas Desulphurization (FGD) plant of 4X250 MW NABINAGAR TPP, Distt. Aurangabad, Bihar of M/s BHARTIYA RAIL BIJLEE COMPANY LTD, a Joint Venture amongst INDIAN RAILWAYS AND NTPC LTD. The following points may be noted.

a. **Agitators are part of various slurry tanks**, details of which are given in Technical Information of Agitators.

b. Bidder shall assume full unit responsibility for the entire equipment assembly and make all possible efforts to comply strictly with the requirements of this specification and other specifications/attachments to inquiry/order.

c. The Bidder shall offer only proven design which meets the Provenness /Pre-qualification requirement of NTPC. Necessary document evidences as per Attachment-3K for qualification shall be submitted along with the bid. If bidder doesn't meet the specified Provenness criteria, their offer will be rejected.

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 **Agitators for FGD slurry tanks.**

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

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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.

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.-II 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 along with cost of withdrawal in the enclosed schedule (in Section -II); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/it's customer.

1.9 In the event of any conflict between the requirements of two clauses of this specification & requirements of different codes/standards and between respective clauses of sub-section C & sub-section D, more stringent clause as per the interpretation of the owner shall apply.

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

1.11 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.

1.12 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.

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1.13 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.

1.14 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.

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

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

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PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

PROJECT INFORMATION - 4X250 MW BRBCL NABINAGAR TPP

CLAUSE NO.	PROJECT INFORMATION

1.00.00 BACKGROUND

Details of proposed Stage / Units

Project name	:	Nabinagar TPP
No. of Units x capacity	:	4 x 250 MW
Project setting up by	:	NTPC(FOR BHARTIYA RAIL BIJLEE COMPANY LTD.)

The SG with ESP package and TG package of the subject project is being executed by M/s. BHEL.

1.01.00 LOCATION AND APPROACH

Project Location	:	(i) Place : Nabinagar
	:	(ii) District : Aurangabad
	:	(iii) State : Bihar
Latitude and Longitude of project location	:	North : 24 deg. 42' 30" (N) East : 84 deg. 05' 36" (E)
Nearest Railway station	:	Dehri-On-Sone
Distance of project location from the Railway station	:	30 KM (Approx.)
Nearest MajorTown	:	Aurangabad
Distance of the town from the Project site	:	50 KM
Nearest CommercialAirport	:	Gaya
Distance of airport from the project site	:	100 KM
Nearest Highway	:	National Highway-2
Distance from nearest highway point to the site	:	25 KM
Vicinity plan	:	Vicinity plan of the project enclosed at Annexure-I.
Any other information	:	Further to the information given in this sub-section, Bidders are advised to visit the project site and collect data on local site conditions.

CLAUSE NO.	PROJECT INFORMATION		
1.02.00	**LAND REQUIREMENT**		
	Total area of land acquired for the project	:	1700 Acres
	Any other information	:	Approximately 1700 acres of land has been identified near Dhundhua village for the Plant, Township and Ash Disposal Area. In principle commitment for the availability of land for Plant, Township and Ash Disposal Area has been obtained from Revenue Department, Govt. of Bihar vide letter dated 29.3.2003. Further, Central Coalfields Ltd., (CCL) vide their letter dated 29.05.03 have indicated that Central Mine Planning & Design Institute Ltd (CMPDI) have confirmed that plant location along with its other allied infrastructure are not coming on coal bearing area.
1.03.00	**WATER**		
	Nearest Water Source	:	The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms from the proposed site.
	Proposed water requirement for the Stage	:	60 Cusec
	Proposed source / arrangement to the meet the water requirement	:	The project site is located near the river Sone which is the only source of water for the project. Therefore, the make up water requirement for the project is proposed to be drawn from the pondage created by Indrapuri Barrage, which is about 3 kms. from the proposed site. The make up water requirement for the project operating on cooling towers is about 4300 cubic m/hr with ash water recirculation system and about 5900 cubic m/hr. with once through ash water system. Water Resource Department, Govt. of Bihar, accorded in-principle clearance of 60 cusecs of consumptive water from upstream of Indrapuri Barrage vide their letter dated 06.03.03.

CLAUSE NO.	PROJECT INFORMATION
1.04.00	**COAL and WATER, Utility details:** (i) Coal Quality Parameters and Fuel Oil Characteristics Source:Pachra and Pachra south blocks in North Karanpura coalfields Requirement: 5 MTPA The Coal quality parameters and Fuel Oil Characteristics are enclosed at Table-1, & Table-2A & 2B of this Sub-Section. **Water data** (ii) Process water: Process water quality based on COC in Table-3. (iii) Clarified water: Clarified water quality is indicated in Table-3. (iv) DM water for Equipment cooling water system. 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	**RAILWAY SIDING** For bringing the equipment and material to the power house through rail, railway siding is proposed to be constructed from nearest railway station.
4.00.00	**METEOROLOGICAL DATA** Meteorological data of the nearest observatory Dehri station is enclosed as Annexure-II to this subsection.
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:

Steel structures	2%
Reinforced Concrete structures	5%
Reinforced Concrete Stacks	3%
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).

CLAUSE NO.	PROJECT INFORMATION
	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 ($\overline{V}_B$) 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 $\overline{V}_B$/ V_B. However, no reduction is permitted if $\overline{V}_B$ 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
   f) for Steel chimney, Absorber tower : 0.06

   g) 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 New Nabinagar project

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.050	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

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
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
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

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRAL COEFFICIENTS
In units of 'g' for New Nabinagar project

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
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
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

SPECIFIC TECHNICAL REQUIREMENT – MECHANICAL

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1.0. APPLICABLE CODES & REGULATIONS

The design and materials shall conform to the requirements of applicable codes and regulations of the latest edition. The design, manufacture, installation and testing of the Agitator shall follow the latest applicable Indian/International (AISI / ASME/EN/Japanese) Standards.

Bidder shall supply the equipment in accordance with relevant regulations, codes and standards specified in the specification. If required by relevant regulations, codes and standards specified in the specification, Successful Bidder shall assist BHEL to obtain approval against the equipment, documents and drawings by Indian authorities.

2.0. PROVENNESS CRITERIA/Pre-QUALIFICAITON REQUIREMENT

The Bidders are required to meet the Qualification Requirement (PQR) for Agitators as per Proven-ness Criteria & shall submit the credentials as called in the tender document. Bidder shall submit the Annexure to qualification requirement (Attachment-3k). Only OEMs qualifying as per the Qualification requirement shall be considered for placement of order.

3.0. TECHNICAL INFROMATION

3.1 AGITATOR DETAILS:

For agitators refer "Agitator Schedule" in Section-II, Annexure-8 of the specification.

3.2 MATERIAL OF CONSTRUCTION

	Material of construction	Horizontal agitators (side entry)	Vertical Agitators (Top entry)
i.	Impeller blade	Alloy 926 or better material	Alloy 926 or better material
ii.	Impeller Hub	Alloy 926 or better material	Alloy 926 or better material (or) Carbon steel with 6mm thick Bromo/Chloro Butyl Rubber Lining (as per Proven practice)
iii.	Shaft	Alloy 926 or better material	CS with Rubber Lining (min 6 mm thk Chloro/bromo butyl Rubber)
iv.	Fasteners in wetted parts	Alloy 926 or better material	Alloy 926 or better material
v.	Fasteners in Non Wetted	GI fastener (40 µ plated) / SS	GI fastener (40 µ plated) / SS
vi.	Mounting base	Alloy 926/SMO254 (Wetted parts)	Carbon Steel
vii.	Tank Nozzle (for inserting agitator) with Flange	Not applicable (in BHEL scope)	Not applicable (in BHEL scope)
viii.	Flush pipe for Start up with flange	Not applicable	Not applicable
ix.	Tank nozzle with flange (for Flush Pipe)	Not applicable	Not applicable
x.	Agitator Support Leg	Carbon Steel	Not applicable

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3.3 POWER SUPPLY DETAILS:

1.	**POWER SUPPLY**	
	The following voltage levels shall apply:	
	3 phase, 6.6 kV AC ,50 Hz	Voltage for motors rated 175 kW and up to 1500 kW and for power distribution within the plant.
	3 phase, 415 V, AC , 50 Hz	Standard voltage for power supplies to electric power consumers and motors Above 0.2 KW and up to 175 kW.
	1 phase 240V AC / 3 phase 415 V AC, 50 Hz	Standard voltage for power supplies to electric power consumers and motors Up to 0.2 kW.
	1. All equipments at 415V voltage level shall be suitable for voltage variation of ±10% and rated frequency of 50 Hz with a variation of + 3% to -5%, and 10 % (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification. 2. Bidder shall design and supply the equipment suitable for satisfactory operation under above mentioned power supply condition. 3. For further details refer electrical specification under Section-I, Sub-Section-C3	

3.4 AGITATOR ARRANGEMENT

Auxiliary Absorbent Tank Agitator:

For arrangement of Agitators please refer "SIZING CALCULATION, SELECTION PARAMETER FOR ALL TANKS" under Annexure-III, Sub-Section-D, Section-I.
These Agitators will operate continuously when Limestone / Gypsum Slurry is evacuated from Absorber for any Absorber maintenance work.

a) Other Slurry Tank Agitator:

For arrangement of Agitators please refer "SIZING CALCULATION, SELECTION PARAMETER FOR ALL TANKS" under Annexure-III, Sub-Section-D, Section-I.

These Agitators will operate continuously for FGD system operation.

b) Drain Pit Tank Agitators:

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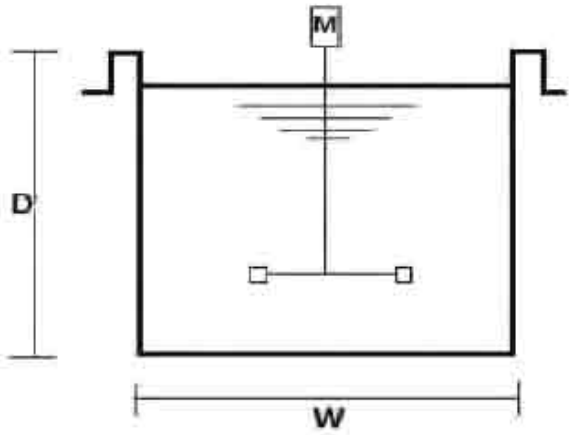

For details of Drain Pits please refer "AGITATOR SCHEDULE" Section-II, Annexure-8 of the specification. These Agitators will operate continuously for FGD system operation.

4 SCOPE OF SUPPLY & SERVICES

The bidder shall assume sole responsibility for the design, fabrication, testing, surface preparation & painting, packing, transportation and performance of the specified equipment with accessories, and shall ensure that the equipment with accessories are in conformance with this specification, as well as other documents which form part of the Purchase Order/Contract.

Various inspections by the BHEL/NTPC shall not relieve the Bidder in any way of his obligation to maintain an adequate test, inspection, and documentation program of his own, and shall not relieve the Bidder of any other obligation under this specification. Furthermore, any inadvertent overlook of deviations from some requirements of this specification by the buyer shall not constitute a waiver of these requirements, or of the Bidder's obligation to correct the condition when it is discovered, or of any other obligation under this specification.

This specification only states the lowest technical requirement, neither specifying all technical details, nor referring the pertaining code and standard fully. It is the Bidder's responsibility to ensure that the complete delivery complies with all relevant codes, standards and specifications.

The Bidder is obliged to supply relevant drawings and documentation to the buyer. All to be in English language and metric system, if not otherwise agreed in writing.

Scope for the bidders shall include Design, Manufacturing, Supply, and Supervision of Erection & Commissioning

Design: Broadly includes basic engineering, detail engineering, preparation and submission of engineering drawings/calculations/datasheets/quality assurance documents/field quality plans, storage instructions, commissioning procedures, Erection & assembly Drawings, operation & maintenance manuals, performance guarantee test procedures and assisting BHEL in obtaining time bound approval from customer.

Supply: The scope includes the following:

- Includes manufacturing/fabrication, shop floor testing, stage inspections, final inspections, painting & packing.

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- Mandatory spares as defined as Section-I, Sub-Section-D, Annexure-II.
- Recommended spare parts list to be furnished (is not part of scope of supply)
- Any special tools & tackles required for the entire equipment to disassemble assemble or maintain the units.
- Start-up & Commissioning Spares
- First fill of consumables

Services: Services to be provided by the bidder:

- Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL.
- Supervision for Erection & Commissioning, trial run at site
- Performance guarantee tests at site & handover in flawless condition of the package to the customer
- Training of customer/ client O&M staff covering all aspects of the Agitators - Operation & Maintenance, Trouble-shooting etc. at site
- Training of customer at manufacturer's works (3 persons for 2 days including lodging and boarding)
- Visits shall be planned by BHEL site team and prior intimation shall be sent to supplier for visit to site for supervision services. Bidder shall be informed at least 10 days in advance for the requirement of visit at site. Visiting team shall consist of one or two expert of bidder as deemed necessary by them.
- Bidder shall prepare the model of all Agitators under scope in an integrated & intelligent 3D software solution using rule-based, data centric 3D Design software with equipment drawings, data sheets, BOQ, schematics and logic diagrams etc. in the aforesaid 3D model. After the completion of engineering the corresponding complete 3D review model shall be handed over to BHEL.

The scope of supply for AGITATORS shall include but not limited to the following:

A) <u>For Horizontal (Side Entry) Agitators:</u>

Sl. No	Scope	
1.	AGITATOR complete with	
	i.	AGITATOR Blades
	ii.	AGITATOR Shafts
	iii.	Coupling arrangement (Flexible)
	iv.	Single Mechanical Seals
	v.	Shaft Sleeve
	vi.	Lanterns/ Stools (Bearing Housing), Safety Guard
	vii.	Bearings
	viii.	Agitator Mounting Flanges with gaskets and fasteners
	ix.	Drive Motor(IE3) with gearbox arrangement
	x.	Supporting arrangement including tie rods, gusset plates etc. of Side Entry Agitator on the tank Wall. Vessel Nozzle and mating flange for supporting on the tank wall, gaskets and fasteners.
	xi.	VOID.
	xii.	Foundation plate with foundation bolts, vessel nozzle
	xiii.	Painting and Rust Prevention during shipment and construction
	xiv.	Packing and transportation

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Sl. No	Scope	
	xv.	Supervision of Erection & commissioning at site
	xvi.	Special tools & tackles as applicable
	xvii.	Start-up spares, Spare parts for commissioning & erection, Mandatory Spares: As per Project Specific Requirement
	xviii.	Installation, operation and maintenance manuals
	xix.	Any other items required for completeness of the equipment except the items covered in the exclusions.

B) For Vertical (Top Entry) Agitators:

Sl. No	Scope	
2.	AGITATOR complete with	
	i.	AGITATOR Blades
	ii.	AGITATOR Shafts
	iii.	Coupling arrangement (Flexible)
	iv.	Gland Packing, Seals, O Rings, Glands
	v.	Shaft Sleeve
	vi.	Lanterns/ Stools (Bearing Housing), Safety Guard
	vii.	Bearings
	viii.	AGITATOR Mounting Flanges with gaskets and fasteners
	ix.	Drive Motor(IE3) with gearbox arrangement
	x.	Mating Flange for Supporting on Slurry Tank Roof
	xi.	Shims
	xii.	Painting and Rust Prevention during shipment and construction
	xiii.	Packing and transportation
	xiv.	Supervision of Erection & commissioning at site
	xv.	Special tools & tackles as applicable
	xvi.	Start-up spares, Spare parts for commissioning & erection, Mandatory Spares: As per Project Specific Requirement
	xvii.	Installation, operation and maintenance manuals
	xviii.	Any other items required for completeness of the equipment except the items covered in the exclusions.

The quantity, location of the agitators have been included in the agitator schedule (Section-II, Annexure-8)

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4.1	TECHNICAL REQUIREMENTS
I	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.
II	All agitators shall be designed for continuous operation unless otherwise specified. The design of the agitators shall be of proven type.
III	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.
IV	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.
V	The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Auxiliary Absorbent Tank Agitators shall be made with Alloy 926 or better material. For Agitators in other tanks, agitator blades shall be made with Alloy 926 or better material and shaft can be rubber lined (minimum 6 mm thick Chlorobutyl Rubber). This does not release the bidder of the responsibility for selecting the correct materials.
VI	Each agitator and its associated equipment shall be arranged in such a manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the side mounted agitators without having to drain completely the slurry inside the tank.
VII	-VOID-
VIII	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
IX	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly. Any deviation to this requirement is subject to customer approval during detailed engineering based on applicable codes and standards to be furnished by the bidders.
X	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.
XI	All exposed moving parts shall be covered by guards.
XII	The shape of the impeller blades of side entry agitators/top entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of slurry specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.
XIII	Belt drives (If applied for side entry agitators) shall be properly designed to provide a minimum lifetime of 2 years under design conditions
XIV	It shall be noted that all Agitators are meant for keeping the solid particles in suspended mode in liquid with "Full Off-Bottom Suspension" of solid particles to 98% of liquid column to virtually "Uniform Solid Concentration". No chemical reaction will take place.
XV	Maintaining a uniform concentration over the 95% of liquid column. Absolute sweeping of solid particle from tank bottom is a must for all Agitators. If speed is required to be increased to guarantee the above requirements; the same can be increased by vendor. Bidder's machines that consume less power will be in an advantageous position.
XVI	It is to be noted that in continuous process any deposit at tank bottom is the loss of material which are not getting converted as per process. Hence, total loss of material by sedimentation is a loss to FGD Process & determines the "In efficiency of the Agitator".
XVII	Vendor should ensure nil settlement; utilization of solid material shall be a guaranteed

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	parameter and will be assessed in percentage (%) term to net wet of solid mass of inflow or out flow. This is one of the guarantee parameter.
XVIII	Agitator and its driver shall perform on the test stand at shop and on the Agitator's permanent location at site within vibration limit. The vibration of combined unit will be the responsibility of Agitator manufacturer. Agitator manufacturer is to ensure that Site performance of vibration is one of the "Acceptance Criteria" of the equipment. Please note that vibration at test stand can only be taken as "for information".
XIX	Every Tank will have a pump whose suction line shall be connected to tank. These pumps are to operate continuously at the lowest operating level which is decided by Process requirement. Hence, the minimum operating level of liquid in every tank for every Agitator is a must to assess the combined operation of Agitator as well as that of pump alone. The Tank water level is indicated in "SECTION-II Annexure-8". Any minor change in liquid level required by Agitator supplier will be accommodated only if it is acceptable to the pump supplier.
XX	Agitator must have low-pitch propeller with low solidity ratio and Power Number. The Maximum Input Power at motor terminal shall be considered as a guaranteed parameter under "Guaranteed Power Consumption Format" in "SECTION-II Annexure-11- and the same shall be calculated for maximum liquid level in tank. A calculation of power specifying the hydraulic power of Agitator, Seal loss, Gear box and Motor internal loss must be submitted along with the offer. A characteristics curve showing power versus liquid level should be submitted from the lowest liquid level, required for Agitator to maximum liquid level in the tank. Motor should be selected based on the highest power demand with a 10%margin at maximum liquid level, taking into account frequency variation.
XXI	The agitator shall be suitably designed for mounting and operation in purchaser's tank whose details are given under **sizing calculation of tanks**, annexed with the enquiry specification (SECTION-I, SUB-SECTION-D, Annexure-III). The bidder shall review and seek clarifications, if any on Tank sizing document.
XXII	In case Bidder provides a Vertical Agitator with hub design, the same has to be of Alloy 926 or better material. Impeller hub material has to be Alloy 926 or better material.
XXIII	Unless otherwise specified, for small diameter impeller, it shall be possible to remove complete agitator assembly without dismantling through the opening provided on the tank/sump, and for large diameter impeller, the blade shall be of removable construction for ease of removal. Bidder shall also provide the headroom required for taking out the agitator as above.
XXIV	Any instruments provided shall be Profibus Compatible.
XXV	Bidder shall provide the design and arrangement of baffle plates in circular tanks. Baffle plates are in BHEL scope.
XXVI	Bidder shall provide proper dowelling between motor and base plate, gear box and mounting tool/base plate, for ease of assembly of agitator unit. Tapered dowell shall be provided.
XXVII	Vendor shall provide suitable arrangement for supporting the agitator shaft with impellers during removal of gear-box for maintenance and details of such arrangements shall be furnished.
4.2	**CONSTRUCTIONAL FEATURES**
A)	**BLADE AND HUB OF PROPELLER**
I)	The blades of the agitators shall be of Alloy 926 or better material.
II)	The Blade design of the Agitator to be of most efficient design in order to offer least power consumption. The Agitator power consumption is part of the guarantee parameters.
III)	Although Agitator will have substantial low speed because of reduction Gear Box, hydraulic unbalance at impeller can cause severe vibration, hence it is mandatory that

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	rotating assembly shall be dynamically balanced to its rated speed. Any deviation to this requirement is subject to customer approval during detailed engineering based on applicable codes and standards to be furnished by the bidders.
IV)	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.
B)	**SEAL**
1	**Horizontal / Side Entry Agitators:**
I.	Agitators should be provided with Single Stage mechanical seal. The mechanical seal should be as per ISO-21049 / API 682.
II.	The Mechanical Seals shall be so arranged that repacking or fitting of replacement seals can be carried out with the minimum of disruption to plant operation.
III.	Design the mechanical seals chamber to have sufficient room to lubricate and get seal face cool with its own slurry.
IV.	Provide requirements for periodical flushing to rinse the seal face for leaked slurry.
V.	All mechanical seals, regardless of type or arrangement, shall be of the cartridge design. Hook sleeve cartridge should not be used.
VI.	-VOID-
VII.	Requirement of flushing water, its quantity, and pressure to be indicated in data sheet.
VIII.	Zero leakage is the intension of this specification. However, quantity of leakage, if it is unavoidable, it should have a provision of collecting / or discharging back to the tank.
IX.	Mechanical seals shall be fitted and installed in the Agitator before shipment and shall be clean. Mechanical seals shall be plugged with screw for shipping.
X	Intention of the specification is not to specify Type of Seal, Seal design, Spring configuration, Seal configuration, Balanced or Unbalance type etc. Agitator manufacturer to decide the same along with seal manufacturer, the best seal that is suitable for the offered Agitator
XI	Seal life has to be guaranteed, taking into consideration all its components **for 25000 hrs.** If the seals fail before the completion of guaranteed period, the same should be replaced free of cost by the bidder.
XII	The sub-vendor of the seal shall be approved by customer during contract execution.
2	**Vertical Agitators for Other Slurry Tanks & Drain Pit Tanks**
I	Agitator shall be supplied with stuffing box or any proven equivalent or superior sealing type. Construction of Gland Packing shaft seal system shall be as per the below fig:

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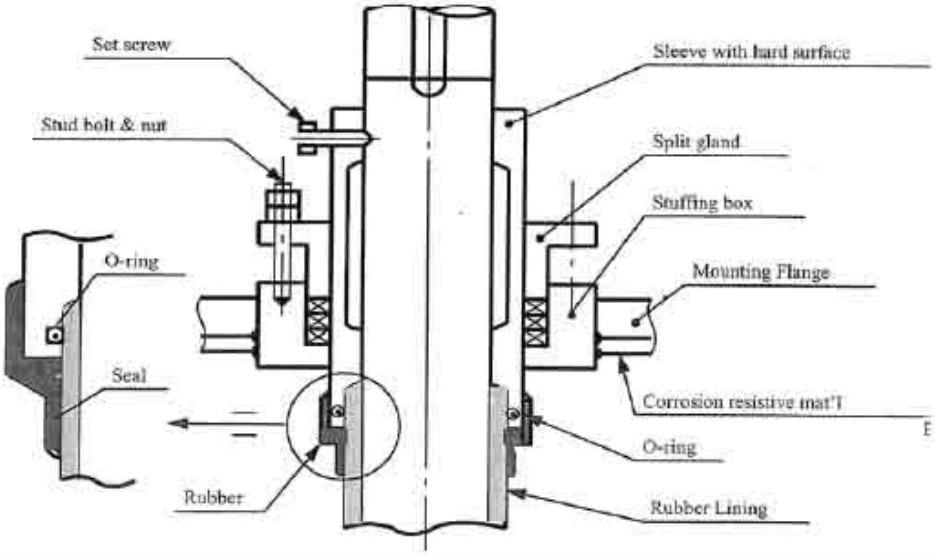

II	Agitator shall be supplied with stuffing box or any proven equivalent or superior sealing type. Mechanical and hydraulic conditions in the seal chamber, required to maintain a stable film at seal face, including temperature, pressure and flow, shall be jointly established by Agitator manufacturer and seal manufacturer, and shall be noted in data sheet submitted in tender. If mechanical seal is offered by bidder, the mechanical seal should be as per ISO-21049 / API 682.
C)	**SHAFT**
I.	MOC of Shaft shall be as per Clause no.3.2 & "Agitator Schedule", Section-II, Annexure-8. Use of dissimilar material at flange joint shall be avoided to eliminate any crevice corrosion. Spacing of the shaft joint should not be more than 3.0 m for easy assembly if it is more than 40kg. If welding is used for joining two tubes, welding joint must be 100% radio graphed. If split shaft is proposed for larger tanks , shaft flange at the joining interface has to be rubber lined at manufacturer's works and necessary fasteners have to be provided.
D)	**BEARING & BEARING HOUSING IN GEAR BOX**
I	Bearing shall be of rolling type radial and thrust bearing (FAG/SKF/Timken make only) as required. Thrust bearing shall be sized for continuous operation under all specified condition.
II	Thrust bearing shall provide full load capability if the Agitator's normal direction of rotation is reversed. Up-thrust and Down-thrust load must be taken into account in sizing bearing. Life of the every anti-friction bearing, used in the bearing housing as per manufacturer's design, should have **L10 of 25000 hr (minimum).**
III	Bearing housing should be grease/oil lubricated. If bearing is oil lubricated, constant–level sight-feed oiler of 100cc size or bigger capacity is to be provided. Bearing housing should have oil drain, constant oil level indicator. A provision of one (1) number G1/2" thread (ISO-228, Part-1)port is required for remote control of temperature of bearing housing oil bath through RTD.
IV	If bearing housing requires cooling water, volume and pressure of cooling water is to be indicated in Technical Data Sheet.
V	Lubricating oil will be the responsibility of Gear Box manufacturer. Hence, manufacturer has to make arrangement of first fill of oil at installation and at commissioning stage. Quantity of oil and its grade is to be indicated in Drawing and Operation Manual.
E)	**MATERIALS**
I	Agitator components designated as "Full Compliance Material" shall meet the

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	requirements of the industry specification as listed for the material in the table as well as in the specification in the respective section.
II	A detail quality plan is to be submitted along with offer for all items marked "Full Compliance Material".
III	Final acceptance of the quality plan will be by ultimate user during detailed engineering without any commercial implication. QAP should be as per the best practice followed internationally to avoid any conflict of interest.
F)	**DRIVER (MOTOR)**
I	Driver shall be sized to meet all specified operating conditions including bearing housing , seal, external gear box and coupling loss(if any).
II	Motor shall be able to accelerate to speed at reduced voltage and frequency as specified in "Site Power Supply Condition" as per Clause: 3.1.
III	It should meet the electrical specification (SECTION-I, SUBSECTION-C3).
G)	**GEAR BOX**
I.	Gear box should be vertical flange mounted solid shaft type (Vertical Agitators), reducing speed type, specially designed for the requirement of Slurry mixing and to be manufactured by the Agitator supplier. Complete up-thrust and down-thrust, developed by Agitator shall be taken by thrust bearing housing of Gear Box. An auxiliary slow drive provision shall be provided in the Gear Box so that slurry is always kept in dynamic condition to avoid settling of slurry at bottom, in the event of Agitator is not operating at its rated speed. Rating of Gear box shall be at least 1.5 times the rated torque of Agitator. Gear box details are subject to customer approval during detailed engineering without any commercial implications.
II.	The reduction unit shall be procured from a reputed manufacturer and shall confirm to BS: 721 (latest edition)/AGMA/Equivalent specifications. The sub-vendor of the gear-box shall be approved by customer during contract execution.
III.	Gear drives shall have splash type oil lubrication. If oil pumps are used, they shall be removable for maintenance without disturbing the motor or drive housing.
IV.	The gear reduction unit shall always be provided with an oil drain, a breather and oil level gauge. The lubrication to be designed keeping in view that the temperature within the bearing should not exceed 85 Deg.C.
V.	VOID.
VI.	The bidder shall provide an easily accessible oil level gauge and a dipstick that will indicate oil level under standstill and operating conditions.
H)	**COUPLING & COUPLING GUARD**
I.	Coupling and coupling guard should be supplied between driver and driven equipment.
II.	Coupling should be designed taking into consideration adequate service factor.
III.	Design rating of the coupling (excluding service factor) should be indicated in data sheet.
IV.	Coupling must be having locking screw so that it does not slide over shaft in due course operation.
V.	Vertical Agitators - Coupling between Motor and Gear Box shall be Spacer-type flexible coupling, made of Cast Iron. Spacer shall be of sufficient length so than Motor and Gear Box shall be able to run independently at no-load condition by detaching the respective coupling.
VI.	It is desirable that for servicing of seal, coupling half should not be removed. Coupling should be dynamically balanced to Gr: G6.3, ISO-1940. Any deviation to this requirement

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	is subject to customer approval during detailed engineering based on applicable codes and standards to be furnished by the bidders.
VII.	Removable coupling guard shall conform to the requirements of all applicable national, industrial or statutory regulations.
I)	**PLATE AND FASTENING BOLTS**
I.	Base plate shall be interpreted as the component of Agitator assembly through which the whole load will be transmitted to the Sole Plate/Nozzle over which the equipment will be mounted. The Base plate shall be fabricated with mild steel of structural quality (UTS=42N/sq mm minimum) with anti-corrosive paint of sufficient dry-film thickness.
II.	Base plate must have provision of leveling on its intended mounting place. Nozzle is not in the scope of supply of Agitator manufacturer. It should be noted that Nozzle will be rubber lined to prevent any leakage of corrosive gases
III.	Alignment between Gear Head Shaft and Agitator shaft shall be within the permissible limit of Gear Box. Similarly, misalignment between Motor shaft and Gear Box Shaft shall be within 0.050 micron (radial) and 2 degree (angular) or better as per requirement of Motor and Gear Box
IV.	Base plate with desired number of hole shall be provided by the bidder, will be machined on one side. Base Plate shall be welded to the structure after leveling, as recommended by Agitator manufacturer and rubber lining is completed before placing the equipment in its desired location.
J)	**OTHER COMPONENTS**
I	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, thread remains unaffected. Raw material of fastener must undergo Inter-granular Corrosion test as per ISO-3651, Part-1 for Nitric Acid test.
II	Mounting flange dimensions shall be as per ASME B16.5 up to 600 Nb, ASME B 16.47 for more than 600 NB.
III	Rubber Lining (As Applicable) a) Rubber lined surfaces shall utilize 6 mm nominal thickness chlorobutyl rubber. b) Areas of high wear (e.g. leading edges on impeller blades) shall have an additional 6 mm of rubber for abrasion protection. c) No field-applied linings are permitted except for file patch kits.
K)	**GENERAL REQUIREMENT OF SIDE ENTRY AGITATORS:**
I.	All Agitators shall be designed for continuous operation.
II.	The Material of Construction (MOC) of Agitators shall be Alloy 926 or better material as per Cl. No. 3.2 & "Agitator Schedule" ", Section-II, Annexure-8.
III.	It should be of Flange mounted type.
IV.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from side. Bidder shall inform the required nozzle size. Further the mating flange shall be in the scope of the bidder.
V.	The Bidder to consider Gypsum Sedimentation during stoppage of Agitator.
VI.	The following information to be provided along with the bid: a) Impeller Diameter b) Impeller Speed c) Agitator Pumping Capacity (m^3/min) d) Volume per Agitator:
L)	**GENERAL REQUIREMENT OF TOP ENTRY AGITATORS IN OTHER**

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	SLURRY TANKS & DRAIN PITS:
I.	All Agitators shall be designed for continuous operation.
II.	The Material of Construction (MOC) of Agitators: Agitator blades shall be made with Alloy 926 or better material & Agitator shaft can be rubber lined as per Clause No.3.2 & "Agitator Schedule" ", Section-II, Annexure-8.
III.	It should be roof mounted.
IV.	Agitators shall be vertical mounted type and shall be driven by motor with reducing speed gear box of rigid type, solid shaft coupling between gear box and agitator and flexible coupling of spacer type between Motor and Gear Box. Both Gear Box and Motor should be vertically/horizontally flange mounted type with a common frame of the whole equipment. The entire thrust load of agitator should be transmitted to the thrust bearing of Gear box.
V.	Nozzle size, on which Agitator shall be mounted, shall have enough opening to Insert rotating assembly from top. Bidder shall inform the required nozzle size. Further the mating flange shall be in the scope of the bidder.
VI.	Cable entry to the Motor terminal box should preferably be from top when motor is vertically mounted at its position and it should be easily accessible.
VII.	Impeller should be dynamically balanced to Gr: G16: ISO-1940 after rubber lining of shaft.
VIII	In case Bidder provides a Vertical Agitator with hub design the same has to be of Alloy 926 or better material
IX	Operation speed of the Agitator motor shall be at least 25% below the first critical speed.
X	-VOID-
XI	-VOID-
4.3	**MOTOR**
	All AC motor shall be Squirrel cage induction motor and, shall be suitable for direct –on-line starting. Rating of the motor should of Type S1 (Continuously rated) as per ISO-60034, Part-1. Rating of motor must be selected with minimum margin(as per the below table) above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation: Agitator Rated BKW — Motor Margin <22KW — 125% of Agitator Rated BKW 22KW-55KW — 115% of Agitator Rated BKW >55KW — 110% of Agitator Rated BKW
	It should meet the electrical specification (SECTION-I, SUBSECTION-C3).
5	**GENERAL REQUIREMENTS**
1	Metric unit shall be used in the drawings and in the any displays on the equipment's. Special attention should be taken that the unit of pressure shall be in dual scales of kPa and kg/cm2(G). For instance the pressure gauges should have dual unit's indication.
2	Descriptions in the drawings, in the documents, and in the displays shall be in English
3	All rotating parts such as coupling shall be covered with suitable protective guards. Guards shall be easily removable type.
4	The equipment shall be designed to withstand the corrosive and moist environment in which these are proposed to operate.
5	Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB measured at a distance of 1.0 meters from the source in any direction and 1.5m above operating floor.
6	The overall vibration level shall be as per ISO 10816.
7	Suitable drain connections shall be provided.
8	The equipment shall be suitable for stable operation continuously.
9	Corrosion allowance: Corrosion allowance for entire equipment shall be in accordance with

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	latest applicable Indian / International standard. Carbon steel shaft shall have a corrosion allowance of 6mm on its diameter. On other non-pressure carbon steel parts a corrosion of 3mm shall be considered on each surface.
10	Unless otherwise specified , flanges shall be in accordance with ANSI B16.5 Class 150
11	Name plate: All equipment shall be provided with nameplates indicating the item number and service name. Name plates shall be of 304 Stainless steel plate and placed at a readily visible location. Nameplate of main equipment shall have enough information, which will be confirmed during engineering phase. Stainless steel nameplates for all instruments and valves shall be provided.
12	Rotation arrows shall be cast in or attached with stainless steel plate on each item of rotation equipment at a readily visible location.
13	Unless otherwise specified, all equipment items where the weight exceeds 15 kg shall be provided with suitable lifting lugs, ears or ring bolts or tapped holes for lifting rings. Minimum shock factor for lifting lugs shall be minimum 2.0. The position of lifting lugs and reference dimension shall be shown on GA and/or outline drawings. NDT shall be conducted for lifting lugs. When any spreader bars are required for lifting and laydown, the bidder shall provide spreader bar with equipment.
14	Skid Mount/Transportation: Equipment shall be fabricated as skid mount design as much as practical to minimize erection at the site.
15	If the driver/driven equipment train is in the resonance condition or any vibration problems occur, the bidder shall solve the problems in a timely manner.
16	Bidder shall provide the necessary gaskets.
17	All the surfaces of the carbon steel should be rust prevented before shipment for the period of at least 12 months for storage and construction.
18	Bidder to provide capacity of hoist required for material handling and the details of heaviest component to be handled. Bidder shall provide a typical arrangement/drawing of the handling arrangement.
19	The list of all Bought out items with makes and country of origin to be mentioned along with offer to be submitted.
20	Cost towards the participation in discussions/meetings, providing technical assistance during technical discussions/meetings with customer for approval of drawing/documents etc. TA/DA, boarding and lodging to attend these meetings shall be borne by the bidder and shall be inclusive in bidder's quoted price.
21	Material of construction for all equipment/components shall be subject to customer/ BHEL approval during detail engineering. Accordingly bidder shall consider MOC for all equipment/component (complying tender specifications), as per best engineering practice, global standard and global references, in case no MOC is available in specs.
22	Bidder to provide sub vendor list and Bidder shall strictly adhere to customer approved vendor list (reference list is included in SUB-SECTION-D, Annexure-I). In case bidder proposes an additional vendor for an item or vendor approval is required for any new item, acceptance shall be subject to approval by customer/ BHEL before placing order and bidder shall submit relevant documents to take up with customer for approval. Bidder shall submit relevant documents as per Sub-Supplier Questionnaire provided in referred Annexure .
23	It shall be the complete responsibility of the successful bidder to obtain "Sub Vendor Approval" from BHEL / customer for all equipment's & components. Any delay in sub vendor's approval should not affect the project schedule. If any of the sub vendors does not have the approval of customer/ BHEL, the same may be replaced with another customer/BHEL approved sub-vendor only, without any price implications to BHEL.

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24	The modalities of inspection (Stage, Final, In-process) shall be finalized during detail engineering after submission of quality assurance plan (QAP). It shall be reviewed by the end customer and BHEL. Bidder shall follow the procedures of inspection as per the approved QAP. Bidder has to submit the following documents along with inspection call and if any other documents required as per approved QAP. - Raw material inspection certificate - Internal test reports - Statutory certificates as required. - All inspection & testing shall be carried out based on the following documents: a. Relevant Standards b. Specifications c. Approved drawings d. Data Sheets e. Calibration certificate for all the measuring instruments
25	During detail engineering, bidder to strictly adhere to BHEL drawing formats, document numbering, quality plan & FQP formats
26	The identification and numbering of equipment, systems, items, etc. of supply, as well as of all documents and drawings shall be in accordance with reference Designation System for Power Plants - KKS system.
27	Complete detail engineering drawings, calculations, selection of components etc. shall be reviewed & subject to approval of BHEL/end customer during detail engineering
28	Bidder shall furnish necessary inputs & drawings of all equipment in editable Auto CAD/ MS-Word /Excel format.
29	During detail engineering, successful bidder shall ensure flow of drawings/documents as per schedule. Any comments from BHEL/end customer should be addressed timely by the bidder.
30	Bidder to note above mentioned points not exhaustive and any work /items required for completing the smooth operation and ensuring satisfactory running of the machines till final hand over to the end user shall also be in the scope of the bidder.
31	Bidder shall provide design support to assist the Purchaser in efficiently integrating the furnished equipment. Design support specifically includes: • Bidder shall verify/ validate the number and location of agitators to keep material in suspension. • Static and dynamic loading information and requirements for agitator support design (applicable for top & side type)
32	Any other item required to meet the stipulations mentioned in GTR , GCC and SCC and relevant to Agitator package unless specifically excluded from scope of supply.
6	**PACKING AND FORWARDING**
1	Proper packing to be ensured. **Indigenous Supply:** Agitator & sub system assembly shall be wrapped in polythene bags & packed in a strong rigid wooden crate. Rain water should not enter into the Agitator internals during storage in the outer yard of power plant. Further the packing shall be done in line with requirements mentioned in point no. 2 to 20 of this section. **Imported Supply:** All imported supply should be packed as per Sea worthy packing standards as per Sub-Section D, Annexure-V. All imported items should have Sea worthy packing. Liberal packing materials and struts shall be provided to arrest rolling and to protect from transit damages.
2	Equipment and process materials shall be packed and semi-knocked down, to the extent possible, to facilitate handling and storage and to protect bearings and other machine surfaces from oxidation. Each container, box, crate or bundle shall be reinforced with steel

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	strapping in such a manner that breaking of one strap will not cause complete failure of packaging. The packing shall be of best standard to withstand rough handling and to provide suitable protection from tropical weather while in transit and while awaiting erection at the site.
3	Equipment and materials in wooden cases or crates shall be properly cushioned to withstand the abuse of handling, transportation and storage. Packing shall include preservatives suitable to tropical conditions. All machine surfaces and bearings shall be coated with oxidation preventive compounds. All parts subject to damage when in contact with water shall be coated with suitable grease and wrapped in heavy asphalt or tar impregnated paper.
4	Crates and packing material used for shipping will become the property of end customer.
5	Packaging or shipping units shall be designed within the limitations of the unloading facilities of the receiving ports and the ship which will be used. It shall be the bidder's responsibility to investigate these limitations and to provide suitable packaging and shipping to permit transportation to site.
6	Packing (tare) shall be part of the equipment cost and shall not be subject to return. The packing should ensure integrity and cohesiveness of each delivery batch of equipment during transportation. In case of equipment assemblies and unit's delivery in the packing of glass, plastics or paper the specification of packing with the material and weight characteristics are to be indicated.
7	Each package should have the following inscriptions and signs stenciled with an indelible ink, legibly and clearly: a. Destination b. Package Number c. Gross and Net Weight d. Dimensions e. Lifting places f. Handling marks and the following delivery marking
8	Each package or shipping units shall be clearly marked or stenciled on at least two sides as per the dispatch instruction givens during the contract. In addition, each package or shipping unit shall have the symbol painted in red on at least two sides of the package, covering one fourth of the area of the side.
9	Each part of the equipment which is to be shipped as a separate piece or smaller parts packed within the same case shall be legibly marked to show the unit of which it is part, and match marked to show its relative position in the unit, to facilitate assembly in the field. Unit marks and match marks shall be made with steel stamps and with paint.
10	Each case shall contain a packing list showing the detailed contents of the package. When any technical documents are supplied together with the shipment of materials no single package shall contain more than one set of such documents. Shipping papers shall clearly indicate in which packages the technical documents are contained.
11	The case number shall be written in the form of a fraction, the numerator of which is the serial number of the case and the denominator the total number of case in which a complete unit of equipment is packed.
12	Wherever necessary besides usual inscriptions the cases shall bear special indication such as "Top", "Do not turn over", "Care" , "Keep Dry" etc. as well as indication of the center of gravity (with red vertical lines) and places for attaching slings (with chain marks)
13	Marking for Safe handling: To ensure safe handling, packing case shall be marked to show the following: a. Upright position b. Sling position and center of Gravity position c. Storage category

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	d. Fragile components (to be marked properly with a clear warning for safe handling)
14	Each crate or package is to contain a packing list in a waterproof envelope. All items are to be clearly marked for easy identification against the packing List. All cases, packages etc. are to be clearly marked on the outside to indicate the total weight where the weight is bearing and the correct position of the slings are to bear an identification mark relating them to the appropriate shipping documents. All stencil marks on the outside of cases are either to be made in waterproof material or protected by shellac or varnish to prevent obliteration in transit.
15	The packing slip shall contain the following information: - Customer name, Name of the equipment, Purchase Order number with Date, Address of the delivery site, Name and Address of the Sender, Serial Number of Agitator, and BHEL item Code, Gross Weight and Net weight of Supplied items.
16	Prior to transport from manufacturer's work to destination, components of the unit shall be completely cleaned to remove any foreign particles. Flange faces and other machined surfaces shall be protected by an easily removable rust preventive coating followed by suitable wrapping.
17	All necessary painting, corrosion protection & preservation measures shall be taken as specified in painting schedule. Supplier shall consider the coastal environment zone which is defined as "very severe" during final finishing/shipping.
18	Successful bidder shall furnish the detail packing /shipment box details with information like packing box size, type of packing, weight of each consignment, sequence no. of dispatch, no. of consignment for each deliverable item against each billing break up units/ billable blocks. Without these details the BBU shall not be approved during detail engineering.
19	All items/equipment shall be dispatched in properly packed condition (i.e. no item shall be dispatched in loose condition such that it becomes difficult to store/identify its location at site at a later stage).
20	Cases which cannot be marked as above shall have metal tags with the necessary markings on them. The metal tags shall be securely attached to the packages with strong steel binding wire. Each piece, Skid, Case or package shipped separately shall be labelled or tagged properly.
8	**SUPERVISION OF ERECTION, TESTING AND COMMISSIONING**
1	The erection of Agitators will be done by owner as per Erection Manual and check List to be provided by the bidder during detail engineering. However, the bidder shall make visit as per enquiry/PO for the supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply & Services.
2	The bidder will be informed well in advance for the visit.
3	-VOID-
4	Price comparison for evaluating the lowest bid will be considered for all main supply, supervision of E&C charges and mandatory spares price all together along with the loading on account of guarantee power consumption (as applicable).
5	Scope of Supervision for Erection & commissioning: Tentatively following visits shall be planned by site team which shall be as follows: - • Three visits (for all agitators) of 20 days each for supervision of erection, pre-commissioning & post- commissioning check-up, start-up, testing and trial runs of all the items covered under the scope of supply & Services. • Two visits of 10 days each (for all agitators) for performance demonstrations and handing over of system.

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	• Any additional visit as per requirement of BHEL site office during erection of equipment.
6	Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system shall be in bidder's scope.
9	**EXCLUSION**
	The following work associated with the Agitators will be by others: a. Access, Walkways, platforms and ladders b. Handling equipment (hoist) along with the handling arrangement. However, bidder shall provide the details of the same to BHEL. c. Baffle plates d. Installation, however, supervision of erection and commissioning shall be in bidder's scope
10	**INSPECTION AND TESTING**
1	The General inspection requirements to be considered are as below:
2	Bidder shall furnish written copies of shop production, fabrication and quality test procedures and drawings to be used on the Agitators for review by BHEL/end customer prior to manufacture.
3	The Bidder shall furnish performance test procedure along with standard. The test procedure will be reviewed and approved by the BHEL/customer.
4	Since there is no standard for "Acceptance Test Procedure" for Agitator, Agitator manufacturer is to submit a test procedure and Quality Plan, clearly indicating that equipment will meet the desired parameter.
5	Power consumption at motor terminal and vibration of equipment will be conducted at site. Vendor to indicate other material tests that are to be conducted as per their practice in their Quality plan.
6	No liquid should enter the tube through any flange joint. "O"-ring used in the flange joint will deteriorate at a highly chlorinated and acidic environment of medium at a maximum operating temperature unless right quality of rubber is used. Hydrostatic testing of tube assembly is required at a pressure of twice that of maximum liquid column in any tank or 30m whichever is higher. The hydro test duration will be for a minimum of 1 hr to check sweating of any flange. Hydrostatic test is meant in part for a check of equipment joint at new condition only. It is cannot be considered as a guarantee of functional objective of rubber used.
7	Mechanical Run Test (in air) Each Agitator unit shall be given a 4-hour mechanical run test in air at vendor's shop. Agitator unit shall be mounted in the same manner as it will operate in the field. During this test the record shall be made of: a) Shaft run out at free end. b) Dynamic shaft deflection adjacent to the mechanical seal/packing/vapor seal. c) Gearbox oil temperature and temperature of bearing housing in stool. The temperature of the gear box oil shall not exceed ambient plus 40 Deg.C and that of bearing housing shall not exceed from room temperature plus 20 Deg.C after temperatures have stabilized. d) Bearing Housing vibration checks shall be carried out. Maximum acceptable vibration velocity shall be 6 mm/sec. e) Noise level shall be checked and shall be within the specified limits mentioned in the specification. f) Agitator shaft RPM and motor RPM. g) Check of satisfactory operation of shut off and retracting arrangement. Please also refer S.N. 9 below.

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8	**Mechanical Run Test (in slurry of similar concentration as applicable for the project)** Each agitator unit shall be given a load test in slurry at the vendor's shop. The duration of this test shall be 4 hours unless agreed otherwise between the Purchaser and the vendor. The following parameters shall be recorded during the test: a) Dynamic shaft deflection adjacent to the mechanical seal/packing/vapor seal. b) Gear box bearing oil temperature and temperature of bearing housing in stool. The temperature of gear box oil shall not exceed ambient plus 40°C and that of bearing housing shall not exceed room temperature plus 20°C after the temperatures have stabilized. c) Bearing housing vibrations. Maximum acceptable vibration velocity is 6 mm/sec. d) Noise levels shall be checked and shall be within the specified limits mentioned in the specification. e) Electrical power input to the motor. f) Agitator shaft RPM and motor RPM. g) Check of satisfactory operation of shut off and retracting arrangement. As a part of the Quality Assurance Plan, where possible as per facility available at bidder's work, bidder may demonstrate the power consumption also of each agitator at shop with the available fluid along with relevant calculation to establish the correlation with the slurry used for the project, apart from necessarily demonstrating power requirement at site. Please also refer S.N. 9 below.
9	In case of any constraints in carrying out shop tests indicated at S.No. 7 & 8 above, the Mechanical run tests for agitators shall be carried out with air/water at shop along with other test requirement in line with the QAP to be approved by customer during detail engineering.
9A	Acceptance Test (at Site) After the agitator has been installed at site and is ready for test, vendor shall depute his representative to supervise the site acceptance test
10	DYNAMICS
10.1	CRITICAL SPEED
10.1.1	Operation speed of the Agitator motor shall be at least 25% below the first critical speed
10.1.2	Additional to the requirement of the critical speed of Agitator, as specified above. Agitator manufacturer is to analyze the torsional critical speed of combined system of Agitator, Gear Box and Motor to establish there is a separation margin of minimum 20% between the torsional critical speed (dry/wet) and any operating speed.
10.2	VIBRATION SEVERITY
10.2.1	During performance test, unfiltered vibration measurements shall be made with running of Agitator in Air. Measurement shall be taken on the Gear Box thrust bearing housings as well in motor top.
10.2.2	Guaranteed Site vibration of the equipment on its own pedestal, at commissioning with normal level of liquid and with maximum liquid at respective tank, Vibration limit at site will be as per ISO-10816 and 1.5-2.3mm/sec even if Motor rating falls below 15kw. Any deviation to this requirement is subject to customer approval during detailed engineering based on applicable codes and standards to be furnished by the bidders.
10.2.3	Vibration measurements of bearing housing shall be made in root mean square (RMS) velocity.
10.2.4	Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions.
11	For surfaces with rubber lining, welding shall be visually inspected to verify the absence of rough area and unacceptable transition between surfaces which prevent the adequate

	adherence of rubber. The acceptance criteria shall be as per latest standard.
12	For surfaces with rubber lining, degree of cleaning shall be visually checked before the application of the coating. There must be no area with oxidation, dirt or partially or generalized corrosion defects.
13	Test certificates shall be issued for each lot of raw material used in the coating, corresponding to specific weight and traction resistance.
14	For surfaces with rubber lining, adherence test shall be conducted on production samples. Adherence test shall be conducted on the actual surface through hammering. In order to verify the absence of air packets (or) surface without adherence.
15	For surfaces with rubber lining, Coating thickness shall be checked at 100%. A High voltage porosity test will be conducted on 100 % of the coated surface.
16	Out of all Agitators One Number of each type will be inspected at the Bidder's works before dispatch or where the test facilities are available.
17	The Bidder shall conduct performance test for the remaining Agitators and submit the reports.
18	Contract shaft mechanical seals shall be used during shop tests, unless the seal design is unsuitable for the shop-test condition, if applicable.
19	Agitators shall not be released for shipment, until shop tests data and performance tests curves have been approved by Owner.
20	Bidder should furnish performance guarantee as per applicable guarantee for the design, manufacture, material and safe operation of the equipments.
21	Bidder to arrange all calibrated gauges, Instruments during inspection.
22	Mechanical running and the performance test shall be carried out. Bidder to arrange Motor of same / higher rating for the shop test and inspection.
23	All testing requirement/certificates shall be in line with QAP to be approved by customer during detailed engineering.
11	**PAINTING**
1	**Painting details for agitator support: -** Please refer painting specification (SECTION-C, SUB-SECTION-C2C).
2	Rust preventive paint after inspection at shop floor before dispatch shall be in bidder's scope
3	Corrosion protection, coating and galvanizing, painting shall be taken care by the bidder. Bidder shall submit the painting scheme during detail Engg in line with the specification and shall be subject to approval of BHEL / End Customer.
12	**SPARES,TOOLS & TACKLES**
	Bidder shall supply a set of special tools and tackles required either for erection or operation or maintenance of the agitator units. A list of such tools shall be submitted by bidder along with the offer.
	Any special tools & tackles required for the entire equipment to disassemble, assemble or maintain the units, they shall be included in the quotation and furnished as part of the initial supply of the machine. List of special tools & tackles shall be decided by bidder as per his proven practice. When special tools are provided, they shall be packaged in separate, boxes with lugs and marked as "Special Tools for (tag / item number)."Each tool shall be stamped or tagged to indicate its intended usage. Levers and eye bolts for the removal of parts to be serviced shall be submitted with special tools (SECTION-II Annexure-7).
12.1	**START UP & COMMISSIONING SPARES**
	Start-up & Commissioning Spares shall be part of the main supply of the Agitators. Start-up & commissioning spares are those spares which may be required during the start- up and commissioning of the equipment/system. All spares required for successful operation till commissioning of Agitator shall come under this category. Bidder shall provide an

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	adequate stock of such start up and commissioning spares to be brought by him to the site for the equipment erection and commissioning. The spares must be available at site before the equipments are energized. The List of such spares to be provided during bidding stage (SECTION-II Annexure-9).
12.2	**RECOMMENDED SPARES**
	Bidders shall also furnish the recommended spares list along with the offer required for 3 years of normal operation of the plant and should be independent of the list of the mandatory spares. Prices of recommended spares will not be used for evaluation of the bids. The price of these spares will remain valid up to 6 months after placement of Notification of Award for the main equipment.
12.3	**MANDATORY SPARES:**
	Bidder to quote for the mandatory spares as per the Mandatory Spare list (SECTION-I, SUB-SECTION-D Annexure-II). Bidder shall quote for the "Mandatory Spares Part List", and it will be considered for L1 evaluation. Mandatory spare parts items shall be handed over separately and shall not be mixed with the supply of the main equipment parts. Spares shall be sent in pre-decided lots in containers/secure boxes. All boxes/containers are to be distinctly marked in red color with boldly written "S" mark on each face of the containers. Spares shall not be dispatched before dispatch of corresponding main equipment's. Each item shall be labelled in English and be packed against damage and sealed to prevent deterioration from corrosion. The protection shall be sufficient for a minimum of 10 years' storage in a dry weatherproof building. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. All the mandatory spares shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.
13.0	**FIRST FILL OF CONSUMABLES**
I	Bidder's scope shall include supply and filling of all chemicals, lubricants, grease, filters and consumable items for operation up to commissioning including top up requirements. All lubricants proposed for the plant operation shall be suitable for all operating and environmental conditions that will be met on site consistent with good maintenance procedures as instructed in the maintenance manuals.
II	Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. (as applicable) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.
III	Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals including items qualities and quantities required per month of the plant operation for the end customer/BHEL's approval herein shall be furnished within 2 months of placement of Order. On completion of erection, complete list of bearings/equipment giving their location and identification marks shall be furnished to BHEL along with lubrication requirements. All types of chemicals, consumables, lubricants and grease shall be readily obtainable locally and the number of different types shall be kept to a minimum. For each type and grade of lubricant recommended, bidder shall list at least three equivalent lubricants manufactured by alternative companies.
14.0	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:**
1.	**POWER GUARANTEE** Bidder to specify the total guaranteed power per Agitators operating at the rated capacity in their offer.

2.	**BID EVALUATION CRITERIA FOR POWER CONSUMPTION:** Refer Annexure 11 of section-II.
15	**LIQUIDATED DAMAGES FOR POWER CONSUMPTION**
1	Refer Annexure 11 of section-II.
16	**PERFORMANCE GUARANTEE**
	All performance tests for Agitators shall be carried out in accordance with any latest international codes/standards. Bidder shall furnish Performance guarantee for the design, manufacture, material, safe and trouble-free operation of the Agitators and its accessories The Bidder shall ensure a design of the equipment to achieve an average target availability of 98% for 120 days and average target availability of 95% for 1 year. Noise level ≤85 dB (A) at 1m horizontal distance from equipment/enclosures and 1.5m above operating floor is to be guaranteed. Vibration levels measured on the non-rotating parts shall not exceed the zone limit "B" as defined in ISO 10816 at steady conditions and shall not exceed the zone limit "C" as defined in ISO 10816 at transient conditions. Life of Agitator components/parts from the date of commissioning for continuous operation shall be guaranteed for 24 months. Acceptance tests to be carried out as per the procedure defined by the bidder which shall be submitted for BHEL/ end customer approval. In the event that the performance test is unsuccessful, bidder shall take necessary remedial action at his cost and the performance test shall be repeated. For additional details of performance guarantee please refer 'functional guarantee' under Sub-section C2, Section-I.
17	**DOCUMENTATION**
A	**DOCUMENTS TO BE SUBMITTED ALONG WITH THE OFFER**
	The Bidder shall submit all documents, drawings, diagrams and all such information, which are necessary to fully understand the offer for techno – commercial Offer. Vendors are requested to comply with above in all respect. List of such documents have been indicated in (SECTION-II Annexure-1).
B	**DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT**
	The Successful bidder shall submit necessary data, documents and drawings for review, approval as specified in this specification. Drawings that are reviewed by the end customer/ BHEL, will be returned to bidder with a transmittal letter with any comments and / or questions marked on the drawings or noted in the letter. All comments and questions must be resolved before a resubmission of drawings / documents. If the design has not developed enough to resolve some of the comments or questions, bidder shall place a "hold" on those items or areas of design. End customer/ BHEL reserves the right to return drawings unprocessed to bidder if there exists any evidence that bidder has not acknowledged all comments and questions. All necessary GA drawings, sections, sub-assembly drawings, specifications of main and sub components and necessary set of operation & maintenance manual as asked by end

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	customer must be furnished by bidder in soft and hard copy forms. For all documents softcopy format shall be searchable pdf, however in addition all drawings, diagrams shall be supplied in ACAD or other editable format and all lists in Excel format. Further break up of technical documents will be discussed during finalization of the purchase contract. All documents in hard and soft form are to be submitted in the English language. Electronic Copies shall be submitted in primary original data format (e.g. DOC, XLS, DWG) as well as in a printable non-proprietary document format (e.g. PDF). Especially P&IDs shall be submitted as DWG files and PDF files. Bidder to ensure submission of hard copies as per end customer requirement for all engineering drg/doc and for all subsequent revisions along with a soft copy through email to concerned project team. The list of such drawing/documents have been indicated in (SECTION-I, SUB-SECTION-D Annexure-IV).
18	**LIST OF REFERENCE DRAWINGS BY BHEL**
I	The document specified in Annexure-III, Sub-Section-D of Section-I are being provided along with the tender specification for estimation and calculation purpose of the bidder.

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CUSTOMER SPECIFICATION

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CUSTOMER SPECIFICATION: TECHNICAL REQUIREMENT

CLAUSE NO.	TECHNICAL REQUIREMENTS
	from the respective systems. Contractor shall make arrangements for pumping the drainage water back to the respective system with vertical sump pumps. Agitators shall also be provided to avoid settling of solids in the sump. Adequate redundancy in line with the standard practice adopted by the bidder shall be provided. This Clause covers the design, manufacture and erection of all vertical sump pumps for the FGD system.
9.02.00	The contractor shall offer only proven design in successful operation in similar application at previous installations. The design, manufacture, installation and testing of the pumps shall follow the latest applicable Indian / International (ASME / EN / Japanese) Standards.
9.03.00	The pumps shall be designed for continuous operation. The pump shall be single stage centrifugal type with semi open or open impeller. The pump impeller shall be cantilever type and shall not be supported below the base plate for easy withdrawal.
9.04.00	The pump shall deliver the rated flow at rated head with margins as specified in the respective clauses. The pump shall be capable of pumping of filtrate water with solid concentration upto 10% & particle lumps of 6-7mm. Sump pumps handling slurry shall be designed with a maximum concentration of 30% solid by weight.
9.05.00	The material chosen for the pump components shall be suitable for the fluid handled and shall be proven in similar application.
9.06.00	The pumps shall not be supported below the base plate level for easy withdrawal without entering the sump.
10.00.00	**SLURRY & PROCESS WATER TANKS**
10.01.00	All the slurry tanks (Slurry Tanks, Filtrate Tank, Secondary hydro cyclone feed tank, vacuum receiver tank, Waste water Tank, Lime Neutralization tanks etc.) shall be designed, fabricated, erected and tested in accordance with the IS:803, latest edition. Additional Corrosion allowance of 3mm on the minimum tank shell thickness as calculated by IS:803, latest edition shall be provided by the Contractor. Tanks shall be made from IS:2062 quality mild steel plates of tested quality. The tanks shall be of welded construction. Interior surface of the tanks shall lined with replacable chlorobuty/bromobutyl rubber lining of minimum 5 mm thickness and the outside surface shall be coated with paint as approved by the Employer. The Tanks shall be provided with drain, manholes, over flow & inlet level control valves etc. Coarse-screen(s) at suction-side of these pumps shall be provided.
11.00.00	**AGITATORS**
11.01.00	Agitators shall be supplied in tanks and vessels to prevent caking and settlement of particles out of the slurry, e.g. in the absorber vessel, limestone mill recycle tanks, limestone slurry tank, Auxiliary Absorbent tank, and sumps etc.
11.02.00	All agitators shall be designed for continuous operation unless otherwise specified.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	Horizontal agitators shall be used for Absorber. Vertical agitators can also be used for Absorber, if it is only the standard & proven practice of the Contractor for the offered Absorber design. In other vessels and tanks vertical agitators are also acceptable if they are of proven make and the Bidders standard practice which can be proven by means of suitable references. The design of the agitators shall be of proven type.
11.03.00	Standard type agitators with suitable characteristics shall be used wherever practical. The agitators shall be complete with motor, gearbox, agitator shaft, coupling, safety guards, mechanical seal (for side entry agitators), impeller, support legs, agitator mounting flange including bolts nuts and gasket etc.
11.04.00	All agitator parts and accessories in contact with the stirred fluid shall be constructed of materials specifically designed for the conditions and nature of the stirred fluid and be resistant to erosion and corrosion.
11.05.00	The material for the shaft (which is continuously in contact with slurry) and agitator blades of the Absorber Agitators shall be made with Alloy 926 or better material. For Agitators in other tanks, agitator blades shall be made with Alloy 926 or better material & shaft can be rubber lined. This does not release the Contractor of the responsibility for selecting the correct materials.
11.06.00	Each agitator and its associated equipment shall be arranged in such **a** manner as to permit easy access for operation, maintenance and agitator removal without interrupting plant operation. It shall be possible to remove the sealing devices of the Agitators of the absorber vessel without having to drain completely the absorber.
11.07.00	To prevent mechanical blocking load start-up after standstill of pumps, piping and agitators for slurries shall be applied with C-hose connection.
11.08.00	Lifting lugs and eyes and other special tackle shall be provided as necessary to permit easy handling of the agitators and their components.
11.09.00	Static and dynamic (as far as applicable) balancing of all agitators shall be carried out after assembly.
11.10.00	All agitator parts and components shall be designed and calculated for fatigue life, considering maximum bending loads, induced by fluctuating hydraulic forces and torsional loads, based on the installed motor power. For side entry agitators the alternating bending moment resulting from impeller and shaft weight has to be considered additionally.
11.11.00	All exposed moving parts shall be covered by guards.
11.12.00	Side entry agitator shall be flange mounted.
11.13.00	The shape of the impeller blades of side entry agitators shall be designed to avoid wear on the impellers which will affect the agitator performance as specified for a minimum period of 2 years of continuous operation under design conditions for the range of coal & limestone specified in the specification. In order to avoid excessive wear impeller tip speeds must not exceed 12 m/s.
11.14.00	Belt drives (if applied) shall be properly designed to provide a minimum lifetime of 2 years under design conditions

	TITLE: 4x250MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION No: PE-TS-463-571-18000-A003	
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CUSTOMER SPECIFICATION: PROJECT GENERAL REQUIREMENTS

	TITLE: 4x250MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION No: PE-TS-463-571-18000-A009	
		SECTION-I, SUB-SECTION-C2B	
		REV. 00	DATE: OCT 2021
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CUSTOMER SPECIFICATION: GENERAL TECHNICAL REQUIREMENTS

PART - C

GENERAL TECHNICAL REQUIREMENTS

4x250 MW BRBCL NABINAGAR TPP

GENERAL TECHNICAL REQUIREMENTS

PART - C

CONTENTS

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS

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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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,

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	(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)

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	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.

<u>Elevated Temperature Test Cycle</u>

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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	(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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
	(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.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS
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	Central station AHU/Application of Central Station AHU
BS:848 (Part-1,2)	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.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & Filling

IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc.

IS: 4701 Code of practice for earth work on canals.

IS: 9758 Guide lines for Dewatering during construction.

IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

Properties, Storage and Handling of Common Building Materials

IS: 269 Specification for ordinary Portland cement, 33 grade.

IS: 383 Specification for coarse and fine aggregates from natural sources for concrete.

IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.

IS: 455 Specification for Portland slag cement.

IS: 702 Specification for Industrial bitumen.

IS: 712 Specification for building limes.

IS: 808 Rolled steel Beam channel and angle sections.

IS: 1077 Specification for common burnt clay building bricks.

IS: 1161 Specification of steel tubes for structural purposes.

IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C.

IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B.

IS: 1367 Technical supply conditions for Threaded fasteners.

IS: 1489 Specification for Portland-pozzolana cement:

(Part-I) Fly ash based.

(Part-II)	Calcined clay based.
IS: 1542	Specification for sand for plaster.
IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
IS: 2062	Specification for steel for general structural purposes.
IS: 2116	Specification for sand for masonry mortars.
IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
IS: 3150	Hexagonal wire netting for general purpose.
IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
IS: 4031	Methods of physical tests for hydraulic cement.
IS: 4032	Methods of chemical analysis of hydraulic cement.
IS: 4082	Recommendations on stacking and storage of construction materials at site.
IS: 8112	Specification for 43 grade ordinary portland cement.
IS: 8500	Medium and high strength structural steel.
IS: 12269	53 grade ordinary portland cement.
IS: 12894	Specification for Fly ash lime bricks.

Cast-In-Situ Concrete and Allied Works

IS: 280	Specification for mild steel wire for general engineering purposes.
IS: 456	Code of practice for plain and reinforced concrete.

	IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
	IS: 516	Method of test for strength of concrete.
	IS: 650	Specification for standard sand for testing of cement.
	IS: 1199	Methods of sampling and analysis of concrete.
	IS: 1791	General requirements for batch type concrete mixers.
	IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
	IS: 2204	Code of practice for construction of reinforced concrete shell roof.
	IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
	IS: 2438	Specification for roller pan mixer.
	IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
	IS: 2505	General requirements for concrete vibrators, immersion type.
	IS: 2506	General requirements for concrete vibrators, screed board type.
	IS: 2514	Specification for concrete vibrating tables.
	IS: 2645	Specification for Integral cement water proofing compounds.
	IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
	IS: 2750	Specification for Steel scaffolding.
	IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
	IS: 3025	Methods of sampling and test waste water.
	IS: 3366	Specification for Pan vibrators.
	IS: 3370	Code of practice for concrete structures for the storage of

(Part I to IV)	liquids.
IS: 3414	Code of practice for design and installation of joints in buildings.
IS: 3550	Methods of test for routine control for water used in industry.
IS: 3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326	Code of practice for earthquake resistant design and construction of buildings.
IS: 4461	Code of practice for joints in surface hydro-electric power stations.
IS: 4656	Specification for form vibrators for concrete.
IS: 4925	Specification for batching and mixing plant.
IS: 4990	Specification for plywood for concrete shuttering work.
IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
IS: 5256	Code or practice for sealing joints in concrete lining on canals.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS: 5624	Specification for foundation bolts.
IS: 6461	Glossary of terms relating to cement concrete.
IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS: 6509	Code of practice for installation of joints in concrete pavements.
IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS: 9012	Recommended practice for shot concreting.
IS: 9103	Specification for admixtures for concrete.

IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS: 10262	Recommended guidelines for concrete mix design.
IS: 11384	Code of practice for composite construction in structural steel and concrete.
IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
IS: 12118	Specification for two-parts poly sulphide.
IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
IS: 13311	Method of non-destructive testing of concrete.
Part-1	Ultrasonic pulse velocity.
Part-2	Rebound hammer.
SP:23	Handbook of concrete mixes
SP: 24	Explanatory Handbook on IS: 456-1978
SP: 34	Handbook on concrete reinforcement and detailing.

Precast Concrete Works

SP: 7(PartVI/	National Building Code- Structural design of prefabrication and Sec.7) systems building.
IS: 10297	Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.
IS: 10505	Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.

Masonary and Allied Works

IS: 1905	Code of Practice for Structural Safety of Buildings-Masonry walls.
IS: 2212	Code of Practice for Brickwork.

IS: 2250	Code of Practice for Preparation and use of Masonry Mortar.
SP: 20	Explanatory hand book on masonry code.

Sheeting Works

IS:277	Galvanised steel sheets (plain or corrugated).
IS: 459	Unreinforced corrugated and semi-corrugated asbestos cement sheets.
IS: 513	Cold-rolled carbon steel sheets.
IS: 730	Specification for fixing accessories for corrugated sheet roofing.
IS: 1626	Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.
IS: 2527	Code of practice for fixing rain water gutters and down pipe for roof drainage.
IS: 3007	Code of practice for laying of asbestos cement sheets.
IS: 5913	Methods of test for asbestos cement products.
IS: 7178	Technical supply conditions for tapping screw.
IS: 8183	Bonded mineral wool.
IS: 8869	Washers for corrugated sheet roofing.
IS: 12093	Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.
IS: 12866	Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced).
IS: 14246	Specification for continuously pre-painted galvanised steel sheets and coils.

Fabrication and Erection of Structural Steel Work

IS: 2016	Specification for plain washers.

IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS: 3502	Specifications for chequered plate.
IS: 6911	Specification for stainless steel plate, sheet and strip.
IS: 3757	Specification for high strength structural bolts
IS: 6623	Specification for high strength structural nuts.
IS: 6649	High Tensile friction grip washers.
IS: 800	Code of practice for use of structural steel in general building construction.
IS: 816	Code of practice for use of Metal Arc Welding for General Construction.
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS: 817	Code of practice for Training and Testing of Metal Arc Welders.
IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
IS: 7215	Tolerances for fabrication steel structures.
IS: 12843	Tolerance for erection of structural steel.
IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP: 6 (Part 1 to 7)	ISI Hand book for structural Engineers.

IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube
IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.
IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

Plastering and Allied Works

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster-of-paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.

IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)
IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars.
	Part I Silicate type
	Part II Resin type
	Part III Sulphur type
IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

Water Supply, Drainage and Sanitation

IS : 458	Specification for concrete pipes.
IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.
IS : 774	Flushing cisterns for water closets and urinals.
IS : 775	Cast iron brackets and supports for wash basins and sinks.
IS : 778	Copper alloy gate, globe and check valves for water works purposes.
IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
IS : 782	Caulking lead.
IS : 783	Code of practice for laying of concrete pipes.

CLAUSE NO.	GENERAL TECHNICAL REQUIREMENTS

IS : 1172	Basic requirements for water supply, drainage and sanitation.
IS : 1230	Cast iron rain water pipes and fittings.
IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.
IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
IS : 1726	Cast iron manhole covers and frames.
IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.
IS : 1742	Code of practice for building drainage.
IS : 1795	Pillar taps for water supply purposes.
IS : 1879	Malleable cast iron pipe fittings.
IS : 2064	Code of practice for selection, installation and maintenance of sanitary appliances.
IS : 2065	Code of practice for water supply in building.
IS : 2326	Automatic flushing cisterns for urinals.
IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.
IS : 2501	Copper tubes for general engineering purposes.
IS : 2548	Plastic seat and cover for water-closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non-ferrous waste fittings for wash basins and sinks.

IS : 3114	Code of practice for laying of cast iron pipes.
IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone-ware pipes.
IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.
IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.
IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.
IS : 10446	Glossary of terms for water supply and sanitation.

IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.
IS : 12701	Rotational moulded polyethylene water storage tanks.
SP: 35	Hand book on water supply and drainage.
-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.

Doors, Windows and Allied Works

IS : 204	Tower Bolts
Part-I	Ferrous metals.
Part-II	Nonferrous metals.
IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.
IS : 1038	Steel doors, windows and ventilators.
IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS : 1341	Steel butt hinges.
IS : 1361	Steel windows for industrial buildings.
IS : 1823	Floor door stoppers.
IS : 1868	Anodic coatings on Aluminium and its alloys.
IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels

IS:2209	Mortice locks (vertical type).
IS:2553	Safety glass
IS:2835	Flat transparent sheet glass.
IS:3548	Code of practice for glazing in buildings.
IS:3564	Door closers (Hydraulically regulated).
IS : 3614	Fire check doors; plate, metal covered and rolling type.
IS:4351	Steel door frames.
IS:5187	Flush bolts.
IS:5437	Wired and figured glass
IS:6248	Metal rolling shutters and rolling grills.
IS:6315	Floor springs (hydraulically regulated) for heavy doors.
IS:7196	Hold fasts.
IS:7452	Hot rolled steel sections for doors, windows and ventilators.
IS:10019	Mild steel stays and fasteners.
IS:10451	Steel sliding shutters (top hung type).
IS:10521	Collapsible gates.

R oof Water Proofing and AlliedWorks

IS:1203	Methods of testing tar and bitumen.
IS:1322	Specification for bitumen felts for water proofing and damp proofing.
IS:1346	Code of practice for water proofing of roofs with bitumen felts.
IS:1580	Specification for bituminous compound for water proofing and caulking purposes.

IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.

Floor Finishes and Allied Works

IS:1237	Specification for cement concrete flooring tiles.
IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:2114	Code of practice for laying in-situ terrazzo floor finish.
IS:2571	Code of practice for laying in-situ cement concrete flooring.
IS:3462	Specification for unbacked flexible PVC flooring.
IS:4971	Recommendations for selection of industrial floor finishes.
IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	Specification for white portland cement.
IS:13801	Specification for chequered cement concrete flooring tiles.

Painting and Allied Works

IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS:1477	Code of practice for painting of ferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:1650	Specification for colours for building and decorative finishes.
IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.
IS:2338	Code of practice for finishing of wood and wood based materials.
Part-I	Operations and workmanship

Part-II	Schedules
IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.
Part-I	Operations and workmanship.
Part-II	Schedule.
IS:2524	Code of practice for painting of nonferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.
IS:2933	Specification enamel paint, under coating and finishing.
IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
IS:5410	Specification for cement paint
IS:5411 (Part-I)	Specification for plastic emulsion paint-for exterior use
IS:6278	Code of practices for white washing and colour washing.
IS:10403	Glossary of terms relating to building finishes.
Piling and Foundation	
IS:1080	Code of practice for design and construction of simple spread foundations.
IS:1904	Code of practice for design and construction of foundations in Soils; General Requirements.
IS:2911	Code of practice for designs and construction of Pile foundations (Relevant Parts).
IS:2950 (Part-I)	Code of practice for designs and construction of Raft foundation.
IS:2974 (Part-I TO V)	Code of practice for design and construction of machine foundations.
IS:6403	Code of practice for determination of Allowable Bearing pressure on Shallow foundation.

IS:8009	Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.
Part-I	Shallow foundations.
Part-II	Deep foundations.
IS:12070	Code of practice for design and construction of shallow foundations on rocks.
DIN:4024	Flexible supporting structures for machines with rotating machines.
VDI:2056	Criteria for assessing mechanical vibrations of machines.
VDI:2060	Criteria for assessing rotating imbalances in machines.
Stop Log and Trash Rack	
IS:4622	Recommendations for fixed - wheel gates structural design.
IS:5620	Recommendations for structural design criteria for low head slide gates.
IS:11388	Recommendations for design of trash rack for intakes.
IS:11855	General requirements for rubber seals for hydraulic gates.
Roads	
IRC:5	Standard specifications and Code of practice for road bridges, section-I general Features of Design.
IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.
IRC:16	Specification for priming of base course with bituminous primers.
IRC:19	Standard specifications and code of practice for water bound macadam.
IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).
IRC:34	Recommendations for road construction in waterlogged areas.
IRC:36	Recommended practice for the construction of earth embankments for road works.
IRC:37	Guidelines for the Design of flexible pavements.
IRC:56	Recommended practice for treatment of embankment slopes for erosion control.
IRC:73	Geometric design standards for rural (non-urban) highways.
IRC:86	Geometric Design standards for urban roads in plains.

IRC:SP:13	Guidelines for the design of small bridges & culverts.
IRC - Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.
IS:73	Specification for paving bitumen

Loadings

IS:875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.
IS:1893	Criteria for earthquake resistant design of structures.
IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.
M.O.T.	Deptt. of railways Bridge Rules.

Safety

IS:3696 (Part I & II)	Safety code for scaffolds and ladders.
IS:3764	Safety code for excavation work.
IS:4081	Safety code for blasting and related drilling operations.
IS:4130	Safety code for demolition of buildings.
IS:5121	Safety code for piling and other deep foundations.
IS:5916	Safety code for construction involving use of hot bituminous materials.
IS:7205	Safety code for erection on structural steelwork.
IS:7293	Safety code for working with construction machinery.
IS:7969	Safety code for handling and storage of building materials
IS:11769	Guidelines for safe use of products containing asbestos.

- Indian Explosives Act. 1940 as updated.

Architectural design of buildings

SP:7	National Building Code of India
SP:41	Hand book on functional requirements of buildings (other than industrial buildings)

Miscellaneous

IS:802	Code of practice for use of structural steel in
(Relevant parts)	overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.
IS:10430	Creteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA	Design and construction of buried thin-wall pipes.
Publication	

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measuremnet by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).
   b) Electonic transmitters BS:6447.
2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
3. Process operated switch devices (Pr. Switch) BS-6134.

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware/ Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controling instrument - ANSI C 39.5 - 1974.
3. Compatability of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).
5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.
6. Printed circuit boards - IPC TM - 650, IEC 326 C.
7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).
11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).
12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.
13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.
14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.
15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.

17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.

18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.

19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.

20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.

21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.

22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.

2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).

2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).

3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.

2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.

3. Instrinsically safe apparatus - NFPA 493 1978.

4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.

5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.
3. Water and steam in power cycle - ASME PTC 19.11.
4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.
2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472
3. Damp heat cycling test - IS:2106
4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA 85 - 2011 or latest version.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.

6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.

7. Printed Circuit Board - IPC TM 650, IEC 326C.

8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.

2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.

3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).

4. Codes for pressure piping - ANSI B 31.1

5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.

2. Seamless carbon steel pipe ASTM - A - 106.

3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.

4. Material for socket welded fittings - ASTM - A - 105.

5. Seamless ferritic alloy steep pipe - ASTM - A - 335.

6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.

7. Composition bronze of ounce metal castings - ASTM - B - 62.

8. Seamless Copper tube, bright annealed - ASTM - B - 168.

9. Seamless copper tube - ASTM - B - 75.

10. Dimension of fittings - ANSI - B - 16.11.

11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.

2. Material of socketweld fittings - ASTM - A105.

3. Dimensions of fittings - ANSI - B - 16.11.

4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorugh 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.
6. Rules for Testing insulated cables and flexible cables : VVDE - 0472
7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)
8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.
9. Oxygen index and temperature index test - ASTM D - 2863.
10. Smoke density measurement test - ASTMD - 2843.
11. Acid gas generation test - IEC - 754 - 1.
12. Swedish Chimney test - SEN - 4241475 (F3).
13. Teflon (FEP) insulation & sheath test - ASTMD - 2116.
14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.
15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

1. Guide for design and installation of cable systems in power generating staiton (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.
2. -do- Test Standards. NEMA VE-1-1979.
3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTMA - 386-78.

Public Address System

1. Specifications for lod speakers - IS:7741 (Part-I, II and III)
2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301
3. Specification for Public Address Amplifiers - IS:10426.
4. Code of practice for outdoor installation of PA system - IS:1982.
5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.
6. Basic environmental testing procedures for electronic and electrical items - IS:9000.
7. Characteristics and methods of measurements for sound system equipment - IS:9302
8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732
9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)
10. Fittings for rigid steel conduits for electrical wiring - IS:2667
11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.

Vibration Monitoring System

1. API 670 - 1994
2. BS : 4675 Part-2

ANNEXURE-I

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

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

MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER
SIGNATURE	

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

FOR NTPC USE

DOC. NO.:		REV..... CAT.....
REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F1-R1 1/1 ENGG. DIV./QA&I

ANNEXURE-II

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

SL. NO	ACTIVITY AND OPERATION	CHARACTERISTICS / INSTRUMENTS	CLASS OF CHECK #	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.

				DOC. NO.:		REV.....
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER	LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. **LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR; 'A'** SHALL BE WITNESSED BY NTPC FQA, **'B'** SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND **'C'** SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)	FOR NTPC USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL

FORMAT NO.: QS-01-QAI-P-09/F2-R1 1/1 ENGG. DIV./QA&I

ANNEXURE-III

एनटीपीसी NTPC	Project : Stage : Package : Supplier : Contractor No. :	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL SUB-SYSTEM :	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks

LEGENDS

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

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

DR – **For these items "Detailed required" for NTPC review. To be identified with letter "DR" in the list.**

NOTED – **For these items vendors are approved by Main Supplier and accepted by NTPC without specific vendor approval from NTPC. To be identified with "NOTED.'**

QP/INSPN CATEGORY:

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

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

CAT-III : **For these items Main Supplier approves the Quality Plans. The final acceptance by NTPC shall be on the basis certificate of conformance by the main supplier.**

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

ANNEXURE-IV

एनटीपीसी NTPC	Project : Stage : Package : Contractor : Contractor No. :	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item / Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-missio n	Date of comm t Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approva l Status	Sub-supplier detail submissio n schedule	Remarks

FORMAT 1/1 Engg. Div. / QA&I

ANNEXURE-V

एनटीपीसी NTPC	Project : Stage : Contractor : Contractor No. : System :	FIELD WELDING SCHEDULE (To be raised by the contractor) Welding Code:	DOC. NO.: REV. NO.: DATE : PAGE : OF

Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method/ Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	

NOTES:

SIGNATURE

FORMAT	1/1	Engg. Div. / QA&I

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	4	-
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-
	▪ P&ID (All sizes)	4	-
	a) Final drawings/documents (Directly to site)	6	2
	b) "As Built" Drawing/Documents (Directly to site)	6	2
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	4 sets	2
3	Operation & Maintenance manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2
4	Plant Hand Book i) First Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk
6	Performance and Functional Guarantee Test Report i) First Submission	2 sets	--
	ii) Approved Copies (Direct to Site)	4 sets	2
7	Project Completion Report (Directly to site)	6 sets	2
8	QA programme including Organisation for implementation and QA system manual(with revisions)	1	--
9	Vendor details in respect of proposed vendors including contractor's evaluation report.	2	--
10	Manufacturing QPs, Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc i) For review/comment	1	--
	ii) Approved final copies of Field QPs, Field welding schedules and their reference document like test procedures, WPS, POR etc (Direct to Site)	4	2
11	Welding Manual, Heat Treatment Manuals, Storage & preservation manuals i) For review/comment	1 set	--
	ii) Approved copies (Direct to Site)	4 sets	2
12	QA Documentation Package for items / equipment manufactured and despatched to site	2 sets	2
13	QA Documentation Package for field activities on equipment/systems at site	2 sets	2

PROJECT SPECIFIC GENERAL REQUIREMENTS INCLUDING: QUALITY ASSURANCE

1.11.0 AGITATORS:

1.11.01 Rubber lining shall be tested for hardness and spark test

1.11.02 Impellers shall be tested for dimensional and balancing check

1.11.03 Gear Boxes shall be tested for run test as per standard practice

1.12.0 FANS:

1.12.01 Rotor components shall be subjected to ultrasonic test at mill and magnetic particle inspection / liquid penetrant examination after rough machining.

1.12.02 Butt welds in rotor components shall be subjected to 100% RT and all welds shall be magnetic particle/dye penetrant tested after stress relieving.

1.12.03 All rotating components and assemblies of fan shall be balanced dynamically

1.12.04 Performance test shall be carried out on fans as per Technical specification/ Relevant standard

1.12.05 Test for Natural Frequency and hardness of Fans blades shall be carried out as per Technical specification/ Relevant standard

1.13.0 Thermal Insulation, Lagging & Cladding:

(a) **Lightly resin bonded mineral wool:**

LRB mattresses/sections of Rockwool/ Glasswool shall conform to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in respective Sub-Section of Technical Requirements of Steam Generator & Auxiliaries.

(b) **Lagging & Cladding:**

All insulation shall be protected by means of an outer covering of Aluminium sheeting confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.

1.14.0 OTHER CRITICAL EQUIPMENTS:

1.14.01 Checks/ NDTs shall be done as per relevant Indian Standards or equivalent International Standards.

Agitator inspection requirement-Please note that attached QP is indicative only. Stage inspection and Quantum of check may vary during final approval by customer (NTPC).

BHEL Ranipet	MANUFACTURER'S NAME AND ADDRESS	**STANDARD QUALITY PLAN**	**QP NO**	**FGS: 720**
		ITEM: AGITATOR	**REV. NO:**	**00**
		SYSTEM: FGD	**DATE:**	**12.02.2019**
			PAGE NO:	**Page 2 of 2**

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	B					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
														Horizontal
4.2	Free Air Run Test of complete assembly	Measurement Current, RPM, Noise & Vibration	MA	Measurement	100%	10%	Vendor Standard / Approved Drawing / Data Sheet		IR	√	P	W	W	
4.3	Review of QA Documents	Verification of QA Documents	MA	Verification	100%	100%	As per Appd. MQP		IR		P	V	V	
5.0	**Painting & Preservation**													
5.1		Painting Material	MI	Review of MTC	100%		Appd. "Painting Procedure"/Approved Painting Schedule		IR	√	P	V	-	
5.2		Surface treatment and inspection	MI	Visual	100%	-	-do-		IR	√	P	-	-	
5.3		DFT Check	MI	Measurement	10%		-do-		IR	√	P	V	-	
5.4		Painting Surface Quality	MI	Visual	100%		-do-		IR	√	P	V	-	
6.0	**Inspection before Delivery**													
6.1	Packing	Size, appearance & firmness	MI	Measurement & Visual	100%		As per "Packing Procedure"		IR	√	P	V	-	
6.2	Deliver Documents	Markings, Packing List & Details Packing List, etc., Check	MI	Verification	100%		As per "Packing Procedure"		IR	√	P	V	-	

NOTES:

1. For Agitator Motor rating is 45KW and motor make NTPC/BHEL Approved source.
2. Routine test report duly witnessed by main contractor as per applicable standard shall be reviewed during inspection (more than 30 KW Rating).

LEGEND: * RECORD, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE. **M:** MANUFACTURER / SUB SUPPLIER, **C:** MAIN CONTRACTOR. **N:** CUSTOMER/CONSULTANT **P:** PERFORM **W:** WITNESS **V:** REVIEW OF RECORDS **MA:** MAJOR AND **MI:** MINOR	**PREPARED BY** **Rakesh Kumar Madhu,(SEr/QA)**	**REVIEWD & APPROVED BY** **K C Gandhi Parimalam,(DGM/QA)**

Ranipet	MANUFACTURER'S NAME AND ADDRESS **M/S BHEL: BAP: RANIPET 632 406 TAMIL NADU**	**STANDARD QUALITY PLAN** **ITEM: AGITATOR** **SYSTEM: FGD**	**QP NO** FGS: 720 **REV. NO:** 00 **DATE:** 12.02.2019 **PAGE NO:** Page 1 of 2

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	B					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D *	** 10.			11.
1.0	**Raw Material Inspection**													
1.1	All materials including casting & forgings	Chem. & Mech. Dimensions Surface Defects	MA MA MA	Review of MTC Measurement Visual	1/Heat 100% 100%	1/Heat - -	As per spec. & Appd. Dwg		TC IR IR	√	P P P	V - -	V - -	
2.0	**Motor : Review Of Manufacture Test Certificate**													
3.0	**In Process Inspection**													
3.1	Welding Qualifications	WPS & PQR	MA	WPS, PQR & WPQ	100%		ASME Sec IX		IR	√	P	V	V	Recent qualified WPS, PQR and WPQ shall be submitted for review during inspection
3.2	Marking, Cutting, Edge Preparation Tacking	Dimensions	MA	Measurement	100%	-	Appd.Dwg.		IR		P	-	-	
3.3	Welds	Dimensions & Surface Quality	MA	Measurement	100%		Appd.Dwg.& ASME Sec VIII		IR	√	P	W	V	
3.4	Machining of Components	Dimensions Surface Defects	MA	Measurement Visual	100% 100%	- -	Appd. Dwg.		IR		P P	- -	- -	
3.5	Impeller	Static balance test	MA	Measurement	100%		As per Specs.		TR	√	P	V	V	
3.6	Rubber Lining	Hardness test & Spark test	MA	Measurement	100%		As per Specs.	Appd. Drg	TR	√	P	W	V	
3.7	Assembly	Dimensions Completeness	MA	Measurement Visual	100% 100%		Appd.Drg.		IR	√	P P	V V	V V	
4.0	**Final Inspection**													
4.1	Final Assembly	Overall Dimensions & Completeness	MA MA	Measurement Visual	100%	10%	Appd. Dwg		IR	√	P	W	V	*10% pf each type (Vertical /

LEGEND: * RECORD, IDENTIFIED WITH "TICK" (√) UNDER COLUMN 'D' SHALL BE SUBMITTED TO CUSTOMER AS A QA DOCUMENTATION PACKAGE.
M: MANUFACTURER / SUB SUPPLIER, **C:** MAIN CONTRACTOR.
N: CUSTOMER/CONSULTANT **P:** PERFORM **W:** WITNESS **V:** REVIEW OF RECORDS
MA: MAJOR AND **MI:** MINOR

PREPARED BY

Rakesh Kumar Madhu,(SEr/QA)

REVIEWD & APPROVED BY

K C Gandhi Parimalam,(DGM/QA)

QUALITY REQUIREMENT

(a) Since this items comes under Sub-QR Category, hence inspection at vendor works is applicable by BHEL/BHEL TPI and NTPC as per NTPC Approved Quality plan.

(b) Supplier shall submit the MQP in NTPC Format (Sample QP attached herewith) for approval of NTPC. Please note that attached QP is indicative and minimum requirement only. Stage inspection and Quantum of check may vary during final approval by customer (NTPC).

(c) Painting : Painting details in the specification are minimum requirement. Painting shall be as per approved schedule which will be submitted by successful bidder during detail engg.

(d) In case of order placed on foreign vendors, vendor has to finalize Inspection agency at their own cost and carry out inspection as per the approved Quality plan . Further, the list of third party insection agencies (as applicable) shall be provided by BHEL during detail engineering.Vendor has to furnish BHEL the inspection reports and other documents required as per approved Quality plan duly signed by the Inspection Agency after their witness for BHEL's review and acceptance.

MOTOR

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y			Y		Y			Y							
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										

Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant
supporting documents during QP finalization. However, No QP for LT motor upto 50KW.
2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
3. Makes of major bought out items for HT motors will be subject to NTPC approval.
4. Y1 = for HT Motor / Machines only.

	TITLE: 4 x 250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION No: PE-TS-463-571-18000-A009
		SECTION-C, SUB-SECTION-C2B
		REV. 00 / DATE: OCT 2021
		SHEET : 1 OF 1

CUSTOMER SPECIFICATION: FUNCTIONAL GUARANTEES

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES
	FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE TESTS
1.00.00	**GENERAL**
	The term "Performance Guarantees" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Guarantee Test(s)".
2.00.00	**PERFORMANCE GUARANTEES / PERFORMANCE TESTS**
2.01.00	**General Requirements**
2.01.01	The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.
2.01.02	The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes.
2.01.03	The Contractor shall conduct performance test and demonstrate all the guarantees covered herein. The various tests which are to be carried out during performance guarantee tests are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.
2.01.04	All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.
2.01.05	The performance tests shall be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.
2.01.06	It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests.

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES
2.02.00	**Test Instrumentation, Flow Measurement and their Calibration**
2.02.01	All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer and submit the same to Employer prior to commencement of test. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer prior to commencement of test. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. Tools and tackles, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Contractor free of cost. The Performance test shall be carried out as per the agreed procedure. The detailed PG test procedure shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.
2.02.02	The P&G test procedures shall be submitted for equipments/system & subsystem under Contractor's scope for all Guarantees as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.
2.02.03	The Contractor shall submit for Employer’s approval the detailed Performance Test procedure containing the following: (a) Object of the test. (b) Various guaranteed parameters & tests as per contract. (c) Method of conductance of test and test code. (d) Duration of test, frequency of readings & number of test runs. (e) Method of calculation. (f) Correction calculations & curves. (g) Instrument list consisting of range, accuracy, least count, and location of instruments.

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

(h) Scheme showing measurement points.

(i) Sample calculation.

(j) Acceptance criteria.

(k) Any other information required for conducting the test.

2.03.00 **Test Reports**

After the conductance of Performance test, the Contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Employer after completing each test run. Four (4) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to Employer for approval.

2.03.01 Performance Guarantee Tests on the equipments/systems not covered in this Sub-section shall be carried out as per the procedure/test codes specified in respective detailed specifications.

2.04.00 **Acceptance of Guarantee Test Results**

(i) For Category-I Guarantees

In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit as specified at **clause 3.00.00** of this sub-section, Employer will accept the equipment/system/plant after levying liquidated damages as per **clause 3.00.00** of this sub-section. However, if, the demonstrated performance guarantee(s) continue to be beyond the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

Reject the equipment / system / plant and recover from the Contractor the payments already made

OR

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages for shortfall in performance indicated in clause 3.00.00 of this sub-section shall be levied separately for each unit. The rates indicated in clause 3.00.00 of this sub-section are on per unit basis. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies.

(ii) For Category-II Guarantees

In case during performance guarantee test(s) it is found that the equipment/ system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met even after the above modifications/replacements with in ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

Reject the equipment /system / plant and recover from the Contractor the payments already made.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as “Category-II” Guarantees.

3.00.00 AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE FOR GUARANTEES FOR EACH PROJECT

The rate of liquidated damages and acceptable shortfall limits for different guarantees shall be as under and such liquidated damages shall be deducted from the Contract Price of the project.

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

NABINAGAR JV RLY-I (4X250 MW)

Sl.No	Guarantee	Rate of Liquidated Damage (LD)	Acceptable Shortfall Limit with LD
i)	For shortfall in guaranteed SO_2 removal efficiency in percentage points under conditions stipulated in clause 4.01.00 (i) of Sub-Section-VI, Part A, Section-VI.	US $ 21,045/- (US Dollar Twenty One Thousand Forty Five only) for every 0.1% point shortfall in SO2 removal efficiency from the guaranteed value	(-)0.25% point from the guaranteed SO2 removal efficiency.
ii)	For increase in the limestone consumption of FGD system in T/hr under conditions stipulated in clause 4.01.00 (ii) of Sub-Section-VI, Part A, Section-VI.	US $ 255,904/- (US Dollar Two Hundred Fifty Five Thousand Nine Hundred Four only) for every 100 kg/hr increase in Limestone consumption from guaranteed value.	(+)10% of the guaranteed limestone consumption.
iii)	**Auxiliary Power Consumption** For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 4.01.00 (iii), of Sub-Section-VI, Part A, Section-VI.	US $ 2129/- (US Dollar Two Thousand One Hundred Twenty Nine only) for every KW increase in Auxiliary power consumption from the guaranteed value.	(+)1% of the guaranteed auxiliary power consumption

NOTES APPLICABLE FOR EACH PROJECT:

i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.

ii) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.

iii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC)

iv) Contractor's aggregate liability to pay Liquidated Damages (LD) for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price.

v) The LD values are applicable on per unit basis.

4.00.00 GUARANTEES PARAMETERS

4.01.00 **Guarantees Under Category-I**

The Performance Guarantees which attract Liquidated Damages (LD) are as follows:

The following shall be guaranteed by the Bidder under guarantee point condition of Sub- Section-V, Part-A of section- VI:

(i) SO2 removal Efficiency

The Contractor shall Guarantee that SO_2 removal efficiency at guarantee point (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) shall not be less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project). (To be conducted as per the stipulation of Cl. no. 6.00.00 of this sub-section.)

(ii) Limestone consumption of FGD system

Limestone consumption of FGD system in kg/hr under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project) and SO2 removal efficiency of not less than the value specified under guarantee point conditions (as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project)

(iii) Auxiliary Power Consumption

The Contractor shall guarantee the total auxiliary power consumption for the FGD plant in normal operation at the guarantee point conditions, as specified in Clause 1.00.00/2.00.00/3.00.00/4.00.00 Sub-section-V, Part-A of Section-VI applicable for respective project, inline with the requirements stipulated in clause 5.00.00 of this Sub-Section.

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4.02.00 **Guarantees Under Category-II**

The parameters/capabilities shall be demonstrated for various systems/ equipments shall include but not limited to the following:-

(i) Wet ball Mill capacity at rated fineness

The contractor shall demonstrate the guaranteed capacity of each limestone pulverizer under the following conditions:

i) Limestone fineness : 90% or higher (as per the requirement of the absorber) through 325 mesh.

ii) Limestone Quality : All available quality from the specified range.

(ii) Wet ball Mill wear parts guarantee

Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in Part B of the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulverizer based on actual total hours of operation.

(iii) Wet ball Mill ball consumption

Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in Part B of the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced.

(iv) Vacuum Belt Filter Capacity

Contractor shall demonstrate the Designed Capacity of the Vaccum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in Part B of the Technical Specification.

(v) Gypsum Purity

The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for guarantee point condition.

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

(vi) Waste Water

The Contractor guarantees that the maximum purge flow rate to waste water treatment system for the complete plant shall be $10m^3$/hr averaged over a 24 hour period from each unit.

(vii) Performance characteristics of fans (capacity, head developed, etc.).

(viii) Margins on fans in case Booster Fan is provided by the Contractor.

Booster Fans - As specified in Part B of **Technical Specifications**

(ix) Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building: Over load tests, travel and hoist speed checks.

(x) Noise

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in Part-C of Section-VI of the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or is 9779.

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. additional measurement points shall be considered based on the applicable standards and the size of the equipment. the measurement shall be done with slow response on the a - weighting scale. the average of a-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. corrections for background noise shall be considered in line with the applicable standards. all the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

(xi) Mist Outlet Droplet Content

The mist eliminator outlet droplet content shall be guaranteed to be ≤ 20 mg/Nm3 at absorber outlet measured over a period of 24 hrs continuous operation.

Mist outlet-droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Employer.

(xii) Availability of FGD Plant

The Contractor shall guarantee the maximum availability of FGD Plant for the range of coal and limestone specified inline with the requirements stipulated in clause 7.00.00 of this Sub-Section

(xiii) Air Conditioning System

A. Following shall be demonstrated at Shop

1) Capacity and static pressure of AHU fans at its rated duty point.

B. Following shall be demonstrated at Site

1) Capacity (TR) of air cooled condensing units (D-X type) for A/C system of FGD control room building.

2) Guaranteed room conditions during summer for all the Air conditioned areas.

3) Vibration and noise level of condensing units & centrifugal fans of AHUs.

(xiv) Ventilation System

A. Following shall be demonstrated at Shop

1) Capacity and discharge pressure of pumps of UAF units at its rated duty point of Ventilation system.

2) Capacity and static pressure of UAF fans at its rated duty point of Ventilation system.

B. Following shall be demonstrated at Site

1) Vibration & Noise level of centrifugal fans & pumps of UAF units.

(xv) Compressed Air System

a) Following shall be demonstrated at shop:

i) Capacity and discharge pressure of each air compressor.

b) Following shall be demonstrated at site:

ii) Dew point of air at the outlet of air drying plants of air compressor.

iv) Pressure drop across air drying plant .

v) Vibration and noise level of air compressors, blowers of air drying plant (if applicable)

xvi) Equipment Cooling Water System

i) Vibration, noise and parallel operation without hunting & abnormal noise and with flow sharing within 10% of each other at the rated duty point shall be demonstrated at site.

ii) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate type heat exchanger on the primary & secondary water circuit to be demonstrated at site.

xvii) Waste Water Treatment System (Applicable for Barh-I (3X660 MW) & Nabinagar (4x250 MW)

The Contractor shall guarantee the followings.

A). Wastewater treatment capacity(m^3/hr) : ≥ 30 for **Barh-I (3X660 MW)**

B). Wastewater treatment capacity(m^3/hr) : ≥ 20 for **Nabinagar (4x250 MW)**

C). Operating time : 16hr for Pre-treatment process, 24hr for Evaporation process

D). The distillate quality (Evaporator and crystallizer combined) shall be a maximum of 50 ppm TDS at 120 ^oF, while the solids produced for disposal which will pass the paint filter test.

5.00.00 AUXILIARY POWER CONSUMPTION (PA) FOR EACH PROJECT

The unit auxiliary power consumption shall be calculated using the following relationship.

$P_a = P_u + T_L$

P_a = Guaranteed Auxiliary Power Consumption.

P_u = Power consumed by the auxiliaries of the unit under test.

T_L = Losses of the transformers supplied by bidder based on works test reports.

While guaranteeing the auxiliary power consumption of each project the bidder shall necessarily include all continuously operating auxiliaries under this package. The auxiliaries to be considered shall include but not be limited to the following:

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i. Absorber Recirculation Pump(s)/Gas Cooling Pumps

ii. Absorber Oxidation Air Blower(s)

iii. Absorber Oxidation Tank Agitator(s)

iv. Gypsum Bleed Pump

v. Limestone Gravimetric feeder, Wet ball mill and their integral Auxiliaries divided by the number of units in the project

vi. Limestone Slurry Pump

vii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries divided by the number of units in the project

viii. Power consumption of Booster water pump (if provided) divided by the number of units in the project.

ix. Process water pump(s) divided by the number of units in the project

x. Mist Eliminator Wash Water pump(s)

xi. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project

xii. DM Cooling (normally working) Water pump one(1) to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling water system.

xiii. Auxiliary Cooling (normally working) water pump one(1) to supply cooling water on the secondary side of the plate type heat exchangers in the closed loop Equipment cooling (unit auxiliary) water system.

xiv. Booster Fans

xv. Power consumption of Limestone Slurry Tank Agitator(s) divided by the number of units in the project

xvi. Power consumption of Filtrate Pump divided by the number of units in the project

xvii. Power consumption of Belt Filter Wash Water Pump divided by the number of units in the project

xviii. Power consumption of Cloth Wash Water Pump divided by the number of units in the project

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xix. Power consumption of Hydro cyclone and Waste Water Pump divided by the number of units in the project

xx. Power consumption of all other continuous running Agitators divided by the number of units in the project

xxi. Air Conditioning System (*)

Total Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of FGD Control Room Building and ZLD Control Room Building (if provided) divided by total nos. of units in respective project..

xxii Total power consumption at motor input terminal at rated duty of fan of UAF divided by total nos. of units in respective project. (*)

((*) Above guaranteed power consumption values shall be at 20 deg C for centrifugal fans of AHUs and at 30 deg C for centrifugal fans of air washer units and at an elevation of RL (+) - m for both AHUs and Air washer unit centrifugal fans.)

xxiii Total power consumption at motor input terminal at rated duty of Air compressor, Air drying plant (Heater and blower, as applicable) divided by total nos. of units in respective project

xxiv. Power consumption of Evaporator feed pump divided by the number of units in the project, in case ZLD system is provided

xxv. Power consumption of Evaporator/Brine concentrator recirculation pump divided by the number of units in the project, in case ZLD system is provided

xxvi. Power consumption of Distillate pump divided by the number of units in the project, in case ZLD system is provided

xxvii. Power consumption of Crystalliser feed pump divided by the number of units in the project, in case ZLD system is provided

xxviii. Power consumption of Crystalliser recirculation pump divided by the number of units in the project, in case ZLD system is provided

xxix. Power consumption of Mechanical vapour Compressor divided by the number of units in the project, in case ZLD system is provided

The equipment's listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption. Power consumption of all equipments provided on unitized basis shall be included in the unit auxiliary power consumption. For common station auxiliaries, the power

CLAUSE NO.	FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

consumption shall be assigned to each unit based on unit load for the purpose of calculating the unit auxiliary power consumption.

Note :

1. The bidder shall furnish a list of equipments to be covered under auxiliary power consumption, which shall be subject to Employer's approval.
2. The equipments listed above for calculating auxiliary power consumption are indicative. Any other equipment required for continuous operation of the system shall also be considered for calculation of auxiliary power consumption.

6.00.00 METHOD OF COMPUTING TEST EFFICIENCY OF FGD

The performance tests shall be carried out in accordance with ASME PTC 40 (1991) code. No tolerance or allowance on the test result will be permitted for instrument errors or inaccuracy, the method of testing or any other causes. The details of the test shall, however be mutually agreed upon between the employer and the contractor.

7.00.00 METHOD OF COMPUTING AVAILABILITY

The Contractor shall guarantee 98 % availability of FGD plant including waste water treatment system for Zero Liquid Discharge (ZLD), wherever provided, for a continuous period of 120 days. An availability guarantee test shall be conducted to assure this level of availability for a period of 240 days as per the procedure indicated below.

Availability 'A' in %:

$$A = \frac{Tc \times 100\%}{Tk}$$

Tc – recorded time of FGD operation, expressed in hours,

Tk – recorded time of boiler operation, expressed in hours,

However, it is required that:

(i) In order to calculate the FGD availability, operation hours will be counted except boiler start-ups when the operation hours counting will start on the moment of shut down of all oil burners,

(ii) FGD will be regarded as a FGD in operation, when by-pass damper is closed and total flow of flue gas from boiler goes via FGD, and SO2

content is below 100 mg/Nm3 (dry basis at 6% O_2) in cleaned flue gas for the range of specified coals & loads.

(iii) If FGD is out of operation during the boiler operation time as a result of the Employer's decision, this time will not be counted as boiler operation time for calculating the FGD availability,

(iv) Boiler operation hours will be counted based on the recorded boiler operation hours and the recorded data will be made available to the Contractor by the Employer.

Mandatory spares have been identified in the Employer. Contractor can use the mandatory spares supplied under the contract during this period in agreement with the Employer. However, if other additional spares are required for demonstration of availability demonstration guarantee, Bidder to should clearly indicate along with their offer.

If the calculated availability after 120 days availability test is lower than the guaranteed value, the Contractor will undertake actions as per clause 2.04.00 (ii) of this Sub-Section to achieve the guaranteed availability.

667046/2022/PS-PEM-MAX

	TITLE:	SPECIFICATION No: PE-TS-463-571-18000-A009	
	4 x 250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION-I, SUB-SECTION-C 2C	
		REV. 00	DATE: OCT 2021
		SHEET : 1 OF 1	

CUSTOMER SPECIFICATION: PAINTING SPECIFICATION

RANIPET	**Bharat Heavy Electricals Limited** **Boiler Auxiliaries Plant** **Ranipet – 632 406**	**BHEL DOC NO.**	**PS: NN FGD: : G201**
		REVISION NO.	**01**
		DATE	**18.11.2019**

NABINAGAR FGD PACKAGE

PAINTING SCHEME for FGD SYSTEM, BOOSTER FAN& GATES& DAMPERS

NTPC CONTRACT NO: CS-0270-109(1A) -2/FC/19-20/18-19 dtd 10.07.2019

NTPC DRG NO: 0270-109-PVM-H-001

BHEL RANIPET Customer No(s).: G201-G204

Prepared By	Reviewed & Approved By
	Certification signature by P S Chowdhury <pschowdhury@ntpc.co.in> Validity Unknown Digitally signed by P S Chowdhury Date: 2019.11.26 16:51:49 IST Reason: CAT I Location: NTPCEOC
Rajamanickam M **Dy.Manager/QA**	**K.C. G**

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

RECORD OF REVISION

REV NO	DATE	DETAILS OF REVISION
00	01.11.2019	Original Issue - First Submission
01	18.11.2019	**NTPC comments:** Sl no: 32, 33& 38 of FGD, DFT- 300 microns **BHEL reply:** The Sl nos: 32, 33& 38 of FGD are of Limestone silo structures, Limestone silo- Outside surfaces and Platform structures are given painting as per the civil specification as they are the steel structures. As per the clause 31.03.00 of Sec.VI, Part-B, Sub section IV-D civil works, total DFT is 240 microns only. We have given as per the NTPC specification only. We request you to kindly consider and approve our painting schedule.
		NTPC comments: We understand that the painting details of DCS and control panels shall be provided in the respective GA/ IA details kindly clarify. **BHEL reply:** We wish to submit that the painting details of DCS and control panels is provided in the respective GA/IA details. We request you to kindly approve the painting schedule.

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

1. FANS

1	Axial Fan tool & fixtures **(Clause 20.03.00 of Part- C Section VI)**	55 000	Power Tool Cleaning to st3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
2	Booster Fan foundation material	55 081	Temporary rust preventive fluid application as per PRQA 523 DFT- 20µ All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents.					
3	Booster Fan Handrails & Insert **(Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)**	55 082	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (min).				
4	Booster Fan Handrails & Insert- Structural items other than the above **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	55 082	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
5	Axial booster cooling/ seal fan **(Clause 1.04.00 of Part- A Section VI)**	55 084	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat	100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ	75	300

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100	**Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	25	
6	Booster fan canopy for motor **(Clause 1.04.00 of Part- A Section VI)**	55 089	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
7	Axial booster fan rotor **(Clause 20.03.00 of Part- C Section VI)**	55 286	Power Tool Cleaning to St3 (SSPC-SP3)	Two coats of Epoxy based Zinc phosphate primer (Two pack system) to IS 13238; DFT- 30µ/coat	60	NIL	--	60
8	Axial booster fan stator **(Clause 20.03.00 of Part- C Section VI)**	55 586	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
9	Axial booster fan coupling **(Clause 1.04.00 of Part- A Section VI)**	55 880	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
10	Booster fan LOS with lubricant **(Clause 1.04.00 of Part- A Section VI)**	55 980	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
11	Booster fan actuator **(Clause 1.04.00 of Part- A Section VI)**	55 983	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

2. FGD SYSTEM

1	Slurry recirculation pump System **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 212	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Light blue RAL 5012	100	210
2	Absorber System Internals – Structural items **(Clause 1.04.00 of Part- A Section VI)**	FW 213	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
3	Mist eliminator and accessories, Absorber baffle grating support, Mist eliminator support& Absorber Spray pipe support - Structural items **(Clause 1.04.00 of Part- A Section VI)**	FW 215 FW 216 FW 217 FW 218	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
4	Absorber System- Base **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 219	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
			conforming to ISO 8501-1	and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
5	Absorber system structures, Absorber shear plate, Duct supports, Structures for RC pump house& Hook up duct structure **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 220 FW 231 FW 232 FW 233 FW 234 FW 236 FW 238	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
6	Absorber system casing bottom- Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 221	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
	Inside surfaces are of C276 cladded sheets, hence no paint is envisaged.			Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
7	Absorber system casing top- Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)** Inside surfaces are of C276 cladded sheets, hence no paint is envisaged.	FW 222	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
8	Absorber system accessories **(Clause 20.03.00 of Part- C Section VI)**	FW 223	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
9	Emergency Quench water tank- Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
10	Emergency Quench water tank- Inside surfaces	FW 226	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Primer: Two coats of Red Oxide Zinc phosphate primer, DFT-30µ/coat; Total-60µ (Primer is only envisaged as lining is given in inside surfaces of the tank)				
11	Emergency quench system, Handling Equipment RC pump **(Clause 20.03.00 of Part- C Section VI)**	FW 227 FW 249	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	120
12	Air oxidation system, Viewing ports (Without glass) **(Clause 20.03.00 of Part- C Section VI)**	FW 230 FW 239	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
13	Absorber W/D interface, W/D wash system, Slurry distribution system, Oxidation Air distribution system **(Clause 1.04.00 of Part- A Section VI)**	FW 228 FW 229 FW 243 FW 244	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300

Sl No	SURFACE LOCATION		PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
					PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
14	Expansion joint between bypass **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 251	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (two coats)	60	--	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
15	Expansion joint **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 252	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
16	Ducts between bypass duct inlet& booster fan **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 255	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
17	Ducts between Booster fan& Absorber **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 256	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40

Sl No	SURFACE LOCATION		PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
					PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
18	Ducts between Absorber& Stack **(Clause 20.03.00 of Part- C Section VI)**	Flue gas swept surface	FW 257	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	NIL	--	60
		Insulated surfaces		Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	NIL	--	40
19	Duct structure between bypass duct& Booster fan **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**		FW 260	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
20	Duct structure between Booster fan& Absorber **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**		FW 261	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ		exposure, gloss less than 30 and colour change less than 2.0Δ E)		
21	Duct structure between Absorber & Stack **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 262	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
22	Foundation material for duct structures, Absorber, Elevator, RC pump shed, tanks, Silo Structure, pipe racks	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 762 FW 763	Temporary rust preventive fluid application as per PRQA 523 DFT- 20µ All Threaded and other surfaces of foundation bolt and its materials shall be coated with temporary rust preventive fluid. During execution of civil works the dried film of coating will be removed using Organic Solvents.					
23	Structures for Emergency Quench water tank Structures for Elevator **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 285 FW 292	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
24	Elevator and accessories **(Clause 20.03.00 of Part- C Section VI)**	FW 293 FW 716	Power Tool Cleaning to st3 (SSPC-SP3	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	120

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
25	Structures for booster fan handling **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 310	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
26	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks **(Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 237 FW 610 FW 612 FW 613 FW 722	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Gratings- Hot dip galvanizing to 610gms/sq.m (minimum) and to a coating thickness of 87µm (minimum)				
27	Galleries and railings for Stairs, Absorber, Dampers, Ducts, Tanks – Structures other than the above **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 237 FW 610 FW 612 FW 613 FW 722	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
28	Slurry pumps & accessories, Water pumps **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 701 FW 702	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Light blue RAL 5012	100	210
29	Monorail for hoist & cranes **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 710	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
30	Handling Equipment- Hoists& Man hole door **(Clause 20.03.00 of Part-C Section VI)**	FW 713 FW 714 FW 717	Power Tool Cleaning to st3 (SSPC-SP3	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Idler roller shall be applied with two coats of 70 microns at shop	70	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	60	130
31	Agitator support **Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 721	Blast cleaning to Sa 2½ (Near white metal) with surface	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
			profile 40-60µm conforming to ISO 8501-1	minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
32	Limestone silo structures **Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 730	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
33	Limestone Silo- Outside surfaces **Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		
34	Lime stone Silo- Inside surfaces (Conical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm conforming to ISO 8501-1	Primer: Two coats of Red Oxide Zinc phosphate primer to IS: 12744 (SS lining is inside the Limestone silo conical portion, hence primer is only envisaged; SS lining will be done at shops itself)	60	NIL	--	60
35	Lime stone Silo- Inside surfaces (Cylindrical portion)	FW 731	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 70 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00	70	--	--	70
36	Air cannon silo, Bag filter & Fan assy, Nozzles& Flanges **(Clause 20.03.00 of Part-C Section VI)**	FW 723 FW 724 FW 725	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
37	Limestone silo approach platform, Platform for Pipe racks& Sub pipe racks **(Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½/ Acid pickling	Hand rails, Ladders, Gratings- Hot dip galvanizing to 610gms/sq. m (minimum) and to a coating thickness of 87µm (minimum)				

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
38	Limestone silo approach platform, Pipe racks, Sub pipe racks platform- Structures other than the above **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 733 FW 766 FW 767	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
39	Limestone Mill – Outside surfaces **(Clause 1.04.00 of Part- A Section VI)**	FW 735	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
40	Lime stone mill- Inside surfaces	FW 735	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	**Primer Coat:** One coat of two component moisture curing Inorganic Ethyl Zinc Silicate Primer to IS 14946, (Solid by volume- 60% (min)), (Metallic zinc content 80% (min)) DFT = 70 µm per coat (min.) Zinc dust composition shall be Type-II as per ASTM D520-00	70	--	--	70

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
41	Gypsum belt filter and accessories Structural items **(Clause 1.04.00 of Part- A Section VI)**	FW 738	Blast cleaning to Sa 2½	**Primer:** Two coats of Epoxy resin based Epoxy Zinc phosphate primer to IS 13238 DFT- 50µ/coat **Intermediate:** One coat of Two component epoxy based intermediate paint pigmented with MIO/Tio2 DFT- 100µ	100 100	**Finish:** One coat of Epoxy based finish paint to IS 14209; DFT- 75µ **Finish:** One coat of acrylic aliphatic polyurethane paint to IS 13213 DFT-25µ Shade: Grey White, RAL9002	75 25	300
42	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydro cyclone waste water tank, Neutralization tank, Process Water tank, Belt filter washing tank, Primary hydro cyclone feed tank, Clarified water tank Outside surfaces **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 785 FW 786 FW 800 FW 802	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
43	Lime stone slurry storage tank, Auxiliary absorber tank, Filtrate tank, Wastage water tank, Hydrocyclone waste water tank, Neutralization tank,	FW 742 FW 743 FW 744 FW 745 FW 747 FW 748 FW 749	Blast cleaning to Sa 2½ (Near white metal) with surface profile 35-50µm	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) (Liner is inside the tank, hence primer is only envisaged; Protection till erection only)	60	NIL	--	60

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
	Process Water tank, Belt filter washing tank, Primary Hydrocyclone feed tank, Clarified water tank, Tank internal structure Inside surfaces	FW 800 FW 802						
44	Process water pipe accessories, Cooling pipe accessories **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 751 FW 752	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
45	Slurry pipe accessories **(Referred from cl. 7.05.00 of Section-VI, Part-B, Sub section-I-M5)**	FW 753	Power Tool Cleaning to St3 (SSPC-SP3)	Primer: Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats) Intermediate: One coat of Synthetic Enamel intermediate coat to IS 2932; DFT- 50µ	60 50	Two coats of Synthetic Enamel to IS 2932, DFT- 50µ/ coat Shade: Grey white RAL 9002 Identification Tag: Sea Green Shade no: 217 as per IS 5	100	210
46	Service Air pipe accessories **(Referred from cl. 10.00 .00 of Section-VI, Part-B, Sub section-I-M3)**	FW 754	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat Identification Tag: Sky Blue Shade no: 101 as per IS 5	60	120
47	Instrument air pipe accessories **(Referred from cl. 10.00 .00 of Section-VI, Part-B, Sub section-I-M3)**	FW 755	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat	60	120

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
						Identification Tag: Sky Blue Shade no: 101 as per IS 5		
48	All valves (Temp <95 deg C) **(Clause 20.03.00 of Part-C Section VI)**	FW 815 to FW 851	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)- 30µ/ coat	60	120
49	Structure for Pipe racks, Sub pipe racks Trestle for pipe racks, Structures inside Gypsum dewatering building & Ball mill building **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	FW 761 FW 765 FW 768 FW 769 FW 787	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	70 100	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)	70	240
50	Supports for cable trays, Air receivers, commissioning& Mandatory spares, Tools & tackles **(Clause 20.03.00 of Part-C Section VI)**	FW 779 FW 798 FW 988 FW 996	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

3. GATES & DAMPERS

01	**Gates & Dampers** > 95° C Insulated Surfaces& Uninsulated surfaces	57 540 57 550 57 583	Power Tool Cleaning to St3 (SSPC-SP3)	HR Aluminium paint to IS 13183 Gr.II (upto 400 deg C)	40	--	--	40
02	Seal air piping	57 141	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coat)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)-30µ/ coat Identification Tag: Sky Blue Shade no: 101 as per IS 5	60	120
03	Blower with Motor Knife Gate valve Mounting bracket Mandatory spares	57 491 57 497 57 209	Power Tool Cleaning to St3 (SSPC-SP3)	Red Oxide Zinc Phosphate Primer to IS: 12744 (Two coats)	60	Synthetic Enamel to IS 2932 Shade: Grey white RAL 9002 (Two coats)	40	100
04	Ladder, Cage for Ladder Toe Guard Plate Floor Grill, Hand Rails, Hand Rail Post **Clause 31.06.00 of Sec.VI, Part-B, Subsection- IV-D**	57 466 57 566	Blast cleaning to Sa 2½/ Acid Pickling	Hot Dip Galvanizing to 610 gm per sq. Meter (minimum) and to a coating thickness of 87 µm (minimum)				
05	Other Structural Items-Other than sl.no. 3 of above **(Clause 31.03.00 of Sec.VI, Part-B, Subsection- IV-D)**	57 466 57 566	Blast cleaning to Sa 2½ (Near white metal) with surface profile 40-60µm conforming to ISO 8501-1	Primer: One coat of Two component moisture curing zinc (ethyl) silicate primer coat (Min 80% metallic zinc content in dry film, solid by volume minimum 60% ±2). Zinc dust composition	70	Finish: Two coats of two pack aliphatic isocyanate cured acrylic polyurethane paint to IS 13213 solid by volume min.55%±2) DFT- 35µ/ coat	70	240

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				and properties shall be as per Type II as per ASTM D520-00 DFT- 70µ Intermediate: One coat of Two component polyamide cured epoxy with MIO content (containing lamellar MIO Min 30% on pigment, solid by volume min. 80%±2) DFT- 100µ	100	Shade: Grey white, RAL 9002 With gloss retention (SSPC paint spec no.36, ASTM D4587, D2244, D523 of level 2 after min. 1000 hrs exposure, gloss less than 30 and colour change less than 2.0Δ E)		

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

4. PAINTING OF DAMAGED AREAS

Areas where paint has deteriorated badly by erosion and areas where the paint film has lost its adhesion property and where the steel has got rusted appreciably - these areas are to be repainted as per the following procedure:

SL NO	SURFACE LOCATION	SURFACE PREPARATION	PRIMER, INTERMEDIATE & FINISH
1	Paint damaged Components falling under Sl.no. 04,05,06,09,10,11 of Fans, Sl no.02,03,04, 05,06,07, 09, 13,19,20,21,23,25,27, 29, 31,32 33,38,39,41,42, 49 of FGD and Sl no. 5 of GAD.	Hand/ Power Tool cleaning to Bare metal to minimum 6 inches peripheral area adjoining to damaged area	Primer: Epoxy Zinc rich primer to IS 14589, DFT-70µ (If Metal surface exposed) followed by intermediate & finish coat as per respective scheme If primer is intact- Intermediate & finish as per respective scheme
2	Paint damaged components failing under other Sl.nos of Fans, FGD& GAD	Power Tool Cleaning to Bare metal	Primer and Finish : As given in respective scheme

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

GENERAL NOTES

1. No painting is required for Galvanized, non-ferrous & stainless steel items, except as indicated above.
2. Machined items are to be applied with coat of temporary rust preventive oil
3. PGMAs covered in sub-supplier (ie., Purchased) items viz., Agitator/ slide bearing and other sub-delivery components etc., are not indicated in the above list. However, the Painting Schedule for all items supplied by all sub-suppliers and BOI under the scope of BHEL shall be same as for main equipment covered in this document.
4. In sub-assy, wherever plates / sheets of thickness less than or equal to 5mm and rods are used, very minor items like clamps, small items etc - Power Tool or Hand Tool Cleaning to SSPC - SP 3 / SP 2 shall be followed and painting under Sl no:01 of Fans shall be followed.
5. Ground shade/colour of finish paints and identification tag/band for equipment, fans, piping, pipe services, supporting structures and other components is followed as per NTPC doc no: QS-01-DIV-W-4 at site.
6. All components covered under different PGMAs are to be painted. Incase any component is left out, the same shall deemed to be included under the relevant section.
7. All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, Sleeves shall be coated with temporary rust preventive fluid and during execution of civil works; the dried film of coating shall be removed using organic solvents.
8. Painting requirement for all electrical equipment shall be as per the details identified in specification for the respective equipment.
9. All steel structures shall be provided with painting as given in the specification. Further, painting system shall also meet the requirements of corrosivity category C3 (durability high) as per ISO 12944.
10. Finish coat to be applied after an interval of min 10 hrs and within 6 months (after completion of intermediate coat).
11. Primer coat on steel shall be applied in shop immediately after blast cleaning by airless spray technique.
12. For the portion of steel surfaces embedded in concrete, the surface shall be prepared by Manual cleaning and provided with Primer coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron DFT.

Specific Note:

1) Painting for PGMAs of Agitator and its sub-components, shall be the same as that of similar items provided in the list. For Example, for motor, gear box, coupling etc. which are applicable for agitators, PGMA-FW 212 & FW 701 may be followed.

2) Painting details in the specification are minimum requirement. Painting shall be as per customer approved schedule to be submitted by successful bidder during detail engineering.

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

PAINTING SCHEME- DETAILS OF PROCUREMENT & APPLICATION PROCESSES

SL NO	TYPE OF PAINT	SPECIFICATION OF PAINT	NO OF PACK	VOLUME OF SOLIDS (% Min)	MODE OF APPLICATION	MIN. OVER COATING INTERVAL (hours)	SHADE
01	Epoxy Zinc phosphate primer	IS 13238	2	40	Spray	24	Grey
02	Zinc Ethyl silicate primer (% Zn on dry film= 80 (min))	IS 14946	2	60	Airless Spray only At Shop	24	Grey
03	Epoxy High solid-Polyamide cured Epoxy based MIO pigmented **intermediate coat**	--	2	80	Airless Spray only At Shop	16	Brown
04	Aliphatic isocyanate acrylic polyurethane paint	IS 13213	2	55	Spray At Shop	16	Corresponding shade no
05	Heat resistant aluminium paint	IS 13183 Grade II	1	--	Brush/ Spray	24	--
06	Long oil alkyd Synthetic enamel finish paint	IS 2932	1	35	Brush/ Spray	12	Corresponding shade no
07	Synthetic Enamel Intermediate coat	IS 2932	1	40	Brush/ Spray	12	--
08	Red oxide Zinc phosphate primer	IS 12744	1	--	Brush/ spray	12	--

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

PGMA DETAILS

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
01	FW 212	Slurry recirculation pump system	RC Pumps incl Shaft seal Common Base Plate Coupling and Guard Gear Box Expansion Bellow Anchor Bolts & Fasteners Special Tools
02	FW 219	Absorber system base	Absorber tank bottom plate
03	FW 220	Absorber system structures	Absorber tank structure Absorber tower structure Spray headers structure
04	FW 221	Absorber system casing bottom	Absorber tank wall casing- bottom
05	FW 222	Absorber system casing top	Absorber Tank wall casing –Top Mist Eliminator supports Spray pipe supports Internal Beam Shim plates in Absorber area Internal Struts
06	FW 223	Absorber system accessories	Nozzles and flanges Inspection doors & Man holes Viewing ports Antifoam dosing equipment Suction strainers- FRP
07	FW 226	Emergency Quench water tank	Base Plate & its supports Roof, Shell
08	FW 227	Emergency Quench System	Emergency Quenching Spray Pipe Nozzle for Emergency Pipe Fasteners Gaskets
09	FW 230	Air oxidation System	Oxidation Blowers Common Base Plate Coupling and Guard Anchor Bolts & Fasteners Expansion Bellow Suction & Discharge Silencers Acoustic Enclosure Water Injection cooling system

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	
				Pipe, Valves & Instruments Special Tools				

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
10	FW 244	Oxidation air distribution System	Pipe & Fittings Flanges Pipe Hanger, Bottom Elbow, Bottom sliding supports
11	FW 251	Expansion joint between bypass	Expansion joints Seal Plates & Fasteners
12	FW 252	Expansion joint between scrubbers	Fabric & its fixing fasteners Sleeves & Flanges Gaskets
13	FW 255	Ducts between bypass duct inlet & booster fan	Plates & Stiffeners Guide Vanes
14	FW 256	Ducts between Booster fan & Absorber	Plates & Stiffeners Guide Vanes
15	FW 257	Ducts between Absorber & stack	Plates & Stiffeners Guide Vanes
16	FW 260	Duct structure between bypass duct& Booster fan	Duct Supports Gusset Plate Divider plate Internal Struts Support bearings
17	FW 261 FW 262	Duct structure between booster fan& absorber & Absorber and Stack	Duct Supports Gusset Plate Divider plate Internal Struts Support bearings
18	FW 292	Structures for Elevator	Columns Seal Plate Bracings Enclosure (Purlin& sheeting)
19	FW 293	Elevator and accessories	Base Frame Buffer Spring Mast Section Cage Control Panel & AC Mandatory Spares

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
20	FW 310	Structures for booster fan handling	Columns Beams Bracings Seal plate
21	FW 610 FW 722	Galleries & railings for Scrubbers, Tank	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners
22	FW 701	Slurry pumps & accessories	Slurry Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Expansion Bellow Anchor Bolts & Fasteners Motor & accessories Sump Pumps incl Shaft seal Common Base Plate Coupling and Guard Belt & Pulley Anchor Bolts & Fasteners Motor & accessories
23	FW 710	Monorail for hoist& cranes	Insert Plate Stiffener plate Monorail beam
24	FW 721	Agitator support	Channels & Beams
25	FW 730	Limestone silo structures	Columns Beams Bracings Seal plate Angles, channels

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
26	FW 731	Limestone silo	Base plate & its supports Shell, Roof
27	FW 723 FW 724 FW 725	Air cannon Bag filter Nozzles & flanges	Bag filter Air cannon bin activator Nozzles & Flanges
28	FW 733	Limestone silo approach platforms	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners
29	FW 734	Limestone mill	Wet ball mill Hydro cyclone- Mill area Mill circuit pump Mill separator tank with Agitator
30	FW 742	Lime stone slurry storage tank	Base plate & its supports Shell, Roof
31	FW 743	Auxiliary Absorber tank	Base plate & its supports Shell, Roof
32	FW 744	Filtrate tank	Base plate & its supports Shell, Roof
33	FW 745	Wastage water tank	Base plate & its supports Shell, Roof
34	FW 747	Hydro cyclone waste water tank	Base plate & its supports Shell, Roof
35	FW 748 FW 785 FW 786	Process Water tank Belt filter washing tank Primary Hydro cyclone feed tank	Base plate & its supports Shell, Roof
36	FW 751 FW 752	Process water pipe accessories Cooling water pipe accessories	CS/FRP Pipes & Fittings Sight Glass R Orifice Gaskets & Fasteners
37	FW 753	Slurry pipe accessories	CSRL/FRP Pipes & Fittings Strainer (Cone) Expansion Joint-Rubber R Orifice Gaskets & Fasteners

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
38	FW 754	Service air pipe accessories	GI Pipes & Fittings Flexible Hose Expansion Joint (Metallic) Hose connector R Orifice Gaskets & Fasteners
39	FW 755	Instrument air pipe accessories	SS Pipes & Fittings Strainer(Y Type) Gaskets & Fasteners
40	FW 815 to FW 851	Valves and fittings	Globe valves Ball Valves Butterfly Valves Diaphragm Valves Gate Valves CheckValves Pinch Valves Knife Gate Valves Control Valves Relief Valves
41	FW 761 FW 765	Structures for Pipe racks Structures for Sub pipe racks	Bracings Columns
42	FW 280 FW 281 FW 282 FW 283 FW 740 FW 760 FW 763	Foundation material for duct structure Foundation material for absorber Foundation material for Tanks Foundation material for Pipe racks Foundation material for Elevator Foundation material for RC pump shed	Foundation bolts Template
43	FW 766	Platforms for Pipe rack	Stairs Handrail Step treads Floor grills Ladders Foundation bolts Fasteners
44	FW 768 FW 769	Trestle for Main & sub Pipe racks	Truss Beams, Supports for all Pipes
45	FW 779	Supports for cable tray	Double Sup Channel & Base plates Single Sup Channel & Base plates

Sl No	SURFACE LOCATION	PGMA	SURFACE PREPARATION	PRIMER		FINISH		TOTAL DFT IN (µm min.)
				PAINT	DFT (µm min.)	PAINT	DFT (µm min.)	

			Cantilever Arm Fasteners & clamps Brackets
46	FW 996	Tools	Erection , commissioning, special tools
SNO	PGMA	PGMA DESCRIPTION	PGMA DETAILS
47	FW 798	Air receivers	Instrument Air receivers Any Instruments/Valves
48	FW 800	Clarified water tank	Base plate & its supports Shell, Roof
49	FW 802	Neutralization tank & accessories	Base plate & its supports Shell, Roof
50	FW 988 FW 997 FW 999	Commissioning spares & Mandatory spares	Startup & commissioning spares Mandatory spares

	TITLE: 4 x 250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION No: PE-TS-463-571-18000-A009	
		SECTION-I, SUB-SECTION-C3	
		REV. 00	DATE: OCT 2021
		SHEET : 1 OF 1	

TECHNICAL SPECIFICATION OF AGITATORS (ELECTRICAL PORTION)

BHEL	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR AGITATOR 4X250 MW BRBCL NABINAGAR FGD	SPECIFICATION NO. VOLUME NO. : II-B SECTION : REV NO. 00 : DATE : 11.3.2020 SHEET : 1 OF 3

TECHNICAL SPECIFICATION

FOR
AGITATOR

(ELECTRICAL PORTION)

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR AGITATOR 4X250 MW BRBCL NABINAGAR FGD	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 11.3.2020
		SHEET : 2 OF 3

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for **AGITATOR.**

e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h) Motor shall meet minimum requirement of motor specification.

i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j) Cable BOQ worked out based on routing of cable listing provided by the vendor for " both end equipment in vendor's scope"shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR AGITATOR 4X250 MW BRBCL NABINAGAR FGD	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
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		SHEET : 3 OF 3

compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor

b) Customer (NTPC) specification for Motors

c) Customer (NTPC) specification for cable lugs and glands

d) Quality plan for motors & NTPC quality assurance

e) Datasheet A & C (Annexure- I)

f) Electrical Load data format (Annexure –II)

g) BHEL cable listing format (Annexure –III)

REV: 0 DATE: 11.3.2020

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: AGITATOR (Supply Package)

PROJECT: 4X250 MW BRBCL NABINAGAR FGD

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415 V MCC	BHEL	BHEL	415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motors.
3	Power cables, control cables and screened control cables	BHEL	BHEL	Incoming cable from BHEL supplied MCC will be informed by BHEL. Vendor shall provide lugs & glands accordingly.
4	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
5	Cable glands and lugs for equipments supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
6	Conduit and conduit accessories for cabling between equipments supplied by vendor	BHEL	BHEL	
7	Equipment grounding & lightning protection	BHEL	BHEL	
8	Below grade grounding	BHEL	BHEL	
9	LT Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to BHEL approval at contract stage.
10	Mandatory spares	Vendor	-	Vendor to quote as per specification.
11	Recommended O & M spares	Vendor	-	As per specification
12	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
13	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL after award of contract.
2. All QPs shall be subject to approval of BHEL after award of contract without any commercial implication.

SUB-SECTION-II-E2

MOTORS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.02.00 All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

1.03.00 Contactor shall provide fully compatible electrical system, equipment's, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for Contactors equipment and systems shall be under the Contactor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows :-

i)	Indoor motors	-	IP 54
ii)	Outdoor motors	-	IP 55
iii)	Cable box-indoor area	-	IP 54
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS/IEC:60034
2)	Single phase AC motors	:	IS/ IEC:60034
3)	Crane duty motors	:	IS:3177, IS/IEC:60034
4)	DC motors/generators	:	IS:4722, IS/IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC:60034-30

3.00.00 **TYPE**

3.01.00 **AC Motors:**

a) Squirrel cage induction motor suitable for direct-on-line starting.

b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30.

c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

3.02.00 DC Motors Shunt wound.

4.00.00 **RATING**

(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

5.00.00 **TEMPERATURE RISE**

Air cooled motors

70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.

Water cooled

80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.

6.00.00 **OPERATIONAL REQUIREMENTS**

6.01.00 **Starting Time**

6.01.01 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

6.01.02 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	**Torque Requirements**
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
6.03.00	**Starting voltage requirement**
	(a) Up to 85% of rated voltage for ratings below 110 KW
	(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW
	(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW
	(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW
	(e) Up to 75 % of rated voltage for ratings above 4000KW
7.00.00	**DESIGN AND CONSTRUCTIONAL FEATURES**
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below
	(a) Fuel oil area : Group – IIB
	(b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)

7.03.00 Winding and Insulation

(a)	Type	:	Non-hygroscopic, oil resistant, flame resistant
(b)	Starting duty	:	Two hot starts in succession, with motor initially at normal running temperature.
(c)	11kV & 3.3 kV AC motors	:	Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15.
(d)	240VAC, 415V AC & 220V DC motors	:	Thermal Class (B) or better

7.04.00 Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.

7.05.00 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

7.06.00 Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

7.07.00 In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.

7.08.00 Motor body shall have two earthing points on opposite sides.

7.09.00 11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

7.10.00 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Employer shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

7.11.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance): (a) From 50KW & upto 110KW : 11.0 (b) From 110 KW & upto 200 KW : 9.0 (c) Above 200 KW & upto 1000KW : 10.0 (d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
10.01.03	In case the Contactor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering

the type test reports to the Employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contactor.

10.01.04 Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

10.01.05 **LIST OF TYPE TESTS TO BE CONDUCTED**

The following type tests shall be conducted on each type and rating of HT motor

(a) No load saturation and loss curves upto approximately 115% of rated voltage

(b) Measurement of noise at no load.

(c) Momentary excess torque test (subject to test bed constraint).

(d) Full load test(subject to test bed constraint)

(e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

10.01.06 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of HT motor

(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.

(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15

(d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

10.02.00 **LT Motors**

10.02.01 LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last *ten* years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

10.02.02 However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

10.02.03 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
4. Full load test to determine efficiency power factor and slip
5. Temperature rise test
6. Momentary excess torque test.
7. High voltage test
8. Test for vibration severity of motor.
9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)

10. Test for degree of protection and

11. Overspeed test.

12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

10.03.00 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW of	Minimum distance between centre stud and gland plate in mm
UP to 3 KW	**As per manufacturer's practice.**
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

3.06.00 **Cable glands**

3.06.01 Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

3.07.00 **Cable lugs/ferrules**

3.07.01 Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to IS/DIN standards.

3.08.00 **Trefoil clamps**

3.08.01 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.

3.09.00 **Cable Clamps & Ties**

3.09.01 The cable clamps/ties required to clamp multicore cables shall be of SS-316 material, 12mm wide, polyster coated ladder lock type. The clamps/ties shall have self locking arrangement & shall have sufficient strength. The cable clamps/ties shall be supplied in finished individual pieces of suitable length to meet the site requirements.

3.10.00 **Receptacles**

3.10.01 Receptacles boxes shall be fabricated out of MS sheet of 2mm thickness and hot dipped gavanised or of die-cast aluminium alloy of thickness not less than 2.5 mm. The boxes shall be provided with two nos. earthing terminals, gasket to achieve IP55 degree of protection, terminal blocks for loop-in loop-out for cable of specified sizes, mounting brackets suitable for surface mounting on wall/column/structure, gland plate etc. The ON-OFF switch shall be rotary type heavy duty, double break,AC23 category, suitable for AC supply. Plug and Socket shall be shrouded Die-cast aluminium. Socket shall be provided with lid safety cover. Robust mechanical interlock shall be provided such that the switch can be put ON only when the plug is fully engaged and plug can be withdrawn only when the switch is in OFF position. Also cover can be opened only when the switch is in OFF position. Wiring shall be carried out with 1100 V grade PVC insulated stranded aluminium/copper wire of adequate size. The Terminal blocks shall be of 1100 V grade. The Terminal blocks shall be of 1100 V grade made up of unbreakable polymide 6.6 grade with adequate current rating and size. The welding receptacles shall be provided with inbuilt ELCB rated for suitable mA sensitivity ranging from 30-300 mA .

3.11.00 **Cable Drum Lifting Jack**

The jack for cable drum lifting shall be of screw type with 10 ton capacity. The cable drum jacks shall be manufactured from fabricated steel. The spindles supplied with the cable drum jack shall be manufactured using BSEN-24 grade steel bar with locking collars. Jack nests shall be of SG cast steel. Cable drum jack supplied shall have undergone load testing and reports for the same shall be submitted. At least Two Nos. of jacks shall be supplied for

BHEL	SYSTEM TITLE : **GENERAL TECHNICAL REQUIREMENTs** **FOR** **LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

BHEL	TITLE : **GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS**	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : **II-B** SECTION : **D** REV NO. : **00** DATE : 29/08/2005 SHEET : 1 OF 4

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

BHEL	TITLE : GENERAL TECHNICAL REQUIREMENTs FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
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		SHEET : 2 OF 4

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

SUB-SECTION-V-QE1

MOTORS

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:27.02.2020
		CUSTOMER :		QP NO.: PED-506-00-Q-006, REV-02	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 2

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	ASSEMBLY	1 WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC	MFG. SPEC	DO		P	-	-	
		2 DIMENSIONS	MA	-DO-	-DO-	-	MFG. DRG / MFG. SPEC	MFG. DRG / MFG. SPEC	DO		P	-	-	
		3 CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC /	MFG.SPEC	-DO-		P	-	-	
2.0	PAINTING	1 SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	SAME AS COL 7	LOG BOOK		P	-	-	
3.0	TESTS	1 ROUTINE TEST INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	IS-325 / IS-12615/ APPROVED DATA SHEET	SAME AS COL 7	TEST/ INSPN REPORT		P	W	W	NOTE -1 & NOTE-2
		2 OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET	TEST/ INSPN REPORT		P	W	W	NOTE -1 & NOTE-2

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by		Hema K.	Checked by		KUNAL GANDHI		
Reviewed by	02/3/2020	P. Dutta	Reviewed by				

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by			
Approved by			

220

बी एच ई एल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO	DATE:27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-006, REV-02	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V)) SYSTEM:	SECTION: II	SHEET 2 OF 2

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3 NAMEPLATE DETAILS	MA	VISUAL	100%	100%	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL 7	TEST/ INSPN. REPORT		P	W	W	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / APPROVED PACKING DRAWING (#)	AS PER MFG. STANDARD / APPROVED PACKING DRAWING (#)	INSPC. REPORT		P	W		(#) APPLICABLE FOR EXPORT JOBS

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER

LEGENDS:

*RECORDS INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M: SUPPLIER/ MANUFACTURER/ SUB SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER
P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE
MA: MAJOR, MI: MINOR, CR: CRITICAL
D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Heena K.	Checked by:	28/2/20	KUNAL GANDHI
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

667046/2022/PS-PEM-MAX

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO
		CUSTOMER :		QP NO.: PED-506-00-Q-007, REV-04 / DATE: 27.02.2020
		PROJECT:		PO NO.:
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV 415V))	SYSTEM:	SECTION: II / SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	W	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES SECTION, EYEBOLTS	1 SURFACE CONDITION	MA	VISUAL	100%			FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-		
		2 DIMENSIONS	MA	MEASUREMENT	SAMPLE		MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	-DO-		P	-	-	
		3 PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-		-DO-	-DO-	TEST REPORT		P/V	-		
1.2	HARDWARES	1 SURFACE CONDITION	MA	VISUAL	100%			FREE FROM CRACKS, UN-EVENNESS ETC	-DO-		P	-	-	
		2 PROPERTY CLASS	MA	VISUAL	SAMPLES		MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIERS TC & LOG		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1 SURFACE CONDITION	MA	VISUAL	100%			FREE FROM CRACKS, BLOW HOLES ETC	LOG BOOK		P/V	-		
		2 CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.		MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	SUPPLIER'S TC		P/V			HEAT NO. SHALL BE VERIFIED
		3 DIMENSIONS	MA	MEASUREMENT	100%		MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V			
1.4	PAINT & VARNISH	1 MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS		MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/3/2020	Heena K.	Checked by:		
Reviewed by:	2/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO	
BHEL		CUSTOMER :		QP NO. : PED-606-00-S-007, REV-04	DATE:27.02.2020
		PROJECT:		PO NO:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9		**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	DO-		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO.	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	SUPPLIER'S TC		P/W	-	-	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	-DO-	MANUFACTURER'S DRG.	LOG BOOK		P/W	-	-	
		4. INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	100%	ASTM-A388	MANUFACTURER'S STD.	DO-	✓	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH, TEMP. DETECTORS, RTD, BTDS	1. MAKE & RATING	MA	VISUAL	DO-	-	MANUFACTURER'S DRG./STD	MANUFACTURER'S DRG./STD	DO-		P/W	-	-	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	DO-		P/W	-	-	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG./ STD	DO-		P/W	-	-	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	-DO-	-DO-	TEST REPORT		P/W	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by	27/2/2020	Hemin K.	Checked by	27/2/20	SUNIL GANDHI
Reviewed by	27/2/2020	P. Dutta	Reviewed by		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

भेल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO	DATE:27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	CN				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURR)	LOG BOOK		P	-	-	
		2 DIMENSIONS (INCLUDING BURR HEIGHT)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	DO-		P/V	-	-	
		3- ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	-	MANUFACTURER'S DRG / STD	MANUFACTURER'S DRG / STD	SUPPLIERS TC		P/V	-	-	
1.9	CONTACTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER
		2.ELECT. PROP. & MECH. PROP.	MA	ELECT. & MECH TEST	SAMPLES	-	MANUFACTURER'S DRG / SPEC	MANUFACTURER'S / SPEC	SUPPLIERS TC & VENDOR'S TEST REPORTS		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/3/2020	Hemraj K.	Checked by:		KUNAL GANDHI
Reviewed by:	02/5/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No.			
	Sign & Date	Name	Seal
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Approved by:			

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO	DATE: 27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV 04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) / SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9		H			
					M	CM				D	M	C	Y	
		3.DIMENSIONS	MA	MEASUREMENT	-DO-		-DO-	-DO-	Log Book / -DO-		P/V			
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%		MANUFACTURER'S ORG / APPROVED DATASHEET	MANUFACTURER'S ORG / APPROVED DATASHEET			P/V			
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE		APPPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	-DO-		P/V			
		3.SURFACE FINISH	MA	VISUAL	100%			FREE FROM VISUAL DEFECTS	-DO-		P/V			
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND	MA	VISUAL	100%			-DO-	-DO-		P			
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE		MANUFACTURER'S ORG	MANUFACTURER'S ORG	-DO-		P			
		3.TEMP WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-		MANUFACTURER'S STD / APPROVED DATASHEET	MANUFACTURER'S STD / APPROVED DATASHEET	-DO-		P/V			
		4.HV/IR	MA	-DO-	100%		-DO-	-DO-	-DO-		P/V			
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%		MANUFACTURER'S ORG/SPECS	MANUFACTURER'S ORG / SPECS	-DO-		P			
		2.SURFACE COND	MA	VISUAL	100%		-	FREE FROM VISUAL DEFECTS	-DO-		P			
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE		MANUFACTURER'S ORG	MANUFACTURER'S ORG	-DO-		P			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by	27/2/2020	Hema K.	Checked by		KUNAL
Reviewed by	02/3/2020	P. Dutta	Reviewed by		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Approved by:			

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO	DATE:27.02.2020
		CUSTOMER :	QP NO.: PED-506-00-Q-007, REV.04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY		
1	2	3	4	5	6		7	8	9		10		
					M	C/N				D	M	C	N
2.0	IN PROCESS												
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1 WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P/W	-	-
		2 DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-
2.2	MACHINING	1 FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-
		2 DIMENSIONS	MA	MEASUREMENT	-DO-	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	-DO-		P	-	-
		3 SHAFT SURFACE FLAWS	MA	PT	100%	100%	MANUFACTURER'S STD / ASTM-E165	MANUFACTURER'S STD / APPROVED DATASHEET	-DO-	✓	P	V	-
2.3	PAINTING	1 SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	SAME AS COL 7	LOG BOOK		P	-	-
		2 PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	-DO-	-DO-	-DO-		P		-
		3 SHADE	MA	VISUAL	-DO-		-DO-	-DO-	LOG BOOK		P	-	-
		4 ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hema R.	Checked by:	27/2/20	KUNAL GHAGHAT
Reviewed by:	02/3/2020	P. Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
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Doc No:			
	Sign & Date	Name	Seal
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Approved by:			

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO	DATE:27.02.2020
		CUSTOMER:	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD	MANUFACTURER'S STD	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD /APPROVED DATASHEET	MANUFACTURER'S STD /APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3.IR/HV/IR	CR	ELECT. TEST	100%	100%	IS-325/IS-12615/IEC-60034 PART-I	IS-325/IS-12615/IEC-60034 PART-I	LOG BOOK	✓	P	V	-	
		4.RESISTANCE	CR	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-I	IS-325/IS-12615/IEC-60034 PART-I	LOG BOOK	✓	P	V	-	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFR'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	-DO-	CONTINUOUS	CONTINUOUS	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✓	P	V	-	THREE DIPS TO BE GIVEN

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/3/2020	Hema K.	Checked by:		GANDHI
Reviewed by:	02/3/2020	P.Dutta	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO
		CUSTOMER		QP NO.: PED-506-00-Q-007, REV 04
		PROJECT:		PO NO.:
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II

DATE:27.02.2020

SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	-	**			
					M	ON				O	M	C	N	
		4 DURATION	MA	-DO-	CONTINUOUS	CONTINUOUS	-DO-	-DO-	LOG BOOK	✓	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1 COMPACTNESS & CLEANLINESS	MA	VISUAL	100%		DO	-DO-	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1 COMPLETENESS	CR	-DO-	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2 SOUNDNESS	CR	MALLET TEST & UT	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		3 HV	MA	ELECT. TEST	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1 RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-		MANUFACTURER'S SPEC / ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-		
		2 SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V		
2.10	ASSEMBLY	1 ALIGNMENT	MA	MEAS.	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		2 WORKMANSHIP	MA	VISUAL	-DO-	-	-DO-	-DO-	LOG BOOK		P	-	-	
		3 AXIAL PLAY	MA	MEAS.	100%	100%	-DO-	-DO-	LOG BOOK	✓	P	V	-	
		4 DIMENSIONS	MA	-DO-	-DO-	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG/ RELEVANT IS	LOG BOOK		P	-	-	
		5 CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6 RTD, BTD & SPACE HEATER MOUNTING	MA	VISUAL	100%	100%	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✓	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	27/2/2020	Hemraj K.	Checked by		KUNAL GANDHI
Reviewed by	02/3/2020	P. Dutta	Reviewed by		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No.			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by			

BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO	DATE: 27.02.2020
		CUSTOMER:	QP NO.: PED-506-00-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1 TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT		P	W	W	[1] NOTE - 1
		2 ROUTINE TESTS INCLUDING SPECIAL TEST	MA	-DO-	100%	100%	-DO-	-DO-	-DO-		P	V,W	V,W	[1] NOTE - 2
		3 VIBRATION & NOISE LEVEL	MA	-DO-	100%	100%	IS 12075 / IEC 60034-14 & IS-12065	IS 12075 / IEC 60034-14 & IS-12065	-DO-		P	V,W	V,W	[1] NOTE - 2
		4 OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC REPORT		P	W	-	
		5 DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	1/TYPE/ SIZE	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY. REFER NOTE-3
		6 MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	-DO-		P	V,W	V,W	[1] NOTE - 2
		7 MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	100%	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	-DO-		P	V,W	V,W	[1] NOTE - 2
		8 NAME PLATE DETAILS	MA	VISUAL	100%	100%	IS-325/IS-12615& DATA SHEET	IS-325/IS-12615 & DATA SHEET	TEST/INSPC REPORT		P	V,W	V,W	[1] NOTE - 2
		9 EXPLOSION FLAME PROOFNESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	1/TYPE	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✓	P	V	V	TC FROM AN INDEPENDENT LABORATORY. REFER NOTE-3
		10 PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC		P	WS	WS	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY [1] NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by	3/2/2020	Hema R	Checked by	3/2/2020	Kunal Ganguly
Reviewed by	03/2/2020	P. Dutta	Reviewed by		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No.			
	Sign & Date	Name	Seal
Reviewed by			
Approved by			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO.	
BHEL		CUSTOMER:		QP NO.: PED-506-00-Q-007, REV-04	DATE:27.02.2020
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	CP*				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING	AS PER MANUFACT. STANDARD / APPROVED CROSS SECTION DRAWING	INSPE. REPORT		P	W	-	IF APPLICABLE, REFER SEAWORTHY PACKING ALSO

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALITY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, C: CUSTOMER.

P: PERFORM, W: WITNESS, V: VERIFICATION, AS APPROPRIATE

MA: MAJOR, MI: MINOR, CR: CRITICAL

D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	2/3/2020	Hemra K.	Checked by:	2/3/20	KUNAL GANDHI
Reviewed by:	03/3/2020	D. Dubey	Reviewed by:		

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No			
	Sign & Date	Name	Seal
Reviewed by			
Approved by			

MOTOR

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating /General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	Routine & Acceptance tests as per IS-325/IS-4722 /IS- 9283/IS 2148/IEC60034\IEC 60079-I/ IS-12615	Vibration	Over speed	Tan delta, shaft voltage & polarization index test	Paint shade, thickness & adhesion
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y										
Shaft	Y	Y	Y	Y	Y	Y			Y										
Magnetic Material	Y	Y	Y	Y			Y			Y		Y							
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y										
Stator copper	Y	Y	Y	Y			Y		Y			Y							
SC Ring	Y	Y	Y	Y	Y		Y	Y	Y										
Insulating Material	Y		Y	Y			Y					Y							
Tubes, for Cooler	Y	Y	Y	Y	Y				Y		Y								
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y								
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y											
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y											
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y			Y	Y										

Wound stator	Y	Y					Y	Y											
Wound Exciter	Y	Y					Y	Y											
Rotor complete	Y	Y					Y						Y	Y					
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y												
Accessories, RTD, BTD,CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y																
Complete Motor	Y	Y	Y												Y	Y	Y	Y1	Y

Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant
supporting documents during QP finalization. However, No QP for LT motor upto 50KW.
2. Additional routine tests for Flame proof motors shall be applicable as per relevant standard
3. Makes of major bought out items for HT motors will be subject to NTPC approval.
4. Y1 = for HT Motor / Machines only.

TITLE	SPECIFICATION NO.
LV MOTORS	VOLUME II B
DATA SHEET-A	SECTION D
4X250 MW BRBCL NABINAGAR FGD	REV. NO. DATE 11.3.2020
	SHEET 1 OF 2

ANNEXURE-I

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	200KW *
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz + 3 % to - 5%
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 110 kW and above (Breaker Controlled)	:	50 KA for 0.25 sec.
	o Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
	f) LV System grounding	:	Solidly
5.0	Winding & Insulation	:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 200kW.
7.0	Power cables data	:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material	:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)	:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.2 kW
11.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
12.0	Makes	: BHEL/ Customer approval (Package owner to take care)	
13.0	Paint shade	:	Blue (RAL 5012) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box	:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 54
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 54
iv) Cable Box-Outdoor area - IP 55

*** LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

CLAUSE NO.	Bidder's Name	एनटीपीसी NTPC

DE-1B	LT MOTORS	
A.	GENERAL	
5.	Manufacturer & Country of origin. (Shall be as per approved QA make)	
6.	Equipment driven by motor	
7.	Motor type	
8.	Quantity	
B.	DESIGN AND PERFORMANCE DATA	
18.	Frame size	
19.	Type of duty	
20.	Type of enclosure /Method of cooling/ Degree of	
21.	Applicable standard to which motor generally	
22.	Efficiency class as per IS 12615	
23.	(a)Whether motor is flame proof	Yes/No
	(b)If yes, the gas group to which it conforms as per IS:2148	
24.	Type of mounting	
25.	Direction of rotation as viewed from DE END	
26.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)	
27.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
28.	Maximum continuous load demand of driven	
29.	Rated Voltage (volts)	
30.	Permissible variation of :	
	a. Voltage (Volts)	
	b. Frequency (Hz)	
	c. Combined voltage and frequency	
31.	Rated speed at rated voltage and	
32.	At rated Voltage and frequency:	
	a. Full load current	

CLAUSE NO.	Bidder's Name	एनटीपीसी NTPC

	b. No load current	
33.	Power Factor at	
	a. 100% load	
	b. NO load	
	c. Starting.	
34.	Efficiency at rated voltage and frequrecy,	
	a.100% load	
	b. 75% load	
	c. 50% load	
35.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
36.	Minimum permissible starting Voltage (Volts)	
37.	Starting time with minimum permissible voltage	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
38.	Safe stall time with 100% and 110% of rated	
	a. From hot condition	
	b. From cold condition	
39.	Torques :	
	a. Starting torque at min. permissible voltage(kg-	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg.m) available	
	e.Rated torque (kg.m)	
40.	Stator winding resistance per phase (ohms at 20	
41.	GD2 value of motors	

CLAUSE NO.	Bidder's Name	एनटीपीसी NTPC

42.	No of permissible successive starts when motor is in hot condition	
43.	Locked Rotor KVA Input	
44.	Locked Rotor KVA/KW	
45.	Vibration limit :Velocity (mm/s)	
46.	Noise level limit (dBA)	
C.	**CONSTRUCTIONAL FEATURES**	
1.	Stator winding insulation	
	a. Class & Type	
	b. Winding Insulation Process	
	c. Tropicalised (Yes/No)	
	d. Temperature rise over specified maximum ambient temperature of 50 deg C	
	e. Method of temperature measurement	
	f. Stator winding connection	
2.	Main Terminal Box	
	a. Type	
	b. Location(viewed from NDE side)	
	c. Entry of cables(bottom/side)	
	d. Recommended cable size(To be matched with cable size envisaged by owner)	
	e. Fault level (MVA),Fault level duration(sec)	
	f. Cable glands & lugs details (shall be suitable for	
3.	Type of DE/NDE Bearing	
4.	Motor Paint shade	
5.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	

CLAUSE NO.	Bidder's Name	एनटीपीसी NTPC

D.	**List of accessories.**	
1.	3 Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)	
2.	Terminal Box for Space Heater (Yes/No)	
3.	Speed switch (Yes/No)	
4.	Insulation of bearing (Yes/No)	
5.	Noise reducer(Yes/No)	
6.	Grounding pads	
	I) No and size on motor body	
	II) Nos on terminal Box	
7.	Vibration pads	
	i) Nos and size	
	ii) Location	
8.	Any other fitments	
E.	**List of curves.**	
1.	Torque speed characteristic of the motor	
2.	Thermal withstand characteristic	
3.	Starting. current Vs. Time	
4.	Starting. current Vs speed	
5.	P.F. and Effi. Vs Load	
F.	**Additional Data to be filled for each rating of DC Motor**	
1.	Rated armature voltage (Volt)	
2.	Rated field excitation (Amp)	
3.	Permissible % variation in voltage	
4.	Minimum Permissible Starting voltage (volt)	
5.	At rated voltage	
	I)Full load Armature current.(Amp)	

	I)Full load Field current (Amp)	
	II)No load Armature current (Amp)	
6.	Full load Field current (Amp)	
7.	No load Aramature current (Amp)	
8.	Minimum permissible field current(Amp) to avoid	
	i) Maximum permissible voltage	
	ii) Rated voltage	
	iii) Minimum Permissible Voltage	
9.	Resistance (indicative Values) in ohm	
	i)Armature winding(Arm + IP + Series) at 25	
	ii) Field Winding at 25 deg. C	
10..	Inductance (indicative values)	
	i) Armature winding	
	ii) Field winding	
11	Value of trimmer resistance (ohm) to be connected in series with the shunt field to	
	i) 220 V DC	
	ii) 250 V DC	
	iii) 187 V DC	
12	Value of the external resistance (ohm)required to be connected in series with armature during starting only	
13	Technical data sheet for external resistance box	
14	GA drawing of motor	
15	Starting time calculation	
16	Starter resistance design calculation	
17	Electrical connection diagram of motor	

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

ANNEXURE-I

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	463	ORIGINATING AGENCY		PEM (ELECTRICAL)	
	PROJECT TITLE	4X250 MW BRBCL NABINAGAR FGD	NAME		DATA FILLED UP ON	
	SYSTEM	AGITATOR	SIGN.		DATA ENTERED ON	
	DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

	TITLE: 4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION No: PE-TS-403-571-18000-A008
		SECTION-I, SUB-SECTION-D
		REV. 00 / DATE: OCT 2021
		SHEET : 1 OF 1

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

241
667

NTPC	PACAKGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL	REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20th April 2017

SI. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-QVE-	QP SUB. SCH.	QP APPL SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL. STATUS AS PER NTPC	SC APPL SCHE DULE	REMARKS
1)	L T (415 V) Motors	Refer Note 1				ABB	FARIDABAD	A		UPTO 55KW
						ABB	BANGALORE	A		55KW – 200KW
						BHARAT BIJLEE	MUMBAI	A		RQP, FOR FLAME PROOF ALSO
						CGL	AHMEDNAGAR	A		FOR FLAME PROOF ALSO
						JYOTI	BARODA	A		
						KEC	BANGALORE	A		FOR FLAMEVPROOF ALSO
						KEC	HUBLI	A		UPTO 90KW; FOR FLAME PROOF ALSO
						LHP	SOLAPUR	A		UPTO 200KW
						MARATHON	KOLKATA	A		FOR FLAME PROOF ALSO
						NGEF	BANGALORE	A		UPTO 15KW
						SIEMENS	MUMBAI	A		
2)	HT MOTOR	I				BHEL	BHOPAL	A		
3)	DC MOTOR	Refer Note 1				BHEL	HARIDWAR	A		
						CGL	AHMEDNAGAR	A		
						KEC	BANGLORE / HUBLI	DR		
4)	VARIABLE FREQUENCY DRIVES PANELS	I				L&T-YASHKAWA	INDIA	A		DR for HT
						DANFOSS	CHENNAI	A		
						SCHNEIDER	NASHIK	A		
						ROCKWELL ALLEN BRADLEY	DELHI-SHAHIBABAD	A		
						ABB	BANGALORE	A		
						SIEMENS	NASHIK	A		
						GE		DR		

For NTPC

Bharat Heavy Electricals Limited PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited C & M Deptt.

एनटीपीसी NTPC	PACAKGE : EPC Sub Package: MOTORS & VVF Drive Panels CONTRACTOR : M/S BHEL CONT. NO. CS-9585-001-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR ; CONTRACTOR-M/S BHEL	REF NO : 9585-001-QOE-R-01 REVISION NO. 00 DATE 20th April 2017

Sl. No.	ITEM	QP / INS CAT.	QP No:- 9585-001-QVE-	QP SUB. SCH.	QP APPL. SCHE DULE	SUB-SUPPLIERS	PLACE	SUB-SUPPLIER APPL. STATUS AS PER NTPC	SC APPL. SCHE DULE	REMARKS
						HITACHI-HIREL	GANDHINAGAR/ SANAND	DR		
						INGETEAM TECHNOLOGIES	SPAIN	DR		
						NIDEC(ANSALDO)	ITALY	DR		
						FUJI ELECTRIC SYSTEMS	JAPAN	DR		
						TMEIC	BANGALORE	DR		
						L&T	MUMBAI	DR		

NOTE 1 : FOR LT MOTORS

a) Less than 30 KW

Acceptance of Motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows:
It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate and tested in accordance with approved drawing /data sheets.

b) 30 KW -50KW

Acceptance of Motor rating between 30 KW & 50 KW is based on NTPC review of Routine Test inspection report as per IS 325 witnessed by main contractor along with COC of the manufacturer & the contractor confirming as follows:
It is hereby confirmed that the above mentioned motor /motors was/ were manufactured taking care of NTPC specific requirements regarding ambient temp., voltage & frequency variation, hot starts, pull out torque, starting KVA/KW, temp. rise, distance between centre of stud & gland plate, space heater and tested in accordance with approved drawing /data sheets.

c) Above 50 KW as per NTPC approved quality plan

Approval Conditions attached to above vendors-as applicable shall prevail.

General Notes:

1) Vendor list & category of the mandatory spares shall be as mentioned above.
2) For item not appearing in the above list, main contractor to approach NTPC for acceptable vendors & inspection categorization of the same.
3) NTPC Approval conditions to above identified vendors shall be adhered to. Vendor's approval conditions will be informed on specific request of Main Contractor.

NTPC

Bharat Heavy Electricals Limited PS-MKTG Delhi

Jatin
(JATIN GAHLAWAT)
BHEL

Bharat Heavy Electricals Limited * Distt-Ramgarh(Jharkhand) * Deptt.

NTPC	PACKAGE : EPC (FGD) Package MAIN CONTRACTOR : M/s BHEL CONTRACT NO : CS-8585-011-2	LIST OF ITEMS REQUIRING QP APPROVAL & ACCEPTABLE VENDOR AS APPROVED BY	REF. NO : REVISION NO : 00 DATE : 16-05-17

No.	Major Equipment	QP Inspection Category	QP No.	QP Submission SCH	QP Approval SCH	Proposed Sub Supplier	Place	SS Approval Status	SS Detail Sub. SCH	SS Approval SCH	Remark
23	Hydro Cyclone	I				FL Smidth	Chennai	DR			
		I				Weir Minerals	Bangalore	A			
		I				Multo Tech	S.Africa	A			
		I				McNally Bharat	Bangalore	DR			
24	Rubber Lining of Pipes	I				Jasmine Polymertech	Taloja	A			
		I				CORI Engineers	Chennai	A			
		I				Western Rubber	Mumbai	A			
		I				Elastomer Lining	Ambernath	A			
		I				Emkay Rubber	Mumbai	A			
		I				Rishi	Bahalgarh	A			
		I				Poly Rubber	Mumbai	A			
		I				Temsec Rubber	Kolkata	A			
		I				Presidency Rubber	Howrah	A			
		I				Apt Rubber Pvt Ltd	Hosur	A			
		I				Industrial Moulders	Vadodara	A			
		I				MILL Industries	Chennai	DR			
		I				Lebracs rubber	Pondicherry	DR			
25	FRP PIPE with fittings	III				Main contractor approved source		A		upto 3"	
26	Rubber Lining for Tank and absorber	III				MIL Industries	Chennai	A			
		III				T.P TOP	Germany	A			
		III				Sealuer	Germany	A			
		III				Arul Rubber	Hosur	A			
		III				Temsec Rubber	Kolkata	A			
						Lebracs Rubber	Pondicherry	DR			
						CORI Engineers	Chennai	DR			
27	Ventillation Fans	I				Patel Air	Ahmedabad	A			
		I				Marathan Electric	Kolkata	A			
		I				Howden	Kolkata / Chennai	A			
		I				SX System	Sonepat	A			
		I				Andrew Yule	Kalyani	A			
		I									

Bharat Heavy Electricals Limited ★ PS-MKTG Delhi

Patratu Vidyut Utpadan Nigam Limited ★ Distt-Ramgarh(Jharkhand) ★ C. M Deptt.

BHEL

एनटीपीसी NTPC	Package : EPC Contractor : BHEL, Hyderabad Contract No.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: BFP, Drive Turbine, Heaters (HP, LP) Drain Cooler and Deaerator	Ref No.: 9585-001-02 Revision No.: 00 Date: 05.04.2017

SN	ITEM	QP/ INS-PN CAT *	QP No. xxxx-110	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
		I				EDELSTAHLWERKE	GERMANY	A			
		I				GROEDITZ	GERMANY	DR			
		I				PILSON STEEL (VHS,SKODA)	CZECKSLOVAKIA	A			
		I				JCFC	JAPAN	A			
		I				JSC ENERGOMASH	UKRAIN	DR			
		I				JSW	JAPAN	A			
		I				KOBE STEEL	JAPAN	A			
		I				CRUIST FORGE	FRANCE	A			
33	PRECISION BLADE FORGINGS	I	QVM-Q-308			PETRO ROSA	GERMANY	A			
		I				FINE FORGE	HYDERABAD	A			
		I				C BLADE	ITALY	A			
		I				WUXI	CHINA	A			A5 PER NTPC APPROVAL CONDITIONS
		I				AZAD ENGG	HYDERABAD	A			FOR MACHINING ONLY
34	BAR STOCK FOR BLADES	I	QVM-Q-308			WALZWERK EINSL	GERMANY	A			
		I				BOEHLER	AUSTRIA	A			
		I				BGH	GERMANY	A			
		I				BREITENFIELD	AUSTRALIA	A			
		I				STARWIRE	BALLABHGARH	A			
35	DRAWN PROFILE FOR GUIDE BLADES (DRIVE TURBINE)	I	QVM-Q-308			FIAV	ITALY	A			
		I				LEISTRITZ	GERMANY	A			
		I				BOEHLER	AUSTRIA	A			
36	GEAR BOX	I	QVM-Q-308			TRIVENI ENGG	MYSORE	A			
		I				FLENDER GRAFFENSTADEN	FRANCE	A			

एनटीपीसी NTPC	Package : EPC Contractor : BHEL, Hyderabad Contract No.:	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUBCONTRACTOR APPROVAL SUB SYSTEM: BFP, Drive Turbine, Heaters (HP, LP) Drain Cooler and Deaerator	Ref No.: 9585-001-02 Revision No.: 00 Date: 05.04.2017

SN	ITEM	QP/ INS-PN CAT *	QP No. xxxx-110	QP SUB-MISSION SCHEDULE	QP APPL SCHEDULE	PROPOSED SUB SUPPLIER	PLACE	SS APPL STATUS / CAT	SS DETAIL SUB-SCHEDULE	SC APPL SCHEDULE	REMARKS
		I				LUFKIN	USA/FRANCE	A#			
		I				RENK TACKE GMBH	GERMANY	A#			
		I				WALCHANDNAGAR	PUNE	A#			
						WINENERGY	CHENNAI	DR			
37	DRIVE TURBINE	I	QVM-Q-308			BHEL	HYDERABAD	A			
38	CONNECTING COUPLING (GEAR TYPE) CONNECTING COUPLING (MEMBRANE)	I	QVM-Q-308			RENK TACKE GMBH	GERMANY	A			
		I				LUFKIN	USA/FRANCE	A			
		I				FLENDER	GERMANY	A			
		I				WALCHANDNAGAR	WALCHANDNAGAR	A			
		I	QVM-Q-308			EUROFLEX LTD.,	HYDERABAD	A			
		I				JOHN CRANE	UK	A			
		I				AMERDRIVES	USA	A			
						RATHI TURBOFLEX	PUNE	A			
39	AUX. CONTROL VALVE BODY & COVER	I	QVM-Q-309			CFFP	HARDWAR	A			
		I				KOLHAPUR STEELS	KOLHAPUR	A			
		I				UP STEELS	MUJAFARNAGAR	A			
		I				STAR WIRES	BALLABGARH	A			
						PRAKASH SPECTRO	VIJAYAWADA	DR			
40	LUBE OIL CENTRIFUGAL PUMP	II	QVM-Q-310			KSB	PUNE	A			
		II				KIRLSOKAR EBARA	KIRLOSKARWADI	A			
		II				SULZER	MUMBAI	A			
41	LUBE OIL PUMP (SCREW PUMP)	II	QVM-Q-311			ALLWEILER	GERMANY	A			
		II				TUSHACO PUMP	DAMAN	A			
		II				LEISTRITZ	GERMANY	A			
		II				IMOPUMP	USA	A			
42	DISCONNECTING COUPLING	II	QVM-Q-312			AMER DRIVES	USA	A			
43	CENTRIFUGE	I	QVM-Q-313			ALFALAVAL	PUNE/SWEDEN	A			

Bharat Heavy Electricals Limited * FS-MKTG Delhi

* Patratu Vidyut Utpadan Nigam Limited * Distt-Ramgarh (Jharkhand)

C & M Deptt.

BHEL HYD

ENGINEERING DIV / QAI-NTPC,NOIDA	Page 10 of 20	BHEL

	TITLE:	SPECIFICATION No: PE-TS-443-571-18000-A008	
	4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION-I, Sub Section-D	
		REV. 00	DATE: OCT 2021
		SHEET : 1	

Sl.no.	Item	Category of Inspection	Sub-vendor	Place	Remarks
1.	PAINT	III	ASIAN PAINT		
		III	BERGER		
		III	KANSAI NEROLAC		
		III	JOTUN		
		III	SHALIMAR		
		III	JENSON & NICHOLSON (I) LTD		
		III	CDC CARBOLINE (I) LTD.		
		III	ADDISON PAINTS LTD		
		III	GRAND POLYCOAT		

NOTES: INSPECTION CATEGORIZATION

CAT I: INSPECTION BY OWNER, BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.

CAT II: INSPECTION BY BHEL/BHEL NOMINATED TPIA & VENDOR. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT IN LINE ITH APPROVED QAP.

CAT III: MDCC WILL BE ISSUSED BASED COC & MTC ISSUSD BY VENDOR AND VERIFICATION BY BHEL / OWNER IN LINE WITH APPROVED QAP/CHECK LIST

- Refer electrical specification for applicable sub-vendor list for motors.
- The list of all bought out items like gearbox, coupling, bearings etc. with makes and country of origin and contact details of the manufacturers to be mentioned along with offer to be submitted in the format attached in Section II, Annexure-6 as information to BHEL.
- Acceptance of makes shall be subject to BHEL/ End customer acceptance during the detailed engineering without cost and delivery implication to BHEL.
- Bidder has to submit the sub-vendor questionnaire (attached herewith) along with necessary credentials in case the proposed sub-vendor is not as per the list provided.
- The complete list will be necessarily submitted within one month of placement of LOI to ensure timely placement of order for BOIs. Bidder to assess the capability of their proposed 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.

CORPORATE QUALITY ASSURANCE

SUB-VENDOR QUESTIONNAIRE

i.	**Item/Scope of Sub-contracting**			
ii.	**Address of the registered office**	**Details of Contact Person (Name, Designation, Mobile, Email)**		
iii.	**Name and Address of the proposed Sub-vendor's works where item is being manufactured**	**Details of Contact Person: (Name, Designation, Mobile, Email)**		
iv.	**Annual Production Capacity for proposed item/scope of sub-contracting**			
v.	**Annual production for last 3 years for proposed item/scope of sub-contracting**			
vi.	**Details of proposed works**			
1.	**Year of establishment of present works**			
2.	**Year of commencement of manufacturing at above works**			
3.	**Details of change in Works address in past (if any)**			
4.	**Total Area**			
	Covered Area			
5.	**Factory Registration Certificate**	**Details attached at Annexure – F2.1**		
6.	**Design/ Research & development set-up (No. of manpower, their qualification, machines & tools employed etc.)**	**Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design) Details attached at Annexure – F2.2 (if applicable)**		
7.	**Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc)**	**Details attached at Annexure – F2.3**		
8.	**After sales service set up in India, in case of foreign sub-vendor (Location, Contact Person, Contact details etc.)**	**Applicable / Not applicable Details attached at Annexure – F2.4**		
9.	**Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any**	**Details attached at Annexure – F2.5**		

CORPORATE QUALITY ASSURANCE

SUB-VENDOR QUESTIONNAIRE

10.	**Quality Control exercised during receipt of raw material/BOI, in-process , Final Testing, packing**	**Details attached at Annexure – F2.6**
11.	**Manufacturing facilities** **(List of machines, special process facilities, material handling etc.)**	**Details attached at Annexure – F2.7**
12.	**Testing facilities** **(List of testing equipment)**	**Details attached at Annexure – F2.8**
13.	**If manufacturing process involves fabrication then-** **List of qualified Welders** **List of qualified NDT personnel with area of specialization**	**Applicable / Not applicable** **Details attached at Annexure – F2.9** **(if applicable)**
14.	**List of out-sourced manufacturing processes with Sub-Vendors' names & addresses**	**Applicable / Not applicable** **Details attached at Annexure. –F2.10** **(if applicable)**
15.	**Supply reference list including recent supplies**	**Details attached at Annexure – F2.11** **(as per format given below)**

Project/ package	*Customer Name*	*Supplied Item (Type/Rating/Model /Capacity/Size etc)*	*PO ref no/date*	*Supplied Quantity*	*Date of Supply*

16.	**Product satisfactory performance feedback letter/certificates/End User Feedback**	**Attached at annexure - F2.12**
17.	**Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product (similar or higher rating)** **Note:- Reports need not to be submitted**	**Applicable / Not applicable** **Details attached at Annexure – F2.13** **(if applicable)**
18.	**Statutory / mandatory certification for the proposed product**	**Applicable / Not applicable** **Details attached at Annexure – F2.14** **(if applicable)**
19.	**Copy of ISO 9001 certificate** **(if available)**	**Attached at Annexure – F2.15**
20.	**Product technical catalogues for proposed item (if available)**	**Details attached at Annexure – F2.16**

Name:		**Desig:**		**Sign:**		**Date:**	

Company's Seal/Stamp:-

	TITLE: 4 x 250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION No: PE-TS-403-571-18000-A008
		SECTION-I Sub Section-D
		REV. 00 / DATE: OCT 2021
		SHEET : 1 OF 1

ANNEXURE-II

MANDATORY SPARE LIST

TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS 4 x250 MW BRBCL NABINAGAR TPP		SPECIFICATION NO. :PE-TS-463-571-18000-A003
MANDATORY SPARE LIST		**ANNEXURE-II**
Sl. No.	**PARTICULARS**	**Unit /Quantity (Nos./SET/%)**
1	**AGITATORS**	
1.1	**AUXILIARY ABSORBENT TANK AGITATOR**	
1	Impeller Assembly	2 no. of each type and size
2	Bearing Assembly	2 no. of each type and size
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type and size
5	Gear Box Assembly (If Applicable)	1 no. of each type and size
6	Agitator shaft assembly	2 no. of each type and size
7	Shaft Seal	2 no. of each type and size
8	Complete Agitator Assembly	1 no. of each type and size
1.2	**LIMESTONE SLURRY STORAGE TANK AGITATORS**	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	2 no. of each type and size
7	Complete Agitator Assembly	1 no. of each type and size
1.3	**PRIMARY HYDRO-CYCLONE FEED TANK AGITATOR**	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	2 no. of each type and size
7	Complete Agitator Assembly	1 no. of each type and size
1.4	**SECONDARY HYDROCYCLONE FEED TANK AGITATOR**	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	2 no. of each type and size
7	Complete Agitator Assembly	1 no. of each type and size
1.5	**FILTRATE WATER TANK AGITATOR**	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	2 no. of each type and size
7	Complete Agitator Assembly	1 no. of each type and size
1.6	**WASTE WATER TANK AGITATOR**	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	2 no. of each type and size
7	Complete Agitator Assembly	1 no. of each type and size

TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS 4 x250 MW BRBCL NABINAGAR TPP		SPECIFICATION NO. :PE-TS-463-571-18000-A003
MANDATORY SPARE LIST		**ANNEXURE-II**
Sl. No.	**PARTICULARS**	**Unit /Quantity (Nos./SET/%)**
1.7	**AGITATOR FOR DRAIN PIT (FOR ABSROBER AREA, GYPSEM AREA AND LIMESTONE AREA)**	
1	Impeller Assembly	1 no. of each type
2	Bearing Assembly	1 no. of each type
3	Motor	1 no. of each type
4	Belt and Pulley (If applicable)	2 no. of each type
5	Gear Box Assembly (If Applicable)	1 no. of each type
6	Agitator shaft assembly	2 no. of each type and size
7	Complete Agitator Assembly	1 no. of each type and size

Note:

1)One set means 100% complete replacement of the particular component/equipment, as mentioned i.e., Set for the particular equipment, would include all components required to replace the item. For example, a set of bearing shall include all hardware normally required while replacing the bearings. It is further, intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly.

2) Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed.

3) In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

4) Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications. The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

5) Mandatory spares shall not be dispatched before dispatch of corresponding main equipment. The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.

6) All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares should include all mounted accessories like components, boards, add or items, fitting, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require any additional item. The vendors must conform the pair to pair compatibility of each electrical spares modules with the modules supplied in the original package. All electronic modules should be pre-set and/or pre-programmed for ready use at site. Alternatively, suitable instruction sheet indicating the details of required PCB jumper position, BCD which is setting, EPROM/PROM listing etc should be packed along with each module. Also a caution mark sign should be put on all such module which needs pre-setting/pre-programming before putting them in to service. The spare shall be treated and properly packed for long term storage.

7) Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

8) Set for the particular equipment, would include all components required to replace the item, for example a set of bearing shall include all hardware normally required while replacing the bearings. It is further intended that the assembly / sub-assembly which have different orientation (like left hand or right hand, top or bottom), different direction of rotation or mirror image positioning or any other reasons which result in maintaining two different sets of the spares to be used for the subject assembly / sub-assembly, these shall be considered as different types of assembly/sub-assembly.

9)All the spares shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.

10)The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.

11) Any cell left blank in the unpriced schedule shall be teated as "Quoted".

12) Bidder to provide mandatory spares as asked above for each type of tank separately ,even in case type & size of tank of agitator is similar.

ANNEXURE-III

SIZING CALCULATION, SELECTION PARAMETER FOR ALL TANKS

01	31.03.2020	Rev_01	KMK	MKT	NPR
00	14.12.2019	Fresh Issue	KMK	MKT	NPR
Rev	**Date**	**Description/Note**	**PRD**	**CHD**	**APD**

REVISIONS

FLUE GAS DESULPHURIZATION (FGD) SYSTEM

TITLE:SIZING CALCULATION & SELECTION PARAMETER FOR ALL TANKS (SLURRY& WATER)

OWNER : BHARTIYA RAIL BIJLEE COMPANY LTD
CONSULTANT:NTPC
PROJECT : NABINAGAR (4X250MW)
FGD SYSTEM PACKAGE

EPC CONTRACTOR:
BHARAT HEAVY ELECTRICALS LTD.
BOILER AUXILIARIES PLANT, RANIPET

COLLABORATOR:
MITSUBISHI HITCHI POWER SYSTEMS LTD
AIR QUALITY CONTROL SYSTEMS TECHNOLOGY DIVISION

	NAME	MHPS	Rev	01
PREPARED BY	Kabilash	Y.Tanaka	STATUS :FOR APPROVAL	
CHECKED BY	Manoj K T		CUSTOMER NO.G201,G202,G203,G204	
APPROVED BY	Naveen R		BHEL DOCUMENT NO.4-FW-000-00877	

NTPC DRG./DOC NO. 0270-109-PVM-U-009

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

NTPC COMMENTS REFERENCE NUMBER CC:PE:0270:109:31244 DATED: 03.01.2020

Sl.No.	NTPC Comments	BHEL Reply
1	Project Owner is BRBCL (a joint venture between NTPC and Indian Railways) NTPC is consultant for this project. Cover sheet may kindly be updated by BHEL for all documents being submitted henceforth.	Document is updated as per the requirement.
2	The document is submitted without MHPS vetting. BHEL to ensure MHPS vetting in next revision.	Submitted document is vetted by MHPS (QFGDM)
3	Why the filtrate tank is being sized based on flow from tank to absorber. It should be sized based on inflow to the filtrate tank from secondary dewatering, cake wash, belt & cloth wash, waste water from waste water tank, gypsum dewatering sump discharge etc.	As explained during TCM, Quantity of flow (m3/hr.) for both inflow to Filtrate water tank from Vacuum belt filter, Secondary hydro cyclone underflow, Waste water return and the Outflow from Filtrate water tank to absorber is same only.
4	0.5 hr retention time appears to be on lower side. What is the basis? Kindly share MHPS practice.	This is decided as per MHPS Standard and the same is followed in all current NTPC Projects.
5	BHEL has considered 0.5m level difference between HH and tank top for all tanks. Kindly share the basis for the same.	This is decided as per MHPS Standard and the same is followed in all current NTPC Projects.
6	Subject to the finalizing of vendor input	LL Level specified in this document is final.
7	What is the basis? Kindly share MHPS practice.	Retention time is arrived as per NTPC Contract specification Part B Clause: 7.07.02

	SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)
BHEL Document No.	4-FW-000-00877
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8	Subject to the finalizing of vendor input	LL Level specified in this document is final.
9	What is the basis? Kindly share MHPS practice	Retention time is arrived as per NTPC Contract specification Part A Clause: 5.05.00
10	Subject to the finalizing of vendor input	LL Level specified in this document is final.
11	What is the basis? Kindly share MHPS practice	Retention time is arrived as per NTPC Contract specification Part B Clause: 7.07.06
12	Subject to the finalizing of vendor input	LL Level specified in this document is final.
13	What is the basis? Kindly share MHPS practice	Retention time is arrived as per NTPC Contract specification Part B Clause: 6.06.00
14	Subject to the finalizing of vendor input	LL Level specified in this document is final.
15	What is the value of spray pipe drain considered?	Details included
16	Subject to the finalizing of vendor input	LL Level specified in this document is final.
17	What is the basis for considering 25m3? BHEL to kindly check the possibility of sump pump starvation with this sump capacity (sump pump flow as per pump sizing document is 85m3/h)	As discussed during TCM, This is as per MHPS Standard practice and the same is followed for all current ongoing NTPC Projects
18	Subject to the finalizing of vendor input	LL Level specified in this document is final.
19	What is the basis for considering 25m3	This is as per MHPS Standard practice and the same is followed for all current ongoing NTPC Projects.

	SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)
BHEL Document No.	4-FW-000-00877
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20	Subject to the finalizing of vendor input	LL Level specified in this document is final.
21	What is the basis for considering 25m3	This is as per MHPS Standard practice and the same is followed for all current ongoing NTPC Projects.
22	Subject to the finalizing of vendor input and approved piping layout	LL Level specified in this document is final.
23	Why is stream 805 divided by 2?	Stream No: 805 is the summation of Filter cloth wash and Cake wash. Generally Process water is used for Filter cloth wash requirement and clarified water is used for Cake Wash requirement. Hence for sizing process water tank 805 was divided by 2.
24	15 min appears to be on a lower side. BHEL to share its experience/basis.	Retention time is arrived as per NTPC Contract specification Part B Clause: 13.01.00
25	Subject to the finalizing of vendor input	LL Level specified in this document is final.
26	Why 805 stream is divided by 2	Stream No: 805 is the summation of Filter cloth wash and Cake wash. Generally Process water is used for Filter cloth wash requirement and clarified water is used for Cake Wash requirement. Hence for sizing clarified water tank 805 was divided by 2.
27	Kindly share the basis?	Retention time is arrived as per NTPC Contract specification Part B Clause: 7.04.07
28	Subject to the finalizing of vendor input	LL Level specified in this document is final.

	SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)
BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

29	Why 805 stream is divided by 2	Stream No: 805 is the summation of Filter cloth wash and Cake wash. Generally Process water is used for Filter cloth wash requirement and clarified water is used for Cake Wash requirement. Hence for sizing Belt filter wash tank 805 was divided by 2.
30	Kindly share the basis?	Retention time of clarified water tank is used for Belt filter wash tank also
31	Subject to the finalizing of vendor input	LL Level specified in this document is final.
32	BHEL to kindly note that all sizing documents are subjected to approval of mass flow balance.	Noted.
33	Kindly furnish the number of top entry agitators in each case? Also confirm that the number of agitators considered are sufficient for the FGD application.	As discussed during TCM, the Quantity of Top entry agitator is always only One (01) no. per tank.

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

1. Gas condition for Tank Sizing:

S.No.	Gas Condition	Feature
1	VWO	Maximum Absorbed SO_2 Condition Maximum Inlet Gas flow condition

2. Tank Sizing Basis

Tank size is decided as per the following

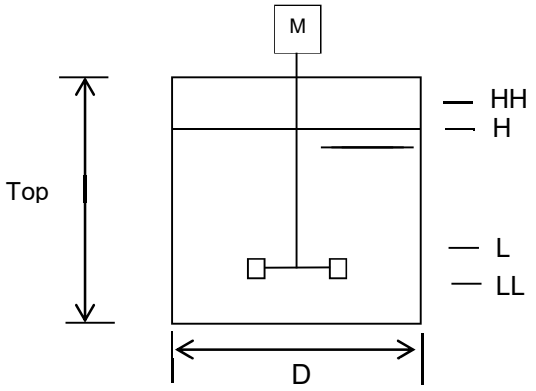
LL – Pump LL level m

L – LL + 0.2 m

H - Effective height m

HH - H + 0.2 m

Top - HH + 0.5 m



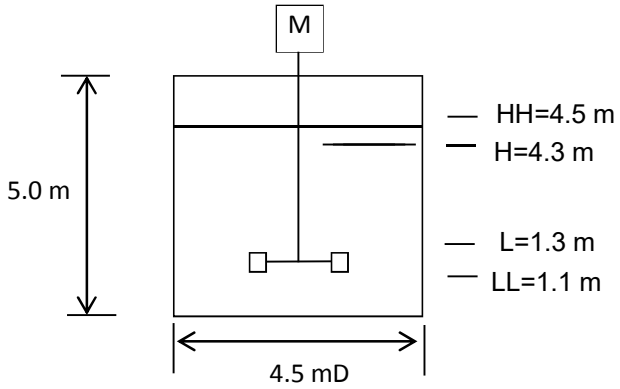
Effective volume = 3.14 / 4 x Φ ^ 2 x (H-L)

Hold volume = 3.14 / 4 x Φ ^ 2 x (HH)

H/D ratio = 1-1.2

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
1	00-HTM-03-BB-001	Filtrate water Tank	4500 mm D X 5000 mm H Quantity = 1 no (Common for four units)	Process Capacity	94.64 m^3/h (Refer Mass Flow Balance (Design Point) data stream no. <402> x 4 units).
				Retention Time	0.5 hr. (As per MHPS Practice and in line with all current ongoing NTPC Projects) ①
				Required volume	94.64 m^3/h x 0.5 hr = 47.32 m^3
					Tank Level is designated as follows

Top	5.0
HH	4.5
H	4.3
L	1.3
LL	1.1

Effective volume

=3.14 / 4 x 4.5 ^ 2 x (4.3-1.3)

= 47.69 m^3>47.32 m^3

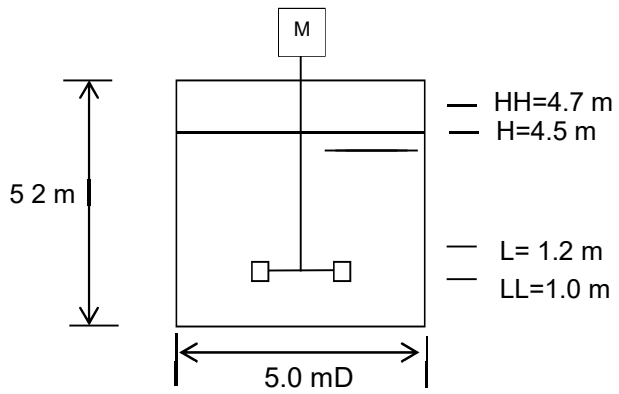
Hold Volume

= 3.14 / 4 x 4.5 ^ 2 x (4.5)

= 71.53 m^3

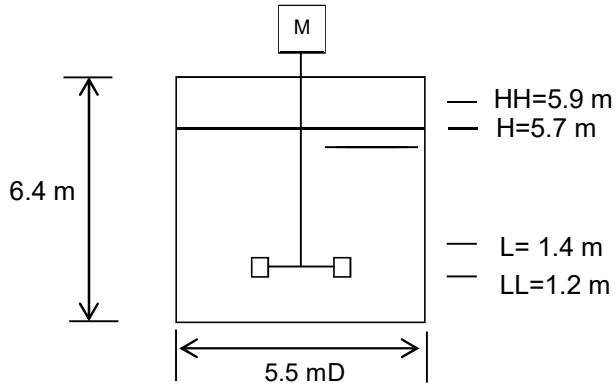
SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
2.	00-HTM-04-BB-001	Secondary waste water Hydro Cyclone feed Tank	5000 mm D X 5200mm H Quantity = 1 no. (Common for four units)	Process Capacity for each tank	61.48 m^3/h (Refer Mass Flow Balance Design Point data stream no. <202> x 4 units.)
				Retention Time	1hr (As per NTPC Contract specification Part B Clause: 7.07.02) ①
				Required volume	61.48 m^3/h x 1hr = 61.48 m^3
					Tank Level is designated as follows Top 5.2 HH 4.7 H 4.5 L 1.2 LL 1.0 **Effective volume** = 3.14 / 4 x 5 ^ 2 x (4.5-1.2) = 64.76 m^3>61.48 m^3 **Hold Volume** =3.14 / 4 x 5 ^ 2 x (4.7) =92 m^3

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
3	00-HTM-00-BB-001	Primary Hydro Cyclone feed Tank	5500 mm D X 6400 mm H Quantity = 1 no. (Common for four units)	Process Capacity for each tank	106.4m^3/h (Refer Mass Flow Balance Design Point data stream no. <201> x 4 units.)
				Retention Time	1hr (As per NTPC Contract specification Part A Clause: 5.05.00) ①
				Required volume	106.4 m^3/h x 1hr = 106.4 m^3
					Tank Level is designated as follows

Top	6.4
HH	5.9
H	5.7
L	1.2
LL	1.0

Effective volume

= 3.14 / 4 x 5.5 ^ 2 x (5.7-1.2)

= 106.86m^3>106.4 m^3

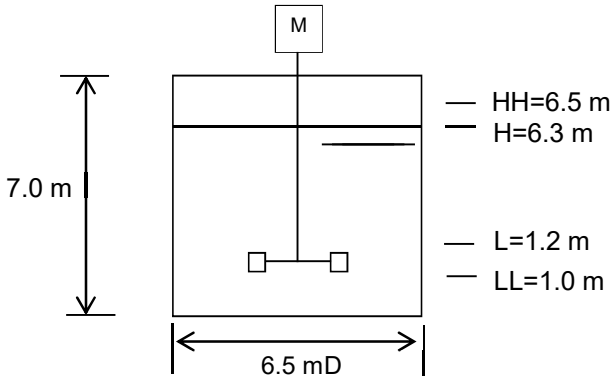
Hold Volume

= 3.14 / 4 x 5.5 ^ 2 x (5.9)

=140 m^3

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
4	00-HTM-05-BB-001	Waste water tank	6500 mmD X 7000 mmH Quantity = 1 no (Common for four units)	Process Capacity	19.64 m^3/h (Refer Mass Flow Balance (Design Point) data stream no. <205> x 4 units).
				Retention Time	8 hr (As per NTPC Contract specification Part B Clause: 7.07.06) ①
				Required volume	19.64 m3/h x 8 hr = 157.12 m^3
					Tank Level is designated as follows Top 7.0 HH 6.5 H 6.3 L 1.2 LL 1.0 **Effective volume** =3.14 / 4 x 6.5 ^ 2 x (6.3-1.2) = 169.15m^3>157.12 m^3 **Hold Volume** = 3.14 / 4 x 6.5 ^ 2 x (6.5) = 215 m^3

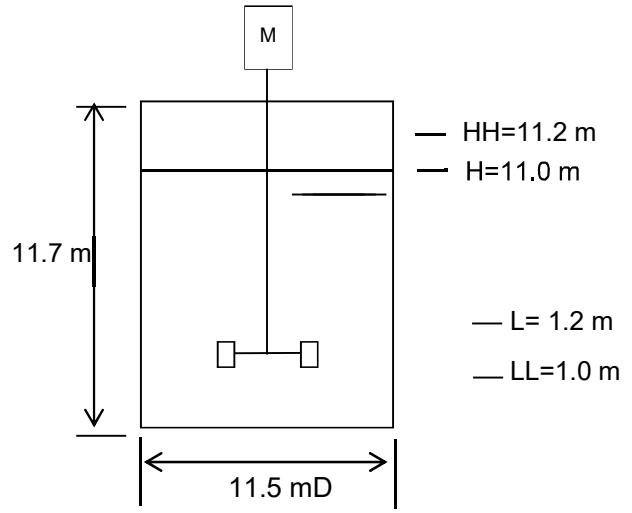
SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
5	00-HTK-03-BB-001/002	Lime stone slurry storage Tank A/B	11500 mmDX 11700 mm H Quantity = 2 no.	Process Capacity for each tank	a) Limestone required = 4.63 TPH per unit from (Refer Mass Flow Balance (Design Point) data stream no <501>) b) 20% (w/w) Limestone slurry = 4.63 TPH / 20% mass flow rate = 23.15 TPH per unit c) 20%(w/w) Limestone slurry density = 1.130 t/m^3 d)20% (w/w) Limestone slurry = 23.15 TPH / 1.130volume flow rate = 20.48 m^3/hr per unit For four (4) units=20.48 m^3/hrX4 =81.92 m^3/h
				Retention Time	12.0 hr (As per NTPC Contract specification Part B Clause: 6.06.00) ①

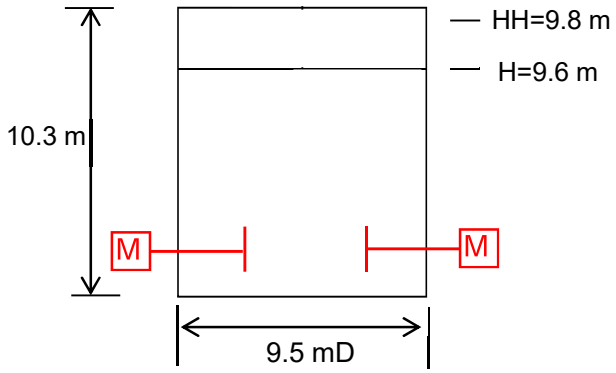
SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

				Required volume	81.92 m^3/h x 12 hr = 983.04 m^3
					Tank Level is designated as follows Top 11.7 HH 11.2 H 11.0 L 1.2 LL 1.0 **Effective volume** = 3.14 / 4 x 11.5 ^ 2 x (11.0-1.2) m = 1017.40 m^3>983.04 m^3 **Hold Volume** = 3.14 / 4 x11.5 ^ 2 x (11.2) m =1162 m^3

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

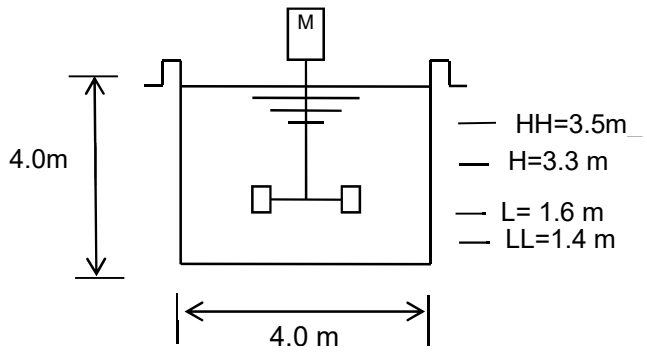
BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

<table>
<tr><th>S.No</th><th>Item No</th><th>Service</th><th>Design Spec</th><th>Process Parameter</th><th>Design Basis</th></tr>
<tr><td rowspan="4">6</td><td rowspan="4">00-HTT-00-BB-001</td><td rowspan="4">Auxiliary Absorbent Tank</td><td rowspan="4">9500 mmD X10300 mmH Quantity = 1 no (Common for four units)</td><td>Process Capacity</td><td>Absorber Tank Volume including the spray pipe drain = 659 m^3.
13.9m(W) X 7.9m (L) X 6.0m(H) = 659 m3(1m extra height taken for spray pipe drain) ①</td></tr>
<tr><td>Retention Time</td><td>Batch Operation</td></tr>
<tr><td>Required volume</td><td>659 m^3</td></tr>
<tr><td colspan="3"> 
</td><td colspan="2">Tank Level is designated to be empty during normal operation. Therefore the volume from bottom to H is considered as hold volume of tank.
<table>
<tr><td>Top</td><td>10.3</td></tr>
<tr><td>HH</td><td>9.8</td></tr>
<tr><td>H</td><td>9.6</td></tr>
<tr><td>L</td><td>1.2</td></tr>
<tr><td>LL</td><td>1.0</td></tr>
</table>
Effective volume
= 3.14 / 4 x 9.5 ^ 2 x (9.6-0.0)
= 680.12m^3>659 m^3
Hold Volume
= 3.14 / 4 x 9.5 ^ 2 x (9.8)
= 694.3 m^3</td></tr>
</table>

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
7	10/20/30/ 40-HTT-00-BB-001	Absorber Area Drain Sump	4000 mmW X4000 mm LX 4000 mm D Quantity = 4 nos. for four Units	Process Capacity for each Sump	25 m^3 (As per MHPS Standard practice and in line with all current ongoing FGD Projects) ①
				Retention Time	Batch Operation
				Required volume	25 m^3
					Tank Level is designated as follows



Top	4.0
HH	3.5
H	3.3
L	1.6
LL	1.4

Effective volume

= 4.0 m x 4.0 m x (3.3-1.6) m

= 27.2 m3 >25 m3

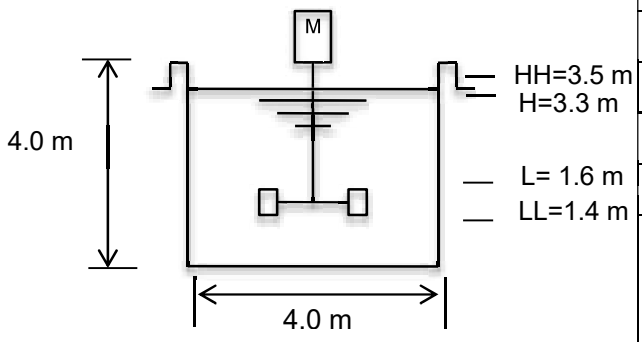
Hold Volume

= 4.0 m x 4.0 m x 3.5 m

= 56 m3

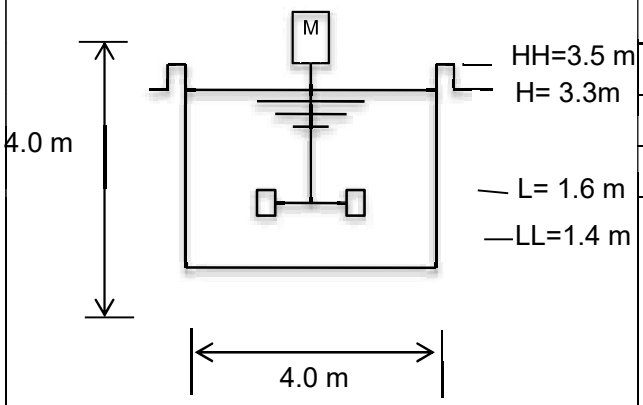
SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
8	00-HTT-01-BB-001	Gypsum Area Drain Sump	4000mmW X 4000mmL X 4000mmH Quantity = 1 no. (Common for four units)	Process Capacity	25 m^3 (As per MHPS Standard practice and in line with all current ongoing FGD Projects) ①
				Retention Time	Batch Operation
				Required volume	25 m^3
					Tank Level is designated as follows Top 4.0 HH 3.5 H 3.3 L 1.6 LL 1.4 **Effective volume** = 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3 **Hold Volume** = 4.0 m x 4.0 m x 3.5 m = 56 m3

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

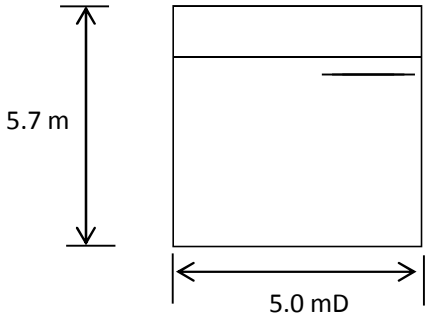
BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
9	00-HTT-02-BB-001	Lime Stone Area Drain Sump	4000mm W X 4000mmL X 4000mmH Quantity = 1 no.(Common for four units)	Process Capacity	25 m^3 (As per MHPS Standard practice and in line with all current ongoing FGD Projects) ①
				Retention Time	Batch Operation
				Required volume	25 m^3
					Tank Level is designated as follows Top 4.0 HH 3.5 H 3.3 L 1.6 LL 1.4 **Effective volume** = 4.0 m x 4.0 m x (3.3-1.6) m = 27.2 m3 >25 m3 **Hold Volume** = 4.0 m x 4.0 m x 3.5 m = 56 m3

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
1	00-HTQ-00-BB-001/002	Process Water Tank A/B	5000 mmD X 5700 mmH Quantity = 2 nos. (common for all four Units)	Process Capacity	274.56m^3/h (Refer Mass Flow Balance (Design Point) data stream no. (<801> + <802> + <803> + <804> + <805>/2 + <806>) x 4 units).
				Retention Time	0.25 hr (As per NTPC Contract specification Part B Clause: 13.01.00) ①
				Required volume	274.56m^3/h x 0.25 hr = 68.64 m^3
					Tank Level is designated as follows



Top	5.7
HH	5.2
H	5.0
L	1.5
LL	1.3

Effective volume

= 3.14 / 4 x 5.0 ^ 2 x (5.0-1.5) m

= 68.7 m^3>68.64 m^3 ①

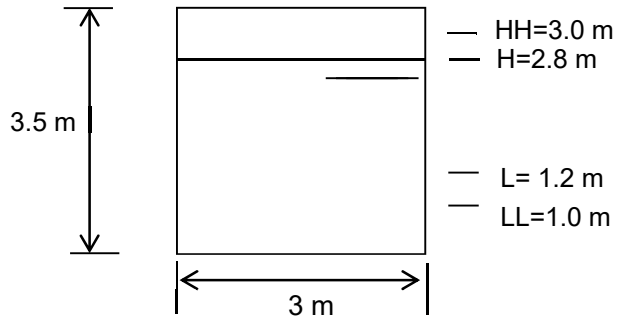
Hold Volume

= 3.14 / 4 x 5.0 ^ 2 x (5.2) m

= 102 m^3 ①

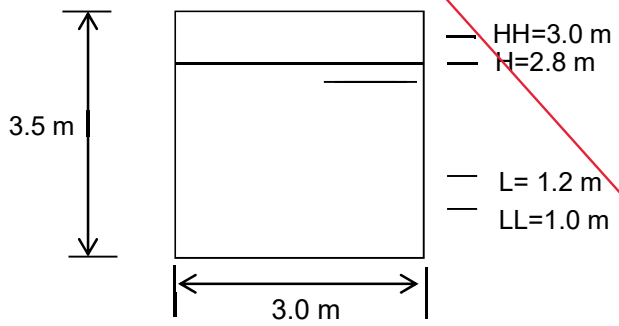
SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S. No	Item No	Service	Design Spec	Process Parameter	Design Basis
2	00-HTQ-01-BB-001/002	Cake wash (Clarified water) Tank	3000mmDX 3500 mmH Quantity = 2 nos. (Common for all four Units)	Process Capacity for each tank	11.2 m^3/h (Refer Mass Flow Balance Design Point data stream no.(<805>/2) x 4 units
				Retention Time	1hr (As per NTPC Contract specification Part B Clause: 7.04.07) ①
				Required volume	11.2 m^3/h x 1hr =11.2 m^3
					Tank Level is designated as follows Top 3.5 HH 3.0 H 2.8 L 1.2 LL 1.0 **Effective volume** = 3.14 / 4 x 3.0 ^ 2 x (2.8-1.2) m =11.30 m^3>9.8 m^3 **Hold Volume** = 3.14 / 4 x 3.0 ^ 2 x (3.0) m =21.20 m^3

SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)

BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

S.No	Item No	Service	Design Spec	Process Parameter	Design Basis
3	00-HTM-01-BB-001/002	Belt Filter Wash Tank	3000 mm D X 3500 mm H Quantity = 2 nos. (Common for all four Units)	Process Capacity for each tank	11.2 m^3/h (Refer Mass Flow Balance Design Point data stream no.(<805>/2) x 4 units.
				Retention Time	1hr (In line with clarified water tank and followed the same for all current ongoing projects) ①
				Required volume	11.20 m^3/h x 1hr = 11.20 m^3
					Tank Level is designated as follows

Top	3.5
HH	3.0
H	2.8
L	1.2
LL	1.0*

Effective volume

= 3.14 / 4 x 3 ^ 2 x (2.8-1.2)

=11.30 m^3>11.20 m^3

Hold Volume

= 3.14 / 4 x 3.0 ^ 2 x (3.0)

=21.20 m^3

Reference Documents

- Mass Flow Balance data – 0270-109-PVM-W-002

	SIZING CALCULATION ,SELECTION PARAMETER FOR ALL TANKS (SLURRY & WATER)
BHEL Document No.	4-FW-000-00877
Customer Document No.	0270-109-PVM-U-009

Annexure – 1:

Reference of big tank with top entry agitator

<MHPS experience for big tank with top entry agitator>

Plant Name & Location	Plant Capacity [MW]	FGD Capacity [Nm3/h]	Delivery Year	Tank Size
AFSIN-ELBISTAN-B, Turkey	360	2,226,280	2005	Absorbent Feed Tank 15 mφ x 12.5 mH Gypsum Storage Tank 11 mφ x 15.8 mH Emergency Storage Tank 12.6 mφ x 19.1 mH
Compostila #4,5, Spain	360	1,390,000	2008	Hold Up Tank 10.9 mφ x 9.1 mH
Rabigh#4,5, Saudi Arabia	240 x 2	769,720	2015	Emergency Storage Tank 13.0 mφ x 13.0 mH
Prunerov Ⅱ, Czech	210	1,100,000	1996	Hold Up Tank 12.2 mφ x 13.0 mH
Teruel #1,2,3, Spain	350	1,400,000	2007	Hold Up Tank 18.0 mφ x 15.0 mH
Ratchaburi, Thailand	700	2,224,000	2000	Hold Up Tank 13.0 mφ x 20.0 mH

	TITLE:	SPECIFICATION No: PE-TS-463-571-18000-A009	
	4 x250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION-I, SUB-SECTION- D	
		REV. 00	DATE: OCT 2021
		SHEET : 1 OF 1	

ANNEXURE-IV

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

	TITLE:	SPEC. NO.: PE-TS-463-571-18000-A003
	4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION-I, SUB-SECTION- D
		REV. NO.: 00 DATE OCT 2020

ANNEXURE-IV

DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

The successful bidder shall submit the following drawings / documents during detail engineering for approval / information / reference (as the case may be): -

Sl. No.	BHEL Drawing / Document No.	Title	Schedule Date	Drawing Classification
1	PE-V0-463-XXX-A001	GA drawing, Exploded view, sectional view with Material of construction, mechanical seal , gearbox for all Agitator models	2 weeks from LOI	Primary
2	PE-V0-463-XXX-A002	Data sheet for all Agitator	2 weeks from LOI	Primary
3	PE-V0-463-XXX-A003	Agitator Performance curve of all Agitators	2 weeks from LOI	Primary
4	PE-V0-463-XXX-A004	Electrical motor GA drawing & Data sheet and performance curves of all motors	2 weeks from LOI	Primary
5	PE-V0-463-XXX-A005	Quality plan & Inspection and Test Procedure	2 weeks from LOI	Primary
6	PE-V0-463-XXX-A006	Agitator and Motor Sizing Calculation	2 weeks from LOI	Primary
7	PE-V0-463-XXX-A007	O&M Manual for Agitator	4 weeks from LOI	Secondary
8	PE-V0-463-XXX-A008	Utility Consumption	4 weeks from LOI	Secondary
9	PE-V0-463-XXX-A009	Foundation Data including Anchor plan	4 weeks from LOI	Secondary
10	PE-V0-463-XXX-A010	Lubricating oil list	4 weeks from LOI	Secondary
11	PE-V0-463-XXX-A011	Special tools list, Start-up & Commissioning Spares	4 weeks from LOI	Secondary
12	PE-V0-463-XXX-A012	Installation and assembly procedure including Pre Commissioning Check List	4 weeks from LOI	Secondary

	TITLE:	SPEC. NO.: PE-TS-463-571-18000-A003
	4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION-I, SUB-SECTION- D
		REV. NO.: 00 DATE OCT 2020

NOTEs:

1. 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.

   a) internet explorer version – minimum internet explorer 7.
   b) Internet speed – 2 mbps (minimum preferred).
   c) Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
   d) Vendor's internal proxy setting should not block DMS application's link (http://dmsserver.bhelpem.com/wrench%20web%20access/login.aspx.).

2. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
3. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
4. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
5. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:

a) All drawings and documents shall indicate the list of all reference drawings including General Arrangement.
b) All drawings shall include / show plan, elevation, side view, cross-section, skin section, blow-up view; all major self-manufactured and bought out items shall be labelled and included in BOQ / BOM in tabular form.
c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

e) Void.

f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No. Documents marked for submission to BHEL's Customer shall also bear BHEL's Customer's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule.

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

m) Bidder to submit revised drawings complete in all respects incorporating all comments.

n) The primary drawings are to be considered as the basic engineering drawings.

Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

	TITLE:	SPEC. NO.: PE-TS-463-571-18000-A003
	4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION-I, SUB-SECTION- D
		REV. NO.: 00 DATE OCT 2020

SIGNATURE: _____

COMPANY SEAL

NAME : _____

DESIGNATION: _____

COMPANY: _____

ANNEXURE-V

SEA-WORTHY PACKING PROCEDURE

SEAWORTHY PACKING
(PACKING INSTRUCTIONS FOR GENERAL COMPONENTS / ASSEMBLIES / EQUIPMENT)

1 GENERAL

This standard lays down packing instructions for seaworthy packing of Components /Assemblies/ Equipment to be dispatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit for storage. For specific applications the concerned engineering department shall issue a product standard. Reference of this standard, must appear in the Shipping list/Packing List.

2 SCOPE

This procedure gives minimum guidelines for seaworthy packing to be complied with for packing of Components /Assemblies / Equipment. This packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage for periods more than one year.

3 CROSS REFERRED SPECIFICATION

- Multi-layered cross laminated plastic film : AA51420
- Packing Wood : AA51401
- Silica gel : AA55619
- Thermocole : AA51416
- Packing slip holders : AA7240901
- Corrugated Fibre Board : AA51414
- Rubber sheet : AA59001
- VCI paper : AA51406
- High quality full glossy out door finishing paint : AA56126
- Polyethylene air bubble film : IS 12787
- Structural steel - standard quality (plates, sections, strips flats & bars) : AA10108
- International Standards For Phytosanitary Measures No. 15 : ISPM-15:2009

4 WOOD SPECIFICATION FOR PACKING

The wood shall conform to specification AA51401.

For export packing wood in addition to the above the following has to be met:

The standard requires the use of debarked wood in the construction of compliant wood packaging material. Debarked wood is defined in the ISPM 5.

5 TYPE OF PACKING

The following 5 types of packings have been standardized for packing of General Components /Assemblies.

– ‘OP’ - Open Type
– ‘PP’ - Partially Packed
– ‘CP’ - Crate Packing - Components/Equipment requiring physical protection
– ‘CQ’ - Case Packing - Small medium Components/ Assemblies/ Equipment which require corrosion & physical protection
– ‘CR’ - Case Packing - Electrical Components/Assemblies which require special packing viz. Water Proof, Shock Proof, etc.

6 DESCRIPTION OF TYPES OF PACKING

The various types of packing, as standardized above, are described below.

6.1 ‘OP’ - Open Type

In case, of components which are not affected by water & dust & do not require special protection &, are generally not machined, shall be sent as open packages. However these components may be sent in crates, wherever necessary.

6.2 ‘PP’ - Partially Packed

Components which need special protection, at selected portions only, shall be dispatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces after application of TRP should be protected with Multi-layered cross laminated plastic film to AA51420.

6.3 ‘CP’ - Crate Packing – General

Assemblies/Components which need only physical protection from the point of view of handling shall be dispatched duly packed in crates.

6.4 ‘CQ’ - Case Packing - Machined Components/Assemblies/Equipment

a) Small & Medium sized components/assemblies/equipment due to size/weight & to avoid handling, and pilferage, problems shall be packed in Case/Containers.

b) Wherever required adequate quantity of silica gel to AA55619 or VCI Powder/ Tablets, packed in thin muslin cloth cotton bags shall be suitably placed.

c) Small machines/components of less weight shall be provided with suitable cushioning. Wood Wool/Expanded Polyethylene Foam Sheet, if used, shall be sandwiched between polyethylene sheets and sealed.

d) The components inside the case shall be entirely covered with Multi-layered cross laminated plastic film to AA51420, where-ever required.

6.5 ‘CR’ - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons.

a) Adequate quantity of Silica gel to AA55619 packed in cotton bags, of 100 grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with Multi-layered cross laminated plastic film to AA51420, before being packed in the cases.

b) VCI Powder/Tablets can be used as an alternative to Silica Gel to AA55619.

c) Empty space in the cartons shall be filled with small chips of Expanded Polystyrene (Thermocole), Wood Wool etc. Polyethylene air bubble film shall conform to IS 12787/AA51420 Expanded polystyrene (Thermocole) shall conform to AA51416.

d) The cartons shall be manufactured from corrugated Fibre Board, meeting requirements of AA51414.

6.6 Special Packing

Components requiring special packing (as per customer/contractual/ engineering requirements) not ncluded in this specification shall be covered by product standards.

7 PREPARATION OF PACKING CASE

1) Cases and crates with gross weight up to 1,000 kgs. shall be provided with bottom cleats of min. 40 mm thicknesses to ensure clearance for handling by forklift. Cases and crates exceeding gross weight of 1,000 kgs. shall be provided with skid runners, number and size according to weight of package.
2) The base of the case shall be made of wooden batons for planks giving necessary reinforcement, such that the bottom of the equipment is at a height of 100 to 200 mm from the ground level depending upon size & weight of equipment. However for packing cases of smaller size equipment can be at a height of 40 mm from the ground level.
3) In case of 'CR1 - Packing Viz. Electrical & Electronic components for instruments/assemblies, a rubber sheet, Self-expanded polyethene foam sheet, preferably 10 mm thick, shall be fixed on to the base to act as cushioning to the equipment.
4) The four sides, shall be lined, from inside with multi-layered cross-laminated polyethylene sheet of 90GSM as per AA51420 and tacked at suitable places.

   Whenever specified the top cover will have a layer of multi-layered cross laminated polyethylene sheet of 90 GSM over the cover. This should project about 100 - 250mm on all sides.

   It is preferable to have a single piece of the above Multi-layered cross laminated polyethylene sheet fixed on the four sides. In case jointing is unavoidable, it should be done by overlapping of approximately 100mm.
5) Place the Components/cartons with corrosion inhibitors duly applied wherever necessary for place suitably, thin muslin cloths bags containing 100 grams (approx.) of activated Blue Silica Gel to AA55619, wherever necessary. Alternatively VCI Powder or Tablet may be used.
6) In case, depression is formed, at the top, after the equipment is lowered, provide ply board/wooden batons.
7) Cover the whole equipment with polyethylene sheet of at least 100 micron thickness, on all sides preferably by a single piece.
8) For indoor panels/equipment, provide suitable packing batons with covering of Thermocole/expanded soft polyethylene foam/polyethylene air bubble film wrapped with suitable cords, to avoid cutting of the polyethylene sheet so that finished surface is not damaged.
9) Empty space in the box shall be filled with adequate cushioning material e.g. Thermocole Chips, Wood Wool etc. to avoid movement for shocks. Alternatively put wooden blocks/batons wherever necessary.
10) The inner side of the top cover shall be lined with polyethylene sheet, of at least
11) 100 micron thickness, which shall project approximately 25 to 150 mm depending upon the size of the case on all sides of the top cover shall be provided below the top cover. This projection, after nailing the top cover, shall be folded over, on the sides of the crates & tacked, to, prevent ingress of water from the top.
12) For specific requirement of packing the cases are to be provided with Tongue and Groove joints.

8 STEEL CONTAINERS

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies.

The containers are to be made of structural steel as per AA10108 with proper reinforcement with I, C and T Sections.

Following precautions are to be taken during packing:

– Put the Components/Assemblies/Equipment in the steel container properly. Cover the Components/Assemblies/Equipment with polythene.

– To arrest the movement in the steel container necessary wooden Blocks/Batons may be put.

– Put cover on steel, container and Bolt Properly.

9 SEALED PACKING

Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture.

The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.

10 SLING PLATE

Sling plate shall be provided to prevent damage to the packing box during lifting. Size of the sling plate shall be selected depending upon the net weight of the consignment.

11 PACKING SLIP HOLDERS

Two nos. steel packing slip holders, specification no. AA7240901 containing the packing list, sealed in thick polyethylene film, shall be fixed one inside and the other outside the packing box.

12 Volatile Corrosion Inhibitor (VCI) Paper

a) Un-protected surfaces of steel and cast iron components, tools bearing, shaft seals etc. are covered with VCI paper. VCI paper has been impregnated with corrosion inhibitors which by evaporation and chemical conversion protect metals in an enclosed area against corrosion.

b) 7 m^3 VCI paper is necessary for 1 m^3 of packed item approximately as per AA51406.

Application Limitation:

VCI paper shall not be used for components made of aluminium, aluminium alloys as well as Zinc, copper, brass, cadmium and silver.

VCI powder is sprinkled inside the piping components ends shall be protected with end cover as specified in plant standards, drawings.

13 Moisture Absorber

Silica gel is used for this purpose to protect the contents over sufficiently long time from corrosion. At the time of use, silica gel should be so dried that its colour becomes dark blue. These shall be filled in small cotton bags. Before sealing the equipment, the silica gel bags should be kept inside the polyethylene film cover at different locations. The quantity of silica gel should not be less than 1.0 kg per cubic metre volume of the packing box

14 GENERAL PRECAUTIONS

a) While fixing nails during packing, necessary care shall be taken to ensure that materials used for protection inside the case e.g. paper, polyethylene sheet, coir etc. do not get damaged.

b) Sling protection brackets to be provided on cases wherever required.

c) It shall be ensured that all stencil marks external, front & rear sides of the casing shall be of water proof Material to prevent obliteration in transit.

d) The various caution signs shall be marked with stencil on both sides of the packing box.

e) Do not pack any other Mechanical items with this case (do not use any other non-permitted packing materials).

THE FOLLOWING DETAILS ARE TO BE MARKED ON THE PACKING CASES.

a) Address of consignee.

b) Purchase Order No./ SO No/WO No.

c) Description of item or title of packing list.

d) Case identification Number/ Packing List No.

e) Net Weight.

f) Gross Weight.

g) Dimensions of box

h) Marking showing upright position.

i) Marking showing sling position.

j) Marking showing umbrella (i.e. for machines/components to be stored under covered storage.

k) Loading and unloading precautions

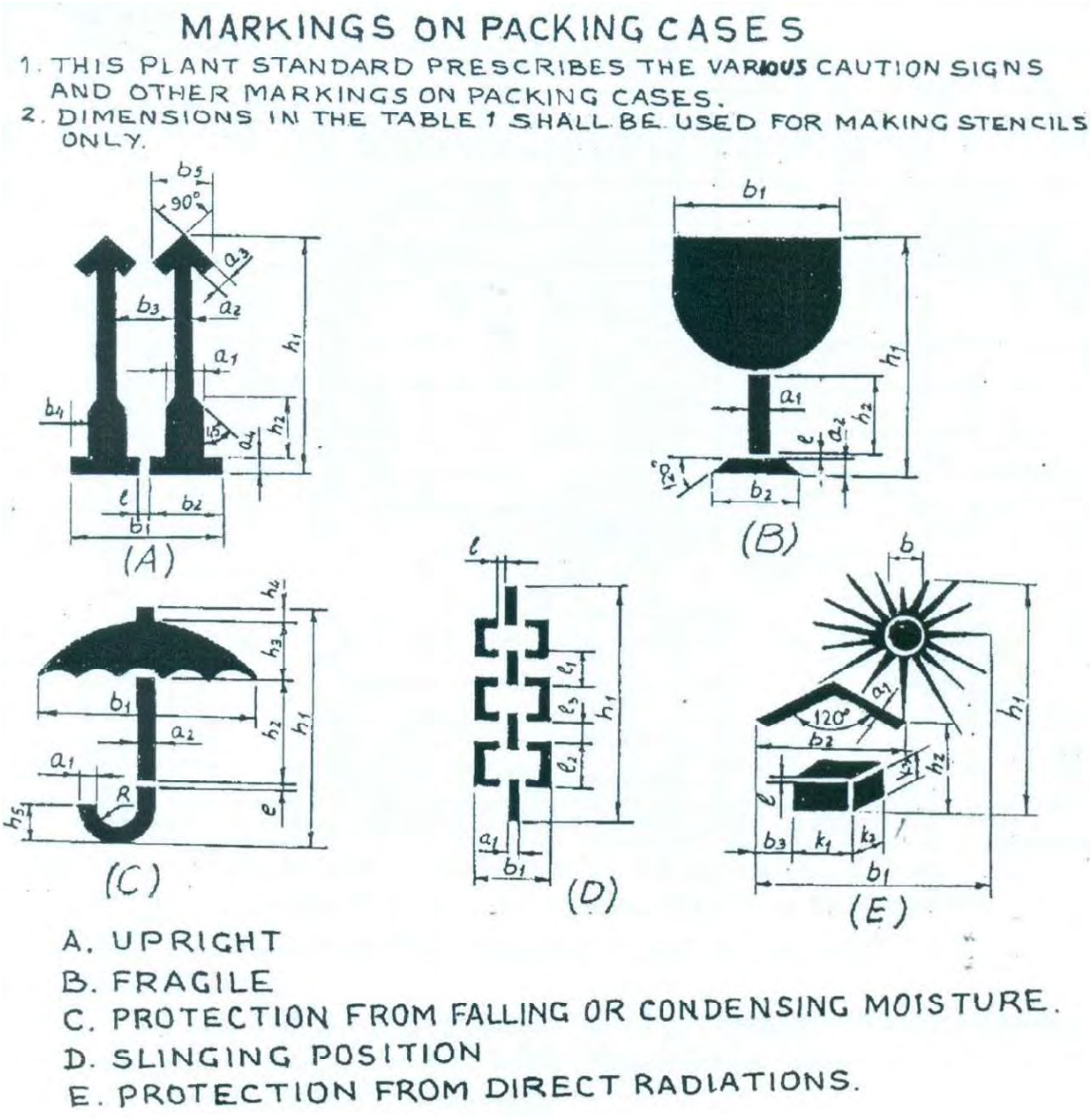


Figure 1

CENTER OF GRAVITY

Figure 2

Table 1

DESIGNATION		DIMENSIONS IN mm.																						
		a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4	b_5	b	l	h_1	h_2	h_3	h_4	h_5	K_1	K_2	K_3	l_1	l_2	l_3	R
A	1	12	5	5	4	52	25	19	8	21	–	2	84	23	–	–	–	–	–	–	–	–	–	–
	2	17	7	7	6	75	36	29	11	30	–	3	119	33	–	–	–	–	–	–	–	–	–	–
	3	24	10	10	8	104	50	38	16	42	–	4	168	46	–	–	–	–	–	–	–	–	–	–
	4	34	14	14	11	147	71	59	23	60	–	5	239	65	–	–	–	–	–	–	–	–	–	–
B	1	5	5	–	–	50	33	–	–	–	–	2	84	25	–	–	–	–	–	–	–	–	–	–
	2	7	7	–	–	71	47	–	–	–	–	3	119	36	–	–	–	–	–	–	–	–	–	–
	3	10	10	–	–	100	66	–	–	–	–	4	168	50	–	–	–	–	–	–	–	–	–	–
	4	14	14	–	–	142	94	–	–	–	–	5	239	71	–	–	–	–	–	–	–	–	–	–
C	1	4	3	–	–	66	–	–	–	–	–	2	80	39	19	5	11	–	–	–	–	–	–	6
	2	6	4	–	–	85	–	–	–	–	–	3	114	55	27	7	16	–	–	–	–	–	–	9
	3	8	6	–	–	120	–	–	–	–	–	4	160	78	38	10	22	–	–	–	–	–	–	12
	4	11	9	–	–	170	–	–	–	–	–	5	227	110	54	14	31	–	–	–	–	–	–	17
D	1	6	–	–	–	30	–	–	–	–	–	4	148	–	–	–	–	–	–	–	30	30	10	–
	2	9	–	–	–	42	–	–	–	–	–	5	209	–	–	–	–	–	–	–	42	42	14	–
E	1	3	–	–	–	69	47	10	–	–	16	2	91	26	–	–	–	17	8	11	–	–	–	–
	2	4	–	–	–	98	67	15	–	–	23	3	128	33	–	–	–	24	11	16	–	–	–	–
	3	6	–	–	–	138	94	20	–	–	32	4	182	62	–	–	–	34	16	22	–	–	–	–

Black and Red Marking Ink to IS: 1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink.

"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".

Besides the caution signs the product information shall be stencilled of letters with 13mm to 50mm height.

In case of consignment consists of more than one package, each package shall carry its Package No. as given in shipping list. All caution signs shall be stencilled in higher quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel (AA56126).

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks. Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: In case the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

15 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

15.1 Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.

15.2 Appropriate material handling equipment like fork lifters, cranes etc. Shall be used where needed.

15.3 Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. Shall be done carefully.

15.4 For critical items, where specified, special handling fixtures shall be used for lifting.

15.5 Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.

15.6 Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.

15.7 Precision machined components like blades, catches, rollers etc. Shall be lifted using suitable wooden pallets.

15.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH:

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

– The markings showing the upright position.

– The markings showing the sling position

– Markings showing the fragile contents.

– Other required markings as per Clause No. 12

15.8.1 Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15º.

15.8.2 Handling and lifting should be done without jerks or impacts.

15.8.3 Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.

15.8.4 On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.

15.8.5 Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.

15.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

16 GI SHEET

The packing cases are covered with GI sheet on outside for sides and top; inside for bottom as per the Figure-3 (GI sheet covering is applicable for all closed type of wooden packing).

17 Treatment of Wood & Application and use of the mark

For seaworthy export packing, treatment of wood has to be carried out as below subject to BHEL Engg & QC approval.

As per customer requirement for export packing, wood to be treated as applicable should be done as per International Standards for Phytosanitary Measures ISPM: 15 to control the growth stages viz. egg to adult of structural insects (beetles, borers, bugs, fleas, flies, lice, moths, roaches, termites) and other pests (mice, rats, spiders) etc. in stored products.

The specified marks applied to wood packaging material treated in accordance with ISPM 15 must conform to the requirements described in Annex 2 of ISPM 15.

17.1 Heat treatment using a conventional steam or dry kiln heat chamber (treatment code for the mark: HT)

When using conventional heat chamber technology, the fundamental requirement is to achieve a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including its core).

This temperature can be measured by inserting temperature sensors in the core of the wood. Alternatively, when using kiln-drying heat chambers or other heat treatment chambers, treatment schedules may be developed based on a series of test treatments during which the core temperature of the wood at various locations inside the heat chamber has been measured and correlated with chamber air temperature, taking into account the moisture content of the wood and other substantial parameters (such as species and thickness of the wood, air flow rate and humidity). The test series must demonstrate that a minimum temperature of 56 °C is maintained for a minimum duration of 30 continuous minutes throughout the entire profile of the wood.

Treatment schedules should be specified or approved by the National Plant Protection Organisation (NPPO). Treatment providers should be approved by the NPPO.

17.2 Heat treatment using dielectric heating (treatment code for the mark: DH)

Where dielectric heating is used (e.g. microwave), wood packaging material composed of wood not exceeding 20 cm when measured across the smallest dimension of the piece or the stack must be heated to achieve a minimum temperature of 60 °C for 1 continuous minute throughout the entire profile of the wood (including its surface). The prescribed temperature must be reached within 30 minutes from the start of the treatment.

Treatment schedules should be specified or approved by the NPPO.

17.3 Methyl bromide treatment (treatment code for the mark: MB)

Wood packaging material containing a piece of wood exceeding 20 cm in cross-section at its smallest dimension must not be treated with methyl bromide.

The fumigation of wood packaging material with methyl bromide must be in accordance with a schedule specified or approved by the NPPO (National Plant Protection Organisation) that achieves the minimum concentration-time product (CT) over 24 hours at the temperature and final residual concentration specified in Table 1. This CT must be achieved throughout the profile of the wood, including its core, although the concentrations would be measured in the ambient atmosphere. The minimum temperature of the wood and its surrounding atmosphere must not be less than 10 °C and the minimum exposure time must not be less than 24 hours. Monitoring of gas concentrations must be carried out at a minimum at 2, 4 and 24 hours from the beginning of the treatment. In the case of longer exposure times and weaker concentrations, additional measurement of the gas concentrations should be recorded at the end of fumigation.

If the CT is not achieved over 24 hours, corrective action needs to be taken to ensure the CT is reached; for example, the treatment is restarted or the treatment time extended for a maximum of 2 hours without adding more methyl bromide to achieve the required CT (see the footnote to Table 2).

Table 2 – Minimum CT over 24 hours for wood packaging material fumigated with methyl bromide

Temperature (°C)	CT (g·h/m^3) over 24 h	Minimum final concentration (g/m^3) after 24 h#
21.0 or above	650	24
16.0 – 20.9	800	28
10.0 – 15.9	900	32

In circumstances when the minimum final concentration is not achieved after 24 hours, a deviation in the concentration of ~5% is permitted provided additional treatment time is added to the end of the treatment to achieve the prescribed CT.

One example of a schedule that may be used for achieving the specified requirements is shown in Table 3.

Table 3 – Example of a treatment schedule that achieves the minimum required CT for wood packaging material treated with methyl bromide (initial doses may need to be higher in conditions of high sorption or leakage)

Temperature (°C)	Dosage (g/m^3)	Minimum concentration (g/m^3) at:		
		2 h	4 h	24 h
21.0 or above	48	36	31	24
16.0 – 20.9	56	42	36	28
10.0 – 15.9	64	48	42	32

Treatment providers should be approved by the NPPO.

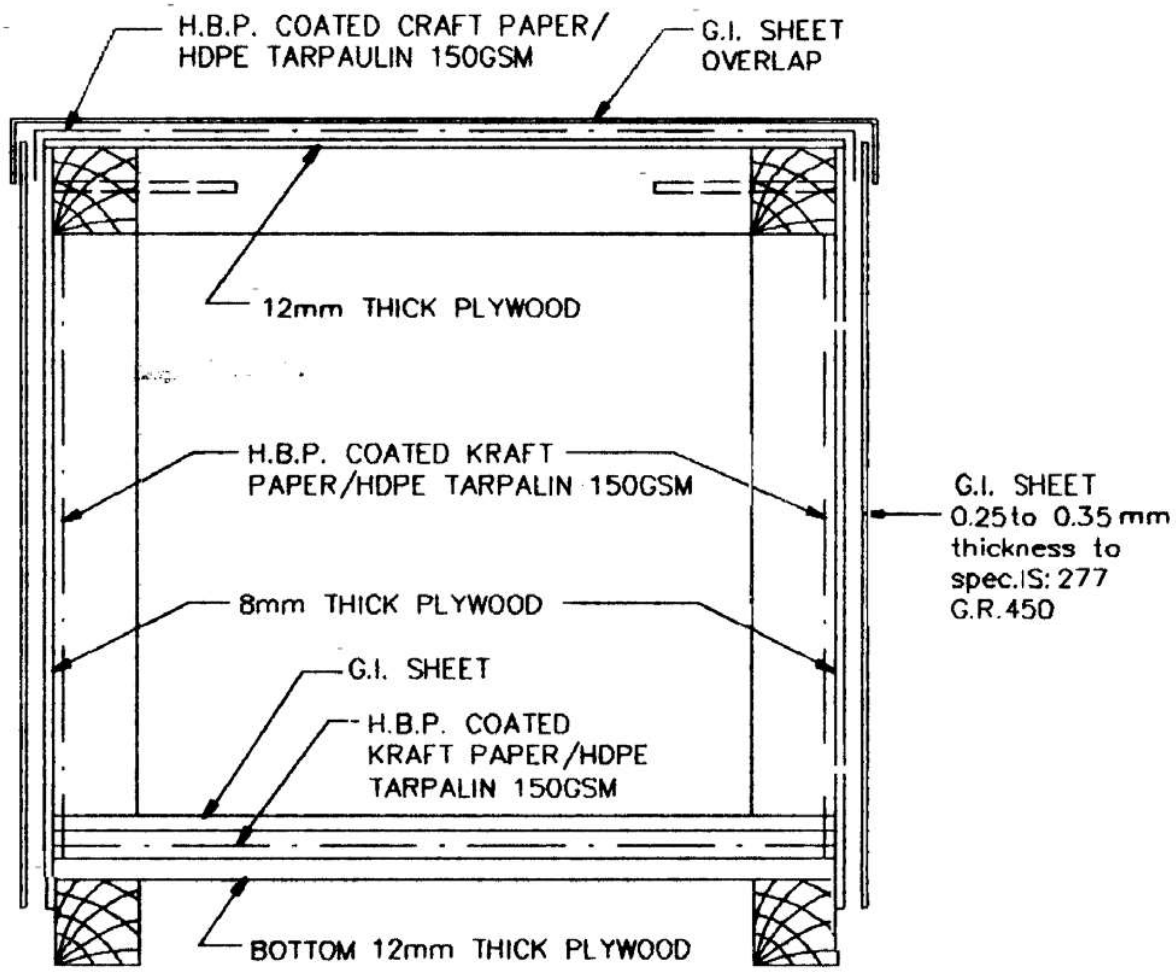
17.4 Marking

The specified marks applied to wood packaging material treated in accordance with ISPM 15 must conform to the requirements described in ISPM 15.

18 PROVISION FOR INSPECTION

This clause is applicable only where contractual requirement of customer is there. For other packings this is not applicable.

Each transportable packing's shall have provision for inspection by customer authority etc. during transport from origin of dispatched till destination. This inspection may require opening of the package and subsequently closing it again. For this purpose suitable designed opening with bolted cover shall be provided. Such an opening shall be clearly marked as "OPENING" with clear instruction for opening & closing written on this cover. For large consignment the size of the opening shall be suitable to facilitate entry of personnel.



CLOSED PACKING CASE WITH
G.I.SHEET SHOWING LAYERS
OF PACKING MATERIALS

Figure 3

	4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS LIST OF DOCUMENTS TO BE SUBMITTED WITH BID	SPECIFICATION No: PE-TS-463-571-18000-A009
		SECTION : II
		REV: 00 / DATE: OCT 2021
		SHEET 1 OF 1

ANNEXURE–1

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

Document for Evaluation:

1. Compliance cum confirmation certificate (Refer Annexure-2 of section-II).
2. Pre-bid clarification, if any, as per format given under Section-II (Annexure-3)
3. Amendment to specification, if any, issued by BHEL dully signed and stamped.
4. Deviation schedule as per format given under Section-II (Annexure-4), in case of any deviations by bidder.
5. Documents for meeting the Pre-Qualification Requirement (3K format has to be submitted along with supporting documents as given under Annexure-10, section-II).
6. List of special tools and tackles (Refer Annexure-7 of section-II).
7. Dully filled Guaranteed power consumption format (In the format attached with the price schedule) declaring guaranteed power consumption value in KW along with the Technical offer.

Document for Reference:

1. Agitator Schedule filled up by the bidder (Refer Annexure-8 of section-II).
2. GA drawing, Exploded view with Material of construction, total weight of all Agitators models offered.
3. Agitator Motor Sizing Calculation.
4. Electrical Load data filled up by the bidder (Refer Annexure-5 of section-II).
5. Test arrangement at shop
5. Product catalogue for offered agitators

Details mentioned under reference documents are subject finalization during detail engineering meeting requirements mentioned in various parts of the specification.

ANNEXURE -2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.

b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.

d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.

e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.

g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.

h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions

i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the

scope of work as per tender specification. This clause will apply in case during site commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

k) As built drawings shall be submitted as and when required during the project execution.

l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

n) Document approval by customer under Approval category or Information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

ANNEXURE-3

PRE-BID CLARIFICATION SCHEDULE

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE:_____

NAME : _____

DESIGNATION:_____

COMPANY: _____

DATE:_____

COMPANY SEAL

ANNEXURE-4

SCHEDULE OF TECHNICAL DEVIATION

(PLEASE REFER GCC FOR THE FORMAT OF DEVIATION SCHEDULE)

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
ANNEXURE-5																		
Filtrate Water Tank Agitator				1	0				C									
Secondary Waste Water Hydro-cyclone Feed Tank Agitator				1	0				C									
Waste Water Tank Agitator				1	0				C									
Limestone Slurry Storage Tank Agitator				2	0				C									
Absorber Area Drain Sump Agitators				4	0				C									
Gypsum Area Drain Sump Agitator				1	0				C									
Limestone Area Drain Sump Agitator				1	0				C									
Auxiliary Absorbent Tank Agitator				3	0				C									
Primary hydro cyclone feed tank Agitator				1	0				C									

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

	ANNEXURE-5 LOAD DATA (ELECTRICAL)	JOB NO.	463	ORIGINATING AGENCY		PEM (ELECTRICAL)	
		PROJECT TITLE	4x250 MW BRBCL NABINAGAR TPP	NAME		DATA FILLED UP ON	
		SYSTEM	AGITATOR	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MAUX	SHEET 1 OF 2	REV. 01	DE'S SIGN. & DATE	

	4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS SUB-VENDOR LIST	SPECIFICATION NO. PE-TS-463-571-18000-A003 SECTION : II REV 00 OCT 2021 SHEET 1 OF 1

ANNEXURE -6

LIST OF MAKES OF ITEMS

S.N.	ITEM NAME	MANUFACTURER	LOCATION

	4X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION NO. PE-TS-463-571-18000-A003	
		SECTION : II	
		REV 00	DATE: OCT 2021
		SHEET: 1 OF 1	

ANNEXURE-7

Bidder shall supply a set of special tools and tackles required either for erection or operation or maintenance of the agitator units. A list of such tools and tackles shall be submitted along with the offer.

	TITLE: 4 X250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SPECIFICATION No: PE-TS-403-571-18000-A008
		SECTION-II
		REV. 00 / DATE: OCT 2021
		SHEET : 1 OF 1

ANNEXURE-8

AGITATOR SCHEDULE

AGITATOR SCHEDULE (To be sumbmitted with the offer by Bidder) , 4x250 MW BRBCL NABINAGAR TPP

Sl.no.	Description	Primary Hydrocyclone feed tank Agitator	Filtrate water tank Agitator	Secondary Hydrocyclone feed tank Agitator	Waste water Tank Agitator	Limestone Slurry Storage tank Agitator	Auxiliary Absorbent Tank Agitator	Absorber Area Drain Pit Agitator	Gypsum Dewatering Area Drain Pits Agitator	Limestone Area Drain Pit Agitator
1	Agitator Sl No.	1	2	3	4	5	6	7	8	9
2	Type	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Marine Propeller – Horizontal Type (Side Entry),	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)	Vertical Type – (Center Mounted)
3	Medium to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry
4	Seal Type	Not required	Not required	Not required	Not required	Not required	Mechanical Seal (Flushless)	Not required	Not required	Not required
5	Duty	Continuous	Continuous	Continuous	Continuous	Continuous	Intermittant , Whenever FGD is under maintenance	Intermittant	Intermittant	Intermittant
6	Agitator Location	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor	Outdoor
7	Tank details									
a)	Tank Shape	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Vertical cylindrical	Rectangular	Rectangular	Rectangular
b)	Tank name	Primary Hydrocyclone feed tank	Filtrate water tank	Secondary Hydrocyclone feed tank	Waste water Tank	Limestone Slurry Storage tank	Auxiliary Absorbent Tank	Absorber Area Drain Pit	Gypsum Dewatering Area Drain Pits	Limestone Area Drain Pit
c)	Capacity of Slurry (in m3)	140.0	71.5	92.0	215.0	1162.0	694.3	56.0	56.0	56.0
	Dimension (in m)									
d)	Diameter	5.5	4.5	5.0	6.5	11.5	9.5	-	-	-
e)	Length	-	-	-	-	-	-	4	4	4
f)	Breadth	-	-	-	-	-	-	4	4	4
g)	Height	6.4*	5.0*	5.2*	7.0*	11.7*	10.3*	4	4	4
8	MOC of Agitator	Refer Clause no 3.2, Material of construction in SECTION-I, SUB SECTION-C1 of Specific technical requirement (Mechanical)								
9	Quantity of Agitator per tank	1	1	1	1	1	3 (Refer note-2)	1	1	1
10	Total quantity of agitators (for four units)	1	1	1	1	2	3 (Refer note-2)	4	1	1
11	Slurry Analysis									
a)	Slurry to be handled	Gypsum slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry	Gypsum slurry	Gypsum slurry	Gypsum slurry	Limestone slurry
b)	Maximum solid particle size	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	200 mesh (75 µ)	6-7 mm	6-7 mm	6-7 mm
c)	Normal solid particle size, d50	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)	325 mesh (43 µ)
d)	Solid to be handled	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	gypsum along with Limestone & other impurities	Limestone + impurities
e)	Chloride concentration	max 30000 ppm	max 30000 ppm	max 30000 ppm	max 30000 ppm	max 1000 ppm	max 30000 ppm	max 30000 ppm	max 30000 ppm	max 1000 ppm
f)	Hardness of particle	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale	5-7 mho scale
g)	Slurry concentration, wt%	30 wt%	11%	16.60%	3%	30 wt%	30%	30%	30%	30 wt%
h)	Sp. Gravity of slurry	1.216	1.069	1.112	1.023	1.215	1.216	1.216	1.216	1.215
i)	Sp. Gravity of Lime Stone & Gypsum	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)	2.32(avg)
j)	Viscosity of Slurry	10 cP	4 cP	4 cP	3 cP	30 cP	10 cP	10 cP	10 cP	30 cP
k)	pH	4 to 8	4 to 8	4 to 8	4 to 8	5 to 8	4 to 8	4 to 8	4 to 8	5 to 8
l)	SiO_2 Content	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l	4 to 6 g/l
m)	Temperature	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -45 deg C; Design-55 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -62 deg C; Design-70 deg C.	Normal -45 deg C; Design-55 deg C.
12	Motor									
a)	Total Power consumed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	Motor Rating	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Motor Explosion Proof Class	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof	Non-Flame Proof
d)	Motor Protection Class	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor	IP-55/ Outdoor
e)	Motor Efficiency Class	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3	IE-3
13	Various Tank Levels									
a)	Minimum Liquid level (m)	1.0	1.1	1.0	1.0	1.0	1.0	1.4	1.4	1.4
b)	Normal Liquid level (m)	5.7	4.3	4.5	6.3	11.0	9.6	3.3	3.3	3.3
c)	Maximum Liquid Level (m)	5.9	4.5	4.7	6.5	11.2	9.8	3.5	3.5	3.5
14	Impeller									
a)	Type of impeller	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	No. of impeller stages per Agitator	1	1	1	1	2	-	1	1	1
c)	Impeller diameter	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
d)	Impeller tip speed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
e)	Operating speed	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
f)	Agitator Pumping Capacity	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
g)	Volume/Agitator	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
15	Baffle Plates (not in bidder's scope)									
a)	No. & size of baffle plates	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	Thickness of baffle plates (mm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Distance from Bottom of the tank	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
16	Nozzle (not in bidder's scope)									
a)	Size of the nozzle on which agitator frame is mounted	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	NA	NA	NA
17	Loads									
a)	Static Load	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
b)	Dynamic load	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
c)	Torsional Moment (Nm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
d)	Bending Moment (Nm)	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder	To be filled by bidder
18	Power loading for Auxiliary power consumption	Applicable	Applicable	Applicable	Applicable	Applicable	Not applicable	Not applicable	Not applicable	Not applicable
19	Parameters to be considered compulsarily by bidder for design of Agitators									
a)	Uniform suspension of solids by Agitators	The agitators shall keep the solid particles in suspended mode in liquid slurry with "Full off-Bottom Suspension" of solid particles to 98% of liquid column to virtually "Uniform Solid Concentration".								
b)	Mounting of Agitaor	The Agitators shall be mounted on the Agitator platform which shall be approximately at a height of 1.0 m from the tank roof. However, the Agitator platform is excluded from bidder's scope.								
c)	Maximum permitetd impeller Tip speed	12 m/s								
d)	Impeller tip dia/ tank dia	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)	1/3 (approx)	-	1/3 (approx)	1/3 (approx)	1/3 (approx)
Notes										

1	There shall be complete re-suspension of all solids after a 24 hour outage. Accumulation of solids shall not prevent agitator restart.
2	Agitation shall be provided to prevent settlement of slurry by side entry agitators . All the side-entry agitators shall be similar.
3	Maximum Sound Pressure Level at a height of 1.5 m above floor level in elevation, and at a distance of 1.0 m horizontally shall be 85 dBA.
4	*Although the height of all tanks is fixed above, same may vary slightly during detailed engineering as per design calculation of tanks.
5	Normal solid particle size shall be used for design of all Agitators in tanks and sumps.
6	Slope of roof shall be considered approximate 5 deg for all the tanks.

ANNEXURE - 09

4x250 MW BRBCL NABINAGAR TPP - AGITATORS
FOR FGD SLURRY TANKS

Break up price for COMMISSIONING SPARES

Sl.no	Description	Qty.	Unit rate (INR)

NOTE -

Bidder shall furnish unit price of commissioning spares in above format alongwith the Bid. Any part even though not mentioned in list furnished but required at later date shall be supplied free of cost.

	TITLE:	SPECIFICATION No: PE-TS-463-571-18000-A009	
	4 x250 MW BRBCL NABINAGAR TPP TECHNICAL SPECIFICATION FOR AGITATORS OF FGD SLURRY TANKS	SECTION-II	
		REV. 00	OCT 2021
		SHEET : 1 OF 1	

ANNEXURE-10

ATTACHMENT – 3K
(OF NTPC)

Sl. No.	Drawings Title	Drawings No.	No. of Sheets
	Enclosure, purging scheme, DP transmitter		
9.	Interfacing of actuators	0000-999-POI-A-063	1
10.	Interfacing of field instruments/Electrical interface/PLC Interface	0000-999-POI-A-065	15

(C) ELECTRICAL

(1) Electrical single line diagram for FGD Package : Drg No. 0011-109-POE-J-001/A-E

Note : All the above drawings are indicative of Employer's requirements to enable the Bidder to make a suitable offer. All variations/alternations shall be clearly brought out in the technical deviation schedule with implications, if any. Such variations may be acceptable, after assessment of its implication and shall be subjected to the Employer's approval. However, the flexibility of operation and maintenance desired by the schemes and layouts shall be binding.

Electrical drawings (except Electrical single line diagram) are attached with respective Electrical Chapters in Part b, Section VI.

4.00.00 QUALIFYING REQUIREMENTS FOR EQUIPMENTS/SYSTEMS

4.01.00 **Provenness criteria for critical equipment, auxiliaries, systems and bought out items:**

The Bidder / Bidder's sub-vendor(s) is required to meet the provenness criteria and/or qualification requirement for critical equipment, auxiliaries, system and bought out items as per criteria stipulated below:

4.01.01 Booster Fans, Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, Agitators & Vacuum Belt Filters for the Wet Limestone based Flue Gas Desulphurisation (FGD) System offered by the Bidder shall be only from such manufacturer(s) who has previously designed (either by itself or under collaboration / licensing agreement), manufactured / got manufactured the respective equipment(s) of the type, application and minimum equipment rating as stipulated below such that the respective equipment(s) should have been in successful operation in at least one (1) plant for a period not less than one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder:

CLAUSE NO.	INTENT OF SPECIFICATION

Type and Rating for Qualification

Sl. No.	Name of Equipment	Type of Equipment	Application	Equipment Rating
(a)	Booster Fans	Axial type with variable pitch control	Coal fired power plant	80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum)
(b)	Slurry Recirculation Pumps	Centrifugal type	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Recirculation Pump
(c)	Oxidation Blowers	Centrifugal/ positive displacement type blower	Wet Limestone based FGD application in Coal fired power plant	80% of the flow & 100% of the head of the offered Oxidation Blower
(d)	Wet limestone Grinding mills	Horizontal Wet Ball mill	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Ball mill capacity with pulverizing fineness not less than 90% thru 325 mesh
(e)	Slurry Pumps	Centrifugal type	Wet Limestone based FGD application or ash slurry application in Coal fired power plant	80% of the flow & 100% of the head of the offered Slurry Pump(s)
(f)	Agitators	Vertical/Horizontal	Wet Limestone based FGD application in Coal fired power plant	Agitator rating not less than that supplied for 500 MW or higher size unit for similar application
(g)	Vacuum Belt filters	Belt type	Wet Limestone based FGD application in Coal fired power plant	80% of the offered Vacuum Belt filter capacity

CLAUSE NO.	INTENT OF SPECIFICATION
	Bidder shall offer and supply only the type of the above equipment(s) for which he himself or the manufacturer proposed by the bidder for the above equipment(s) is qualified. The provenness criteria for equipment (Booster Fans) stipulated at Sl. No. 4.01.01 (a) above shall also be considered acceptable provided the rating parameters (i.e., flow, head and rated rpm) is covered within the operating regime of the respective fan performance curve of the reference plant equipment.
4.01.02	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Booster Fans as per clause 4.01.01 (a) above but is a manufacturer of such equipment for units of at least 500 MW rating, the Bidder or the proposed sub vendor can manufacture such equipment for 660 MW units also, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (a) above for the Booster Fans.
4.01.03	A JV / Subsidiary Company formed for manufacturing and supply of equipment(s) as listed at clause no. 4.01.01 above in India, can also manufacture such equipment(s), provided that it has a valid collaboration or licensing agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 above (or the technology provider of the qualified equipment manufacturer) for the respective equipment(s). Before taking up the manufacturing of such equipment(s), the bidder/ his sub-vendor(s) must create /have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system for such equipment(s). Further, in such a case, such qualified equipment manufacturers should have, directly or indirectly through its holding company/ subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/ Subsidiary Company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture/ Subsidiary or upto the end of defect liability period of the contract, whichever is later.
4.01.04	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Oxidation Blowers as per clause 4.01.01 (c) above but is a manufacturer of Blowers/compressors for minimum 50 NM^3/min capacity, the Bidder or the proposed sub-vendor can also manufacture Oxidation Blowers, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Oxidation Blowers in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (c) above for the Oxidation Blowers. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.
4.01.05	**(i)** In case the Bidder or the proposed sub-vendor is not manufacturer of proven Wet limestone Grinding mills as per clause 4.01.01 (d) above but is a manufacturer

CLAUSE NO.	INTENT OF SPECIFICATION
	of dry Grinding mills for power or cement industry of minimum 20 T/h capacity, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding mills, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Wet limestone Grinding mills in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments. In addition, the Bidder along with the qualified equipment manufacturer shall furnish DJU in which executant of the DJU shall be jointly and severally liable for the successful performance of the equipment as per the format enclosed in the bidding document. The DJU shall be submitted prior to the placement of order on the approved sub-vendor for Wet limestone Grinding mills. In case of award, each executant of the DJU except the Bidder shall be required to furnish an on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project. **OR** **(ii)** In case, the bidder or proposed sub vendor is not a manufacturer of proven Wet Limestone Grinding Mills as per clause 4.01.01 (d) above, but have designed, manufactured & supplied dry Grinding Ball Tube mills for at least 500 MW pulverized coal fired power plant, the Bidder or the proposed sub-vendor can also manufacture Wet limestone Grinding Mills provided it has a licensing agreement with a Wet limestone Grinding mills manufacturer who meet the requirements stipulated at clause 4.01.01 (d) above for the Wet limestone Grinding mills and provides extended warranty of three (3) years for the Wet Limestone Grinding Mills. In such a case Bidder shall provide an additional on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project.
4.01.06	In case the Bidder or the proposed sub-vendor is not manufacturer of proven Agitators as per clause 4.01.01 (f) above but is a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry, the Bidder or the proposed sub-vendor can also manufacture Agitators, provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such Agitators in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (f) above for the Agitators. Before taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipments.
4.01.07	In case the Bidder or the proposed sub-vendor is a manufacturer of Slurry Pumps who meets the requirements stipulated at clause 4.01.01 (e) above, the Bidder or the proposed sub-vendor can also manufacture Slurry Recirculation Pumps,

CLAUSE NO.	INTENT OF SPECIFICATION
	provided it has collaboration or valid licensing agreement for design, engineering, manufacturing, supply of such equipment in India with such manufacturer who meet the requirements stipulated at clause 4.01.01 (e) above for the Slurry Recirculation Pumps. **Before** taking up the manufacturing of such equipment, the bidder/ his sub-vendor must create /have created manufacturing facilities at his works as per collaborator's /licenser's design, manufacturing and quality control system for such equipment.
4.01.08	Before taking up the manufacturing of such equipment(s) as per clause 4.01.02, 4.01.03, 4.01.04, 4.01.05(i), 4.01.06 & 4.01.07 above, the Bidder / its sub vendor(s) must create (or should have created) manufacturing and testing facilities at its works as per Collaborator / licenser's design, manufacturing and quality control system for such equipments duly certified by the Collaborator / licensor. Further, the Collaborator / Licenser shall provide (or should have provided) all design, design calculation, manufacturing drawings and must provide (or should have provided) technical and quality surveillance assistance and supervision during manufacturing, erection, testing, commissioning of equipments.
4.01.09	Bidder shall offer and supply only the type of the above equipment(s) for which it, itself or the manufacturer / Collaborator(s) / Licenser(s) proposed by the Bidder for the above equipment(s) is qualified.
4.01.10	The Employer reserves the right to fully satisfy himself regarding capability and capacity of Bidder / its sub-vendor(s) and the proposed arrangement and may prescribe additional requirement before allowing manufacture of the equipment listed above for this contract.
	Note to clause 4.01.01 (1) Whenever the term 'coal fired' is appearing above, "Coal" shall be deemed to also include bituminous coal/brown coal/Anthracite Coal/lignite.
4.02.00	**Sub QR for Civil Works:**
4.02.01	Bidder or its agency should have in past executed civil and structural works for 500 MW or higher capacity coal based/Lignite based power plant including earthwork in filling involving mechanical compaction and cutting in hard rock, foundations, Bulk material handling plant involving underground storage hopper and underground tunnels.
4.02.02	Bidder can engage more than one agency, in case the Bidder itself is not able to meet the requirement at 4.02.01. The agency being engaged for a particular work should have in the past executed such works of 500 MW or higher capacity plant.

FLUE GAS DESULPHURISATION (FGD) SYSTEM PACKAGE
FOR
LOT-1A PROJECTS
BIDDING DOCUMENT NO. CS-0011-109(1A)-2

Bidder's Name and Address:

To
Contract Services-II
NTPC Limited
Noida-201301

Summary of Critical Equipment indicated under clause 4.01.00, sub-section-I, Part-A of Section-VI.

Equipment Name	Sub-Vendor Name	Collaborator's Name, if applicable	Seeking Qualification as per clause..... Sub-Section-I, Part-A of Section-VI
~~Booster Fans~~			~~*4.01.01 /*4.01.02 /*4.01.03~~
~~*Slurry Recirculation Pumps~~			~~*4.01.01 /*4.01.03 /*4.01.07~~
~~Oxidation Blowers~~			~~*4.01.01 /*4.01.03 /*4.01.04~~
~~Wet limestone Grinding mills~~			~~*4.01.01 /*4.01.03 /*4.01.05 (i)/ 4.01.05 (ii)~~
~~Slurry Pumps~~			~~*4.01.01/*4.01.03~~
Agitators			*4.01.01 /*4.01.03 /*4.01.06
~~Vacuum Belt filters~~			~~*4.01.01 /*4.01.03~~

Note : *Strike-off whichever is not applicable.

1. If qualification sought as per clause 4.01.01, sub-section-I-A, Part-A of Section-VI then the details of the sub vendor (manufacturer) shall be filled by the bidder in the format A to G.

2. If the qualification sought as per the clause 4.01.02, sub-section-I-A, Part-A of Section-VI, then the details of proposed sub vendor (i.e manufacturer of such equipments for at least 500 MW unit rating) shall be filled individually by the bidder in the format A and the details of collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be filled by the bidder in the format A separately. Further, in case of qualification vide clause 4.01.02, sub-section-I-A, Part-A of Section-VI a copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall also be furnished.

3. If the qualification sought as per the clause 4.01.03, sub-section-I-A, Part-A of Section-VI then the details of JV/Subsidiary Company formed for manufacturing of such equipments in India shall be furnished individually for each equipment by the bidder such as,

   i) Copy of document of incorporation of JV/Subsidiary company in India

   ii) Copy of valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing, supply of such equipment in India with the collaborator who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI.

   iii) Copy of document of at least 26% equity participation of qualified equipment manufacturer in the Indian JV company/subsidiary company directly or indirectly through its holding company /Subsidiary company, which shall be maintained for a lock -in period of seven (7) years from the date of incorporation of such JV/subsidiary or up to the end of defect liability period of the contract which ever is later.

   Further, the details of collaborator or technology provider of the qualified equipment manufacturer who meets the requirement stipulated at 4.01.01, sub-section-I-A, Part-A of Section-VI shall be filled by the Bidder in the format A to G (format given at 1.00.00). In addition to that, the sub vendor along with the Indian JV company/subsidiary company, qualified equipment manufacturer and its holding company/subsidiary company as applicable shall furnish the DJU.

*** strike out whichever is not applicable.**

1.00.00 (Applicable for Bidder/his sub vendors seeking qualification as per clause no. 4.01.01, Sub section-I, Part-A of Section-VI. Bidder shall furnish the required data only for those equipments / auxiliaries which are proposed to be sourced under this route.)

We, hereby furnish the data on proveness criteria for critical equipment, auxiliaries, systems and Bought Out Items such as ~~Booster Fans, *Slurry Recirculation Pumps, Oxidation Blowers, Wet Limestone Grinding Mills, Slurry Pumps, &~~ Agitators which have been designed (either by self manufacturer or under valid ongoing collaboration and technology transfer agreement), *manufactured/ *got manufactured and supplied by us /Manufacturer (or manufactured/ got manufactured & supplied by our proposed sub-vendors) and these are in successful operation in at least one (1) plant for a period not less than one year reckoned as on the date

of consideration for approval but not later than six months to award date of contract to the Main bidder. The details of type and minimum equipment rating of such equipment are given below :

A. **For Booster Fans:** We declare that, we/our Sub-Vendor, have designed (either by itself or under collaboration / licensing agreement),*manufactured/*got manufactured and supplied at least one (1) number of Booster Fan of minimum 80% of the flow & 100% of the head of the offered Booster Fan with Fan Speed 900 rpm (maximum), Axial type with variable pitch control working in a Coal fired power plant and which has been in successful operation for minimum one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder, as per the details furnished below:

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether equipment operating in a coal fired power plant	-*Yes/*No
5.	Name of equipment manufacturer & address:	

Sl. No.	Description	Reference Work
6.	Date of commission of the equipments:	
7.	Model no. of the equipment:	
8.	Brief Technical particulars of the equipments:	
9.	Flow -	……..m^3/Sec with

F. **Agitators:** We declare that, we/our Sub-Vendor, have designed (either by itself or under collaboration / licensing agreement),*manufactured/*got manufactured and supplied at least one (1) number of Agitators with rating not less than that supplied for 500 MW or higher size unit for similar application, Vertical/Horizontal type working in Wet Limestone based FGD application in Coal fired power plant and which has been in successful operation for minimum one(1) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder, as per the details furnished below::

Sl. No.	Description	Reference Work
1.	Name of the reference plant & location:	
2.	Client name and his address:	
3.	No. of units and capacity in MW of unit:	
4.	Whether power plant is coal fired	-*Yes/*No
5.	Whether operating in a Wet Limestone based FGD application in coal fired power plant	-*Yes/*No
6.	Name of equipment manufacturer & address:	
7.	Date of commission of the equipments:	
8.	Model no. of the equipment:	
9.	Brief Technical particulars of the equipments:	
10.	Agitators supplied for	.....MW unit size

Sl. No.	Description	Reference Work
11.	Whether the equipment(s) are in successful operation in atleast one(01) plant for a period not less than one(01) year reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder	-*Yes/*No
12.	Flue gas Desulphurization system details:	*Technical extract/ *paper letter/ *email/ *Drwaing from user or *contract docu ment or *scheme or *any document in public domain enclosed at annexure....to Attachment-3K
13.	Scope of Work:	*Letter of Award or *Contract or *P.O. enclosed at Annexure.....to Attachment-3K
14.	Performance details:	*Certificate/*Letter/*E-mail from End user enclosed at Annexure.....to Attachment-3K

*** Strike off whichever is not applicable.**

***Bidder to strike off whichever is not applicable.**

(Data to be furnished in line with format given at 1.00.00 of this Attachment)

2.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the aforesaid equipment as per 2.01.00 above who meets the requirement stipulated at clause **4.01.01**, sub-section-**I**, Part-A, Section-VI are enclosed at **Annexure-.....** to this Attachment. The data in respect of proveneness criteria for these equipment which are in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below. We further confirm that we/ our sub vendor(s) have created manufacturing and testing facilities at our/ their works as per collaborator's/ Licensor's design, manufacturing & quality control system for these equipment(s)/ Auxiliary(ies).

(Data to be furnished in line with format given at 1.00.00 of this Attachment)

***3.00.00 Applicable for JV Company/Subsidiary Company meeting provenness criteria as per clause no. 4.01.01, Sub section-IA, Part-A of Section-VI.**

3.01.00 We, hereby confirm that JV company/ Subsidiary company (Strike off whichever is not applicable) formed for manufacturing and supply of equipment(s) (*Booster Fans, *Slurry Recirculation Pumps, *Oxidation Blowers, *Wet Limestone Grinding Mills, *Slurry Pumps, *Agitators) has a valid ongoing collaboration and technology transfer agreement for design, engineering, manufacturing of such equipment(s) in India with a qualified equipment manufacturer who meets the requirements stipulated at clause 4.01.01 of sub-section-I, Part-A, Section VI of bidding documents (or the technology provider of the qualified equipment manufacturer). Further, in such a case, such qualified equipment manufacturers is having, directly or indirectly through its holding company/subsidiary company, at least 26% equity participation in the Indian Joint Venture Company/subsidiary company, which shall be maintained for a lock-in period of seven (7) years from the date of incorporation of such Joint Venture / Subsidiary or up to the end of defect liability period of the contract, whichever is later. Before taking up the manufacturing of such equipment(s) (*Booster Fans, *Slurry Recirculation Pumps, *Oxidation Blowers, *Wet Limestone Grinding Mills, *Slurry Pumps,*Agitators), we/ our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.

We further confirm that details in respect of collaboration / valid licencing agreement for the aforesaid equipment(s) (*Booster Fans, *Slurry Recirculation Pumps, *Oxidation Blowers, *Wet Limestone Grinding Mills, *Slurry Pumps, *Agitators) who meets the requirement stipulated at clause **4.01.01**, sub-section-**I**, Part-A, Section-VI for are enclosed at **Annexure-.....** to this Attachment.

for the qualified Wet Grinding Mill manufacturer, which is in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below.

(Data to be furnished in line with format given at 1.00.00 of this Attachment)

We further confirm that *we/*our sub-vendors shall provide an extended warranty of three (3) years for the Wet Limestone Grinding Mills provide an additional on demand bank guarantee for INR 10 Million (Indian Rupees Ten Million only) for each project.

(Data to be furnished in line with format given at 1.00.00 of this Attachment)

***7.00.00 Applicable for Bidder/his sub vendors seeking provenness criteria as per clause no. 4.01.06, Sub section-I, Part-A of Section-VI.**

7.01.00 We, hereby confirm that *we/*our sub-vendors is a manufacturer of a manufacturer of Agitators for similar process/duty application in petrochemical or metals and mining industry. (Details of references enclosed at Annexure ……)

(Data to be furnished in line with format given at 1.00.00 of this Attachment))

7.02.00 We further confirm that details in respect of collaboration / valid licencing agreement for the Agitator between *us/*our sub-vendors, as per 6.01.00 above, and with qualified Agitator manufacturer, who meets the requirement stipulated at clause **4.01.01**, sub-section-**I**, Part-A, Section-VI are enclosed at **Annexure-…..** to this Attachment. The data in respect of proveneness criteria for the qualified Agitator manufacturer, which is in successful operation in at least one (1) plant for a period not less than one reckoned as on the date of consideration for approval but not later than six months to award date of contract to the Main bidder are furnished below.

We further confirm that before taking up the manufacturing of such Agitator, *we/ *our sub vendor(s) *will create /*have created manufacturing facilities at his works as per collaborator's/licenser's design, manufacturing and quality control system.

4x250 MW BRBCL NABINAGAR TPP					REV-00,
ANNEXURE-11: GUARANTEED POWER CONSUMPTION FORMAT					
Sl.No.	**Description / Item**	**Quantity (working)**	**Power Consumption (KW) (at motor input terminal)**	**Duty Factor**	**Power Consumption (KW)**
1	**2**	**3**	**4**	**5**	**6 = 3 x 4 x 5**
A)	**Llimestone slurry storage tank agitataor**	**2**	**To be filled by Bidder**	**1**	**To be filled by Bidder**
B)	**Primary hydro-cyclone feed tank agitator**	**1**	**To be filled by Bidder**	**1**	**To be filled by Bidder**
C)	**Secondary hydrocyclone feed tank agitator**	**1**	**To be filled by Bidder**	**1**	**To be filled by Bidder**
D)	**Filtrate water Tank Agitator**	**1**	**To be filled by Bidder**	**1**	**To be filled by Bidder**
E)	**Waste Water Tank Agitator**	**1**	**To be filled by Bidder**	**1**	**To be filled by Bidder**
F)			**Total Guaranteed power (KW)**		**To be filled by Bidder**

Notes

1	Power consumption (KW) of motors shall be measured at motor input terminals when the system operating at the rated capacity.
2	Total Estimated Power Consumption Figure for the above mentioned Agitators is considered as 90 KW which is to be treated as base power. **Declared Guaranteed Power Consumption in this Format duly signed and stamped shall be submitted along with technical bid. Total GPC given by the bidder shall not exceed 90 kW failing which offer of bidder will not be considered for evaluation.**
3	Total power (@ S.No. F above) and not individual power quoted by bidder shall be termed as 'Guaranteed Power consumption' (GPC) and bidder shall be liable to demonstrate compliance to GPC value during PG test/ Demonstration test at site. If the actual power consumption exceeds 90 kW , liquidated damages shall be payable by the successful bidder at the rate of **USD 2129** per KW excess power consumption over 90 kW. Such liquidated damages may be recovered by the BHEL by deduction from the contract price or by enforcing the contract performance guarantee or in any other manner deemed fit by the BHEL. **Acceptable short fall limit for GPC WITH LD will be (+1%) of base power (90 kW)**
4	USD conversion rate shall be taken as defined in NIT.